ΑΚΑΔΗΜΙΑ ΕΜΠΟΡΙΚΟΥ ΝΑΥΤΙΚΟΥ ΜΑΚΕΔΟΝΙΑΣ

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ΕΠΙΒΛΕΠΩΝ ΚΑΘΗΓΗΤΗΣ: ΠΑΝΑΓΟΠΟΥΛΟΥ ΜΑΡΙΑ

PROS AND CONS OF PAPERLESS NAVIGATION

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Ο ΔΙΕΥΘΥΝΤΗΣ ΣΧΟΛΗΣ:

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ABSTRACT

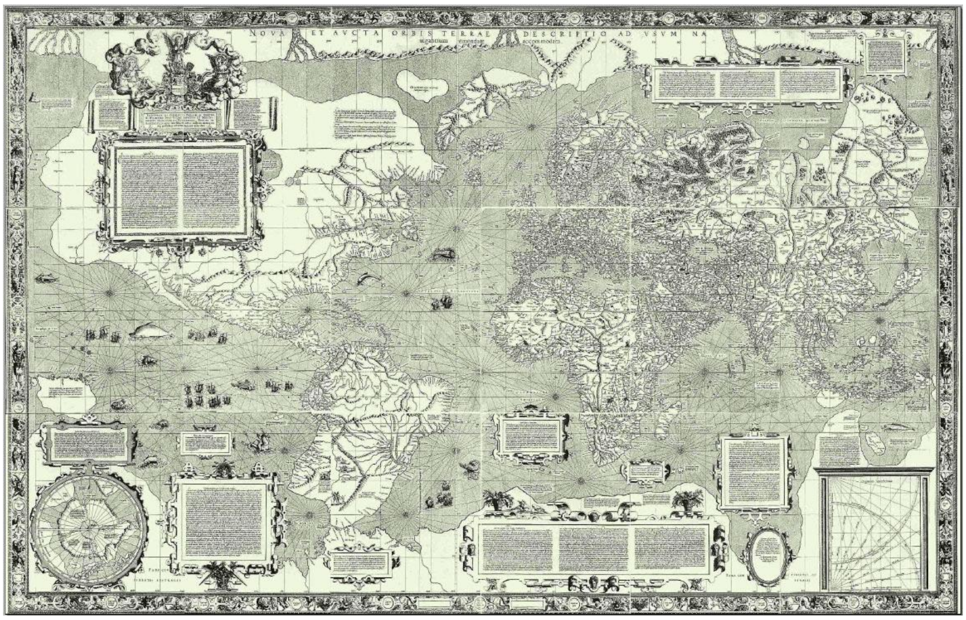
About 17 years back, navigators would have scoffed at the idea of Paperless Navigation on big ocean vessels. After all, since centuries, navigational paper charts had been the heart and soul of ship navigation. Imagining that a day would come where we would no longer have them onboard was nothing short of blasphemy. Every single navigating officer who has been out at sea long enough, still fondly recollects joining vessels with his own treasured Chart Correction Pen. However, the unthinkable did happen. The transition started slowly with smaller vessels like pleasure crafts, yachts and tug boats. But now, armed with the IMO mandate for compulsory ECDIS carriage the, the big ships such as the giant container vessels and the super tankers super tankers are also running pretty smoothly without paper charts. Who is responsible for this change? Well, it is none other than the Electronic Chart Display and Information System aka ECDIS. That is all we are talk about in the following pages, because this is the feature of navigation. We will go all the way back to when the first ever paper chart was used to the day that ECDIS was introduced to the world. We will go thought its systems, its complexity, its usage. Because ECDIS, being a machine after all, can be easily misused. We have to know how properly use it, and what impropriate usage of ECDIS can lead to. Finally, after reviewing its many and different aspects we will try to fully understand its benefits as well as its flaws and if these flaws are nothing more than human error. The conclusions of this writing will give a clear picture of what ECDIS brings to the table.

1.HISTORICAL DEVELOPMENT OF NAVIGATIONAL CHARTS

The oldest know world map is Imago Mundi Babylonian map, from 6th century BC Babylonia. It is a Babylonian clay tablet written in Akkadian, containing a labeled description of the known world, with a short and partially lost description, dated to roughly 6th century BC (Neo-Babylonian or early Achaemenid period).

The usage of maps takes us back to ancient times when groups of people were searching for food, water, wealthy land to grow, moving from place to place. They had to find a way to mark the places so they can remember the path they used to get there. Concerning the sea navigation, the first known systematic collection and recording of essential information on the execution of a route dates also to 6th century BC, when the Greek seafarer Skylax the Carian explored, on behalf of the Persian King Darius, the sea area between the Indus Riven and the Red Sea, writing his famous voyage.

Around 10-11th century Mediterranean's merchant maritime forces (Venetians, Genoese, Catalans) had at their disposal various nautical maps known as the "Portolani". Portolans or harbor/port maps depicted routes, ports and anchorages for ships crossing the oceans and seas. Their construction was based on information gathered by sailors during their voyages. In the 14th and 15th centuries many Portolans appeared, covering areas of the Mediterranean and the Black Sea. Some of them reached as far as Ireland and the west coast of Africa. A bit later (1569 AC) the Flemish cartographer Gerardo Mercator published the first world shipping map, representing the detour in a straight line.



(Mercator's worlds nautical map 1569)

Moving on to the 18th century, the first Hydrographic Services were founded by the great maritime forces of the time in order to issue reliable navigational charts for use by their fleet. Generally, a nautical chapter/map is any map which represents a floating surface on Earth and its creation is based on the mercatorial projection and has been issued by a State Service. They are designed specifically to cover the needs of sea navigation. They also include information such as coastline and sea area elements (depths, nature of the bottom, configuration of the coast), navigational hazards (wrecks, reefs, shallow), buoys and navigational aids.

With time the issuance of maps from different countries emerged the need for international cooperation in order to establish a unified system of symbolism of nautical charts. In 1921 the International Hydrographic Bureau (I.H.B) was founded, to promote the quality of the content of the issued nautical charts. In 1970 it was renamed to International Hydrographic Organisation (I.H.O).

2.ELECTRONIC NAVIGATIONAL CHARTS

The ability of using electronic navigational charts (ENCs) goes back to the early 80's (Loran, Decca, Navsat, etc). The first electronic charts systems with all the information of a printed navigational chart are dated in half past 80's. People realized that the rapid technological developments will allow the construction of electronic charts systems with the possibility of replacing the paper navigation charts. This system is the well-known ECDIS (Electronic Chart Display and Information System). ECDIS is a complex, safety-relevant, software based system with multiple options for display and integration. The ongoing safe and effective use of ECDIS involves many stakeholders including equipment manufacturers, chart producers, software and hardware maintenance providers, operators and shipowners, training providers and of course seafarers[1]. IMO (International Maritime Organization) approved its technical and functional specifications in navigation and identified the conditions under which ECDIS can replace the mandatory and traditional use of printed navigational charts. In 2008 IMO decided the gradually mandatory installation of ECDIS in new ships until 2012 and to all the ships already existing until 2018 after recognizing the advantages of ECDIS in navigation. More specific the amended SOLAS regulation V/19 requires all newly built passenger ships of 500 gross tonnage and upwards, as well as newly built cargo ships of 3000 gross tonnage and upwards engaged on international voyages to be fitted with ECDIS. In addition, it is important that all the stakeholders mentioned above have a clear and common understanding of their roles and responsibilities in relation to ECDIS.

3.BASIC UNITS OF AN ELECTRONIC CHART SYSTEM

A typical electronic chart system for navigation consists of the following sections:

1) Database, which besides the electronic maps contains other information such as vessel details, planned voyages, beacon information etc.

2) Hardware, which includes CPU, RAM, HDD, as well as external optical drive for data transfer and storage and the user communication modules such as color screen, keyboard, mouse or trackball.

3) Software, which has been placed in the computer of the system for display of the electronic maps and the execution of tasks like the preparation, design and execution of the voyage.

4) Interfaces, with other nautical aids and systems like GNNS, RADAR/ARPA, AIS, gyro compass etc.

[1] IMO/ECDIS/Guidance for Good Practice (Further information MSC.1/Circ.1503/Rev.1)

These units of a typical electronic chart system are basically the same as the corresponding ones of a PC.

4.ECDIS

An Electronic Chart Display and Information System (ECDIS) is a geographic information system used for nautical navigation that complies with International Maritime Organization (IMO) regulations as an alternative to paper nautical charts. Besides enhancing navigational safety, ECDIS works to ease the navigator’s workload with its automatic capabilities such as route planning, route monitoring, automatic ETA computation and ENC updating. In addition, ECDIS provides other sophisticated navigation and safety features, including continuous data recording for later analysis. The effective integration of ECDIS onboard, and the safe transition from paper chart navigation, to ECDIS navigation, will required detailed planning. This planning should include:

- A structured risk assessment of the potential hazards.
- Identification of training requirements.
- A thorough review of navigational procedures contained withing the Safety Management System.

The following are some of the key points to be considered:

- Choice of ECDIS manufacturer/ model and whether a single make and model will be fitted across the fleet.
- ECDIS hardware and software service and maintenance requirements and agreements.
- Back-up arrangements.
- Whether ECDIS will be used as primary means of navigation or an aid to navigation
- Contingency planning.
- Training program and schedule.
- Choice of chart management system across the fleet.
- Choice of chart distributor.
- ENC chart availability in relation to trading pattern.
- Alternative charting options should ENC charts be unavailable.
- Safety setting requirements.
- Voyage planning requirements.
- Voyage monitoring requirements.
- ECDIS data transfer requirements.

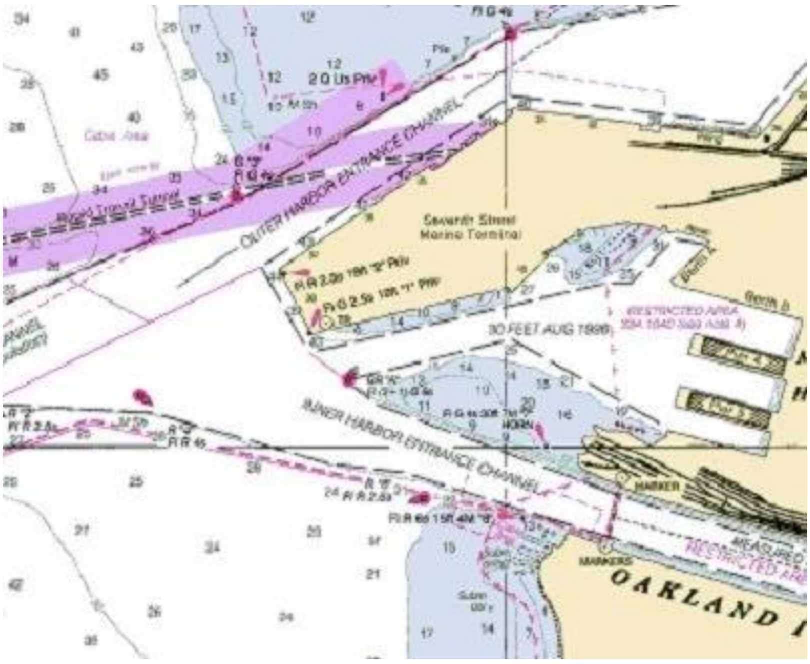
A structured and detailed plan should ensure a safe and smooth transition from paper based navigation to electronic navigation.

5.CATEGORIES OF ELECTRONIC CHARTS

We have two categories, the Raster Navigational Charts (RNC), and the Vector Navigation Charts or Electronic Navigational Charts.

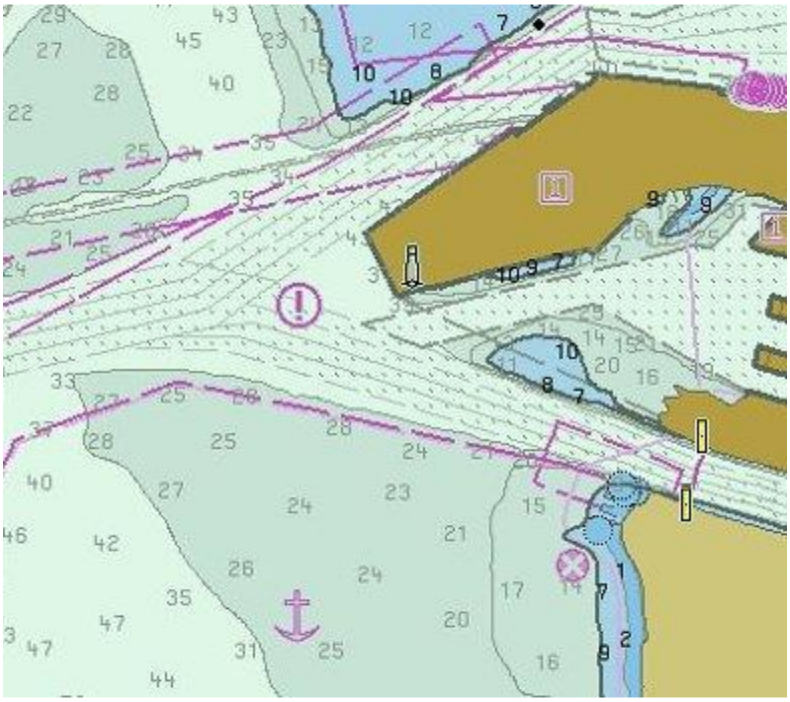
An RNC is a digital imagine originally scanned from paper charts into an electronic format. Geographic references are added to the electronic chart allowing it to refresh in real time, allowing mariners to identify and analyze chart data. Raster Charts integrate with global positioning system (GPS) coordinates using raster chart display systems (RCDS). Raster charts have a similar presentation and style of use to traditional paper nautical charts and maybe preferable to mariners who used to use paper nautical charts. Free weekly notice to mariners (NTM) updates are available to ensure chart information is accurate and reliable for mariners. Raster Navigation Charts (RNCs) are a safe and reliable primary navigation alternative under certain conditions and subject to individual Port and Flag state approval. Large scale raster charts can help identify important information such as dredged depths and berth names that can be hard to find sometimes in ENC's. Raster charts do have their disadvantages when compared to vector charts. Unlike an ECDIS operating in ENC mode, RNC mode operation allows for limited alarm and warning functionality. There is a finite amount of resolution because images are digitally scanned. Vector charts may show more dense information when used to zoom in. Raster charts are limited in their functionality in this regard. The overall usability of RNCs is less robust than ENCs. When using and ENC certain features may be turned off, to allow for a less cluttered view. Text on raster charts may be sideways and difficult to read. Text in vector charts always stays the right side up and easy to read.

Overall, while they do have some disadvantages raster charts are an excellent complementary source of chart data in conjunction with the use of vector charts to help the mariner safely navigate.



Raster Navigational Chart (RNC)

ENCs or vector charts are required to be used if data is available. A vector chart is almost a representation of a database of information. All of the same information that is available on a raster chart is present, with many significant additions, The use of vector charts is highly preferable to raster charts. However, there are locations where vector charts are not available and officers must use raster charts so long as SOLAS provisions are adhered to. An ENC contains far more information than an RNC and has a slightly different look than a paper chart. Different objects on an ENC have attributes. By clicking on a vessel or lighthouse, for example, more information about the object will become available. It is recommended that ships equipped with ECDIS operate using ENCs. No electronic system is completely failsafe and it is always required to employ a second independent ECDIS, operating from a different power source or carry updated paper nautical charts covering the entire route of the voyage. Each object of feature on a vector chart has attributes that vary. These attributes can provide users further than would be provided on raster chart. For example, an icon representing a lighthouse may be clicked upon and attributes of the lighthouse may be viewed, as we mentioned before. Data for vector charts is collected and organized along with a second data authentication and protection standard details security schemes for vector chart data. The data for these charts is produced by governmental bodies following International Hydrographic Organization (IHO) ENC product specifications, Vector chart data produced by organizations that do not meet these specifications should not be used. Vector charts allow users much greater utility. There may be instances where a certain feature is of interest and other nearby features are cluttering the view. The user may turn off the features that are cluttering his view. Text may also be turned off. Because a vector chart is a graphic representation of a database, there are far fewer limits. It is possible to zoom in on an area and gain more detail. It is also possible to zoom out, especially to get a look ahead. Viewing the path of the route significant distance ahead becomes difficult with the limited functionality or raster charts. Vector charts allow users to view the oncoming path with much greater ease. Because of the increased amount of data available, ENCs are suited for use with alarms and warnings to alert crews of danger in the ship's path. Positions of features on vector charts use the World Geodetic System 1984 Datum (WGS84). This system is global navigation satellite system (GNSS) position compatible.



Electronic Navigational Chart (ENC)

The vector and raster charts stored in an ECDIS must be updated regularly both to ensure that the most current data for marine navigational purposes is available and that the ECDIS is able to read the data that is supplied and function correctly.

Updates may be made automatically by network transmission or using a CD-ROM/Flash-drive. Mariners should consult with their electronic chart supplier for acquiring the necessary updates for their electronic chart portfolio. There are instances where mariners may not be sure if the most recent update to the electronic charts in an ECDIS has been applied. Some types of ECDIS provide functionality to check which updates have been applied, while other do not. If there is any doubt it is possible to cross check charts with traditional sources of information such as notices to mariners or the bridge holdings management software to ensure that chart data is up to date. It is also important to ensure that the ECDIS itself conforms to the most recent IHO standard.

The ECDIS provides a great amount of convenience and flexibility to mariners, Previous to its adoption by the industry, mariners were required to purchase charts beforehand, as well as keep an up-to-date inventory of charts mapping their complete route, Using an ECDIS with appropriate back-up provisions allows mariners to have all the electronic charts needed for a voyage, up-to-date, with the latest notices to mariners available. So long as proper safeguards are taken, the ECDIS using vector or raster charts is safer, more usable and efficient, than traditional charts, making it the today's standard.

6.INTEGRATION OF AIS AND ECDIS

Automatic Identification Systems (AIS) transponders are designed to be capable of providing position, identification and other information about the ship to other ships and to coastal authorities automatically. Ships fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide the protection of navigational information. Ever since the requirements set forth in the new Chapter 5 of SOLAS-74 Convention, adopted in IMO Resolution December 5/2000, came into effect, the AIS has been mandatory ship equipment for a major part of the world's sea fleet. The AIS can be connected either to an additional dedicated AIS display unit, possibly one with a large graphic display, or as an input to existing navigational system devices such as a radar display, ECS, ECDIS, or INS. Such system interconnection and data integration is recommended[2]. On the whole, AIS systems, just like electronic chart systems (ECDIS and ECS) and other navigation aids, are intended to enhance safety of life at sea and the safety and efficiency of navigation as well as the protection of the marine environment. SOLAS regulation V/19 requires that AIS exchange data ship-to-ship and with shore based facilites. Therefore, the purpose of AIS is to help identify ships, assist in target tracking, assist in search and rescure operation, simplify information exchange (e.g. reduce verbal mandatory ship reporting) and provide additional information to assist situation awareness. In general, data received via AIS will improve the quality of the information available to the OOW, whether at a shore surveillance station or on board a ship.

The AIS-ECDIS integration provides indisputable advantages in the Collision Avoidance and Surveillance aspect, over other navigation aids like ARPA or Radar. Firstly, because the AIS

[2] It is becoming common practice for pilots to possess their own portable navigational equipment, which they carry on board. Such devices can be connected to shipborne AIS equipment and display the targets they receive.

system operating range is VHF range in the area. This is almost equivalent to the range, which the ARPA or Radar operate in. Secondly, the ARPA/Radar will only be able to show relative target mark on the screen by the bearing and range from own ship, whereas the ECDIS allows the target coordinates, its actual dimensions, full list of identifiers (Name, Call Sign, MMSI, IMO Number) to be accurately determined and the collision avoidance information for this target (bearing and range to the target, CPA distance and TCPA) to be promptly obtained. It is also possible to rapidly view additional information (Voyage Data) on the target for any moment in time. If there is a risk of collision with a target or of getting dangerously close to it, the ECDIS operator can quickly identify dangerous targets, obtain their parameters and promptly establish communication with these targets by transmitting a message via the AIS (Safety Message) should the target fail to respond to the voice call on the VHF. Data on the messages transmitted from the ECDIS via AIS communication is archived in the ECDIS and will prove to be useful should an accident be considered in a court of law.

Furthermore, AIS may be used in search and rescue operations. By receiving messages from AIS-SART, operators get more accurate information, especially on the position of survival craft. In combined aerial and surface searches AIS may allow the direct presentation of the position on other displays such as ECDIS, which facilitates the task of SAR (Search And Rescue) CRAFT. For ships in distress without AIS, the On scene Coordinator (OSC) could create and AIS target. Overall AIS working alongside with ECDIS is a useful source of supplementary information to that derived from navigational systems (including radar) and therefore an important tool in enhancing situation awareness of traffic confronting users.

7.TRAINING

The Manila amendments to the STCW Code entered into force on 1 January 2012. These require all navigational watchkeeping officers to have undergone ECDIS training if they are sailing on a vessel fitted with ECDIS. This training is required whether ECDIS is used as the primary means of navigation or as an aid to navigation. In order to ensure that the training requirements of the 2010 Manila amendments are met, formal ECDIS training will nw also be included as a part of navigational watchkeeping officers Certificate of Competency training.

ECDIS training should be undertaken in two stages to ensure watchkeepers are fully able to understand and utilize the system. Generic training, usually conducted at a dedicated training center. This will ensure that the watchkeeper fully understands the underlying principles of ECDIS and can meet the competencies outlined in the IMO model course. This training will not necessarily focus on a specific type of equipment.

Once the watchkeeper understands the principals of ECDIS, familiriazation with the specific equipment fitted onboard should be carried out prior to a navigational watch being undertaken. This training is known as 'Type Specific". The method of familiriazation will depend on company procedures as there are a number of ways in which this can be conducted. However, familiriazation should ensure the watchkeeper is:

- Familiar with the setup and functionality of the fitted equipment.
- Familiar with the backup arrangements.
- Understands and can demonstrate implementation of the company procedures regarding electronic navigation.

8. LEGAL STATUS OF ECDIS

As for the use of printed nautical charts, the seafarer must use up-to-date nautical cahrts issued by the official Hydrographic Services according to internationally accepted specifications, as well as for the use of electronic chart systems must use systems which meet specific IMO specifications. The main goal of the IMO is to determine the equipment requirements, manning and organization of ships in order to keep safe the human life, but also the development of specifications for all marine equipment and the shipping systems of ships. The IMO is not a control mechanism, and does not imposes penaltys for non compliance. This work is made by the local port state authorities. Efforts to develop specifications for ECDIS systems begun in 1986 and completed in 1995 with the first IMO version of the operating system and technical specifications of these systems, according to which: 1) ECDIS's primary mission is to contribute to safe navigation, 2) the use of ECDIS with adequate alternative settings can be considered that is it equivalent to the seafarer's basic obligation to use updated printed maps. The IMO institutionalization of the use of the ECDIS system as tool equivalent to the use of the printed nautical chart, is historical station in the evolution of navigation methods because with it the execution of all tasks and preparation procedures is fully covered, 3) many additional features are provided, which significantly reduce the tense and workload on the bridge and help to get instant and correct for the safety of navigation, decisions.

The basic definitions of the IMO performance standards for ECDIS are:

Electronic Chart Display and Information System (ECDIS), means a navigation information system which with adequate back-up arrangements can be accepted as complying with the up-to-date chart required by regulation V/20 of the 1974 SOLAS Convention, by displaying selected information from a system electronic navigation chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and if required display additional navigation-related information.

Electronic Navigational Chart (ENC), means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation.

System Electronic Navigational Chart (SENC), means a database resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means and other data added by the mariner. It is this database that is actually accessed by ECDIS for the display generation and other navigational functions, and is the equivalent to an up-to-date paper chart. The SENC may also contain information from other sources.

Standard Display, means the SENC information that should be shown when a chart is first displayed on ECDIS. Depending upon the needs of the mariner, the level of the information it provides for route planning or route monitoring may be modified by the mariner.

Display Base, means the level of SENC information which cannot be removed from the display, consisting of information which is required at all times in all geographic areas and all circumstances. It is not intended to be sufficient for safe navigation.

DISPLAY OF SENC INFORMATION: ECDIS should be capable of displaying all SENC information. SENC information available for display during route planning and route monitoring should be subdivided into the following three categories, Display Base, Standard Display and All Other Information. ECDIS should present the Standard Display at any time by a single operator action. When a chart is first displayed on ECDIS, it should provide the Standard Display at the largest scale available in the SENC for the displayed area. It should be easy to add or remove information from the ECDIS display. It should not be possible to remove information contained in the Display Base. It should be possible for the mariners to select a safety contour from the depth contours provided by the SENC. It should be possible for the mariner to select a safety depth. ECDIS should emphasize sounding equal to or less than the safety depth whenever spot soundings are selected for display. The ENC and all updates to it should be displayed without any degradation of their information content. ECDIS should provide a method to ensure that the ENC and all updates to it have been correctly loaded into the SENC. The ENC data updates to it should be clearly distinguishable from other displayed information.

PROVISION AND UPDATING OF CHART INFORMATION: The chart information to be used in ECDIS should be the latest edition of that originated by a government authorized hydrographic office, and conform to IHO standards. The contents of the SENC should be a adequate and up-to-date for the intended voyage to comply with regulation V/20 of the 1974 SOLAS Convention. It should not be possible to alter the contents of the ENC. Updates should be stored separately from the ENC. ECDIS should be capable of accepting official updates to the ENC data provided in conformity with IHO standards. These updates should be automatically applied to the SENC. By whatever means updates are received, the implementation procedure should not interfere with the display in use. ECDIS should also be capable of accepting updates to the ENC data entered manually with simple means for verification prior to the final acceptance of the data. They would be distinguishable on the display from ENC information and its official updates and not affect display legibility. ECDIS should keep a record of updates including time of application to the SENC. ECDIS should allow the mariner to display updates in order to review their contents and to ascertain that they have been included in the SENC.

SCALE: ECDIS should provide an indication if 1) the information is displayed at a larger scale than that contained in the ENC; or 2) own ship's position is covered by an ENC at a larger scale than that provided by the display.

DISPLAY OF OTHER NAVIGATIONAL INFORMATION: Radar information or other navigational information may be added to the ECDIS display. However, it should not degrade the SENC information and it should be clearly distinguishable from the SENC information. ECDIS and added navigational information should use a common reference system. If this is not the case, an indication should be provided.

RADAR: Transferred radar information may contain both the radar image and ARPA information. If the radar image is added to the ECDIS display, the chart and the radar image should match in scale and in orientation. The radar image and the position from the position sensor should both be adjusted automatically for antenna offset from the conning position. It should be possible to adjust the displayed position of the ship manually so that the radar image matches the SENC display. It should be possible to remove the radar information by single operator action.

DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA: It should always be possible to display the SENC in a "north-up" orientation. Other orientations are permitted. ECDIS should provide for true motion mode. Other modes are permitted. When true motion mode is in use, reset and generation of the neighbouring area should take place automatically at a distance from the border of the display determined by the mariner. It should be possible to change manually the chart area and the position of own ship relative to the edge of the display.

COLOURS AND SYMBOLS: IHO recommend colours and symbols should be used to represent SENC information[3]. The colours and symbols other than those mentioned in 8.1 should be those used to describe the navigational elements and parameters listed in Appendix 3 and published IEC[4]. SENC information when displayed at the scale specified in the ENC should use the specified size of symbols, figures and letters. ECDIS should allow the mariner to select whether own ship is displayed in true scale or as a symbol.

DISPLAY REQUIREMENTS: ECDIS should be capable of displaying information for 1) route planning and supplementary navigation tasks, 2) route monitoring. The effective size of chart presentation for route monitoring should be at least 270 mm by 270 mm. The display should be capable of meeting colour and resolution recommendations of IHO[5]. The method os presentation should ensure that the displayed information is clearly visible to more than one observer in the conditions of light normally experienced on the bridge of the ship by day and by night.

Route Planning, monitoring and voyage recording: It should be possible to carry out route planning and route monitoring in a simple and reliable manner. ECDIS should be designed following ergonomic principles for user-friendly operation. The largest scale data available in the SENC for the area given shall always be used by the ECDIS for all alarms or indications according to Appendix 5.

ROUTE PLANNING: It should be possible to carry out route planning including both straight and curved segments. It should be possible to adjust a planned route by, for example 1) adding waypoints to a route, 2) deleting waypoints from a route, 3) changing the position of a waypoint, 4) changing the order of other waypoints in the route. It should be possible to plan an alternate route in addition to the selected route. The selected route should be clearly distinguishable from the other route. An indication is required if the mariner plans a route across an own ship's safety contour. An indication is required if the mariner plans a route across the boundary of a prohibited area or a geographic area for which special conditions exist[6]. It should be possible for the mariner to specify a limit of deviation from the planned route at which activation of an automatic offtrack alarm should occur.

ROUTE MONITORING: For route monitoring the selected route and own ship's position should appear whenever the display covers that area. It should be possible to display a sea area that does not have the ship on the display (e.g. for look ahead, route planning), while route monitoring. If this is done on the display used for route monitoring, the automatic route monitoring functions (e.g. updating ship's position, and providing alarms and indications) should be continuous. It should be possible to return to the route monitoring display covering own ship's position immediately by single operator action. ECDIS should give an alarm if, withing a specified time set by the mariner, own ship will cross the safety contour. ECDIS should give an alarm or indication, as selected by the mariner, if withing a specified time set by the mariner, own ship will cross the boundary of a prohibited area or of a geographical area for which special conditions exist. An alarm should be given when the specified limit for

[3] Appendix 2 to IHO Special Publiaction S-52 (see Appendix 1).

[4] IEC Publication 61174
[5] Appendix 2 to IHO Special Publication S-52
[6] See Appendix 4

deviation from the planned route is exceeded. The ship's position should be derived from a continuous positioning system of an accuracy consistent with the requirements of safe navigation. Whenever possible, a second independent positioning method of a different type should be providing, ECDIS should be capable of identifying discrepancies between the two systems. ECDIS should provide an alarm[7] when the input from the position fixing system is lost. ECDIS should also repeat, but only as an indication, any alarm or indication passed to it from a position fixing system. An alarm should be given by ECDIS if the ship, withing a specified time or distance set by the mariner, will reach a critical point on the planned route. The positioning system and the SENC should be on the same geodetic datum. ECDIS should give an alarm if this is not the case. It should be possible to display an alternative route in addition to the selected route. The selected route should be clearly distinguishable from the other routes. During the voyage, it should be possible for the mariner to modify the selected sailing route or change to an alternative route. It should be possible to display, 1) time-labels along ships track manually on demand and automatically at intervals selected between 1 and 120 minutes and, 2) an adequate number of points, free movable electronic bearing lines, variable and fixed range markers and other symbols required for navigation purposes and specified in Appendix 3. It should be possible to enter geographical co-ordinates of any position and then display that position on demand. Also, it should be possible to select any point (features, symbol or position) on the display and read it's geographical co-ordinates on demand. It should be possible to adjust the ship's geographic position manually. This manual adjustment should be noted alpha-numerically on the screen, maintained until altered by the mariner and automatically recorded.

VOYAGE RECORDING: ECDIS should store and be able to reproduce certain minimum elements required to reconstruct the navigation and verify the official database used during the previous 12 hours. The following data shall be recorded at one minute intervals 1) to ensure a record of own ship's past track: time, position, heading, and speed, 2) to ensure a record of official data used: ENC source, edition, data, cell and update history. In addition, ECDIS should record the complete track for the entire voyage, with thime marks at intervals not exceeding 4 hours. It should not be possible to manipulate or change the recorded information. ECDIS should have a capability to preserve the record of the previous 12 hours and of the voyage track.

ACCYRACY: The accuracy of all calculations performed by ECDIS should be independent of the characteristics of the output device and should be consistent with the the SENC accuracy. Bearings and distances drawn on the display or those measured between features already drawn on the display should have an accuracy no less than that afforded by the resolution of the display.

CONNECTIONS WITH OTHER EQUIPMENT: ECDIS should not degrade the performance of any equipment providing sensor inputs. Nor should the connection of optional equipment degrade the performance of ECDIS below this standard. ECDIS should be connected to systems providing continuous position fixing, heading and speed information.

PERFORMANCE TESTS, MALFUCTIONS ALARMS AND INDICATIONS: ECDIS should be provided with means for either automatically or manually carrying out on-board tests

[7] Amendment authorized by resolution MSC.87(70).

of major functions. In case of a failure, the test should display information to indicate which module is at fault. ECDIS should provide a suitable alarm or indication of system malfunction.

BACK-UP ARRANGEMENTS: Adequate back-up arrangements should be provided to ensure safe navigation in case of an ECDIS failure.

1) Facilities enabling a safe take-over of the ECDIS functions should be provided to avoid that an ECDIS failure develops into a critical situation.

2) A back-up arrangement should be provided facilitating means for safe navigation of the remaining part of the voyage in case of an ECDIS failure.

POWER SUPPLY: It should be possible to operate ECDIS and all equipment necessary for its normal functioning when supplied by an emergency source of electrical power in accordance with the appropriate requirements of chapter II-1 of the 1974 SOLAS Convention. Changing from one source of power supply to another or any interruption of the supply for a period of up to 45 seconds should not require the equipment to be manually re-initialized.

9. ADVANTAGES OF ECDIS

ECDIS has become essential tool for watchkeeping officers on ships. Navigating a ship with an ECDIS is fundamentally different from navigating with paper charts. It is important that the Masters, navigating officers, and ship-owners are aware of the benefits of managing the chart display, safety settings, and alarm system of ECDIS.

1) Availability: One of the great advantages of ECDIS over paper charts is the availability of electronic charts- especially when voyage orders are received at the last minute. ECDIS uses SENC (System Electronic Navigational Chart). It is a database resulting from the modification of ENC's for installation and use in ECDIS, with the addition of other extra data by the seafarer. It is the database in which ECDIS has access for indicator display and other shipping operations. The result of this is equivalent to an updated printed map. Before that the Officer had to check the chart-catalogue and determine what charts are required for the voyage. Then he had to order these charts with the hope that they will arrive in time. More often than not, this proved a major challenger especially on tramper trades[8] which tend to get last minute voyage orders.

[8] A boat or ship engaged in the tramp trade is one which does not have a fixed schedule or published ports of call.

2) Reduces the navigation workload: The Navigation Officer can plan and summarise the passage plan much faster than on paper charts, especially when he has at his disposal all the required charts and nautical publications updated and ready to be used, chart information for safe and efficient navigation at the click of a mouse.

3) Corrections of charts and publications: One of the most time-consuming tasks that all experienced Officers can recall is that of the corrections. Correcting charts with spped and accuracy was a skill that took a long time to master. Even then there was a possibility of the occasional erroneous correction. It used to be the biggest part of Navigational' s Officer work time. Now he just receives weekly updates to the Electronic Charts via email which he only has to download onto a zip drive and upload them to the ECDIS since ECDIS allows updating the existing charts and installing new charts, too. Charts on ECDIS need to be updated and corrected on a regular basis.

4) Continuous Monitoring of Vessel's Position: It could be the biggest advantage of the ECDIS over paper charts. Its ability to enable the user to see the vessel's position in real time without any action taken. That's because ECDIS is interfaced with both the vessel's independent GPS transceivers, thereby making the system work even if one fails. It also uses a number of other navigational equipment and softwares, including Echo Sounder, Radar/Arpa and Gyro compass. One can also use the Radar Range and Bearings to plot positions on the ECDIS display, just like on paper charts. This is done manually, simply by taking the range and bearing from a suitable radar object and plot it on the ECDIS. As a result, the outmost accuracy is provided making operations quick, convenient and most importantly safe.

5) Anti-Grounding Alarms and Settings: It provides visual and audible indications that the vessel is headed in a dangerous direction along with loud alarms and warning signals with the intention to notify the crew so that they can act quickly and efficiently in the event of an emergency. More specifically ECDIS warns us when the ship is about to approach shallow waters. How does it know that? The user has complete flexibility to determine these safety settings on the ECDIS. Most companies have strict guidelines on the minimum safety parameter settings. Let's take a closer look at these parameters.

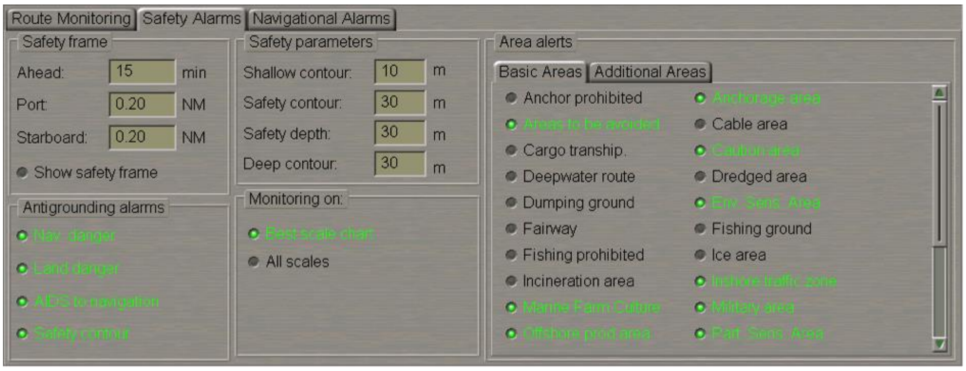
Shallow Contour: This setting indicates the non-navigable area and marks the boundary outside of which the vessel may safely navigate. Crossing this boundary will result in the vessel running aground. It is usually indicated by a deep blue colour which marks the non-navigable area. The setting obviously needs to be equal or more than the draft of the vessel. The contours are in the value of 5,10,15,20,30 and so on. So, for example, let us say the vessel's draft is 14 meters and we enter the shallow contour value of 14 meter. The ECDIS will display 15 meter contour line as the shallow contour.

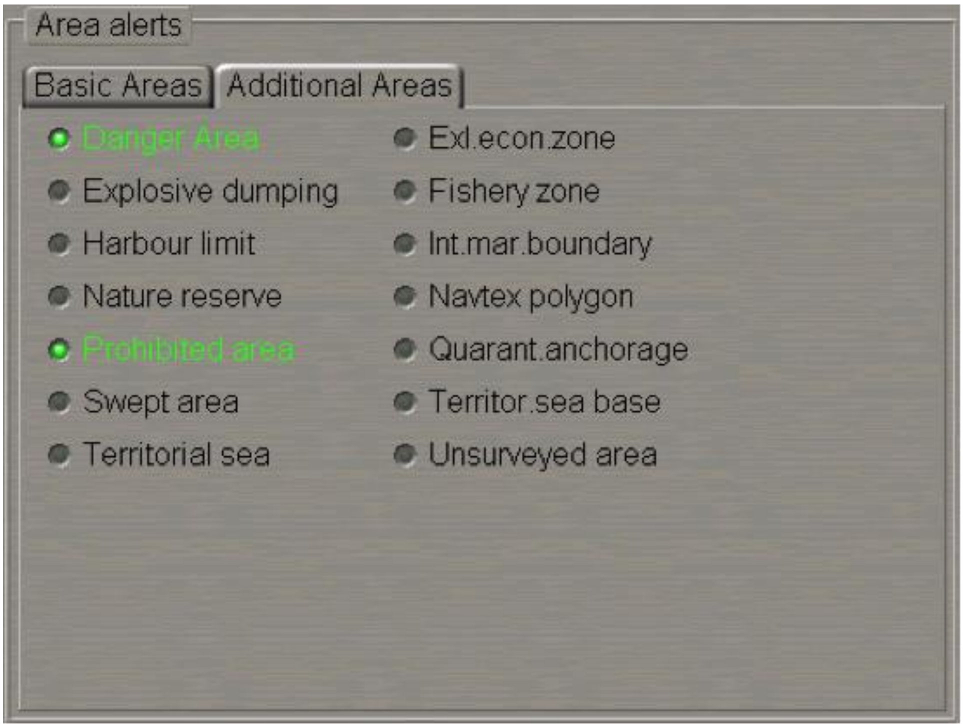
Safety Contour: The safety contour is the most important parameter of all the safety settings for the display of unsafe water areas, detecting isolated dangers and triggering anti-grounding alarms. The safety contour is basically an outline which marks the division between safe and unsafe waters. In general, the Safety Contour may be set equal to but not lower than the Safety Depth settings. Waters with depths lower than the Safety Contour should be construed as NO-GO AREA. The Master may set the Safety Contour to a value higher than the Safety Depth if he determines that an additional safety buffer would be required depending on the prevailing circumstances and conditions. Indicated by a grey coloured area on the ECDIS.

Safety Depth: This marks and highlights the minimum depth required for the vessel to remail safely afloat. It basically is the deepest static draught plus anticipated squat plus Company's minimum UKC (Under Kneel Clearance). It is the only depth setting on ECDIS.

Deep Contour: This setting is very handy for vessels engaged in operations such as Tank cleaning ballast water exchange where it is mandatory to carry out the operation in waters exceeding a certain depth. Vessel' s not engaged in such operations may set this value as deemed appropriate but in any case this should not be lower than the Safety Contour. Indicated by a white coloured area on the ECDIS screen.

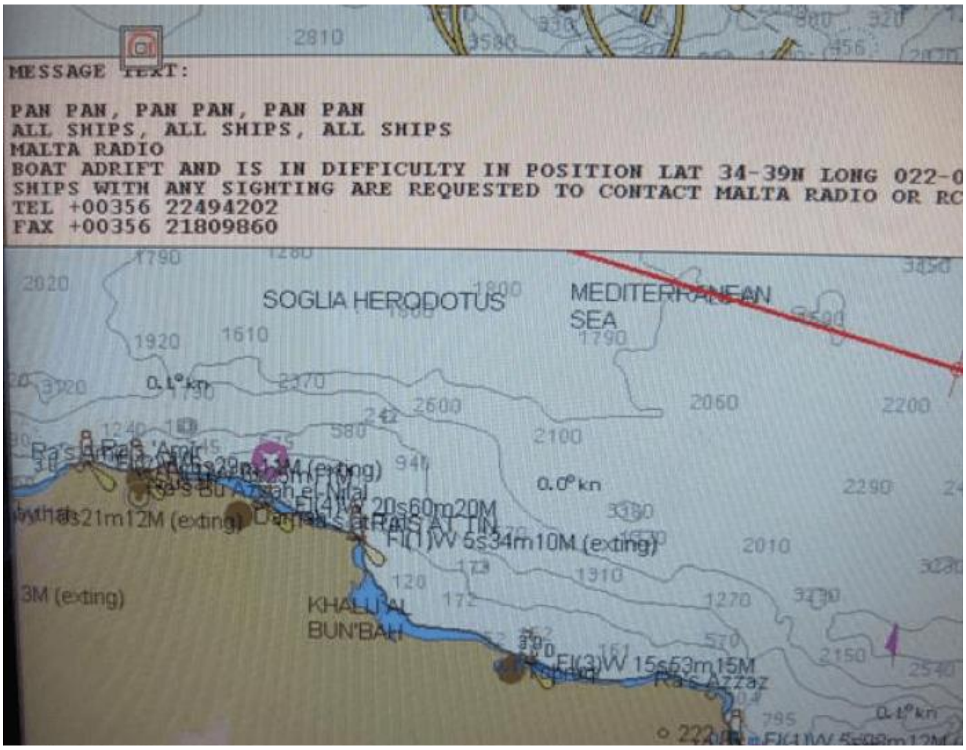
6) User determined alarm settings: While there are certain safety critical alrams that are ON by default and cannot be changed, there is a number of other alarms and warnings that can be switched ON or OFF by the user/OOW depending on the situation. However too many alarms could result in Alarm Deafness (more on this later) and too few alarms might result in a false sense of safety. It is utmost importance that the OOW is fully familiar with all the alarms and warnings which have been actived. A handover checklist of the alarms and warnings should be completed before taking over the watch.





7) Enhances Search and Rescue capability onboard: Modern ECDIS units have the option of interfacing NAVTEX AND EGC with the ECDIS display. Warnings and alerts are automatically displayed on the ECDIS screen, along with an audible and visual indication on the unit itself. Quick range and bearings are obtained by the Electronic Range and Bearing Line (ERBL) function enabling the user to quickly determine if the vessel is in a position cable of providing assistance to the ship in distress.

The ECDIS also has a Man Overboard (MOB) function which is activated in the event of a person falling overboard. This marks the position which is used as a reference for Revover and Rescue.



8) Cost Efficient: Although electronic charts are by no means cheap, they still have an edge over paper charts. Electronic Chart Permits are obtained electronically with minimum data usage. Paper charts have to be delivered physically which involved handling fees by the agents, especially if ordered at the last minute. On rare occasions vessels had to divert only to pick up charts if there was a last minute change of schedule. This involved massive costs such as Agency fees, boat costs etc. All this procedure is avoided by using Electronic charts.

9) Environmentally friendly: A huge amount of paper is still used in ships. Imagine that amount plus the amount of paper charts used and wasted later either because they were old or outdated and provided wrong information or very little information. Imagine also hundred or thousands of ships doing the same. This doesn’t happen with ECDIS. The ECDIS does pack in a strong punch in reducing the carbon footprint of every vessel which goes paperless.

In brief, the benefits of ECDIS are:

- Reduction of the mariner’s workload, reduction of uncertainty and psychological pressure-stress.
- Improved ability to assess the marine environment.
- Availability of extra information, that may not be needed, checked for reliability and integrity.

- Intelligent and effective management of indications and audible warnings/danger warnings.
- Easy chart correction/updating and easy route database management.
- Enhanced safety during the voyage
- Effective decision-making process
- Flexible display of information, adjustable by the operator

10. Disadvantages of ECDIS

1) Over-Reliance: With an equipment which is seemingly “bullet-proof”, there is a tendency for Officers to over rely on it. The consequences of this can be disastrous. Every now and then an Officer gets tunnel visioned on ECDIS, paying zero attention outside using his number one “weapon”, his eyes, his own vision. The ability to keep a proper visual look-out cannot be overlooked here. No matter how good the ECDIS is, its performance still largely depends upon the inputs. A vessel could have switched off its AIS and hence might not be displayed on the screen. If the Radar overlay is not turned on, the vessel will just not be seen at all in the ECDIS display. It is very critical that Officers on watch continue to maintain an efficient look-out and a good radar watch. The purpose of ECDIS is to facilitate efficient navigation, not to substitute it. It is also vitally important to practice essential skills such as Radar Plotting, Sights, Compass Errors and more. All of this will come in handy in the event of an ECDIS breakdown. Last but not least, always go through the company’s procedures.

2)Wrong inputs: ECDIS at the end of the day, is a machine and depends solely on the type of inputs that it receives. Wrong position inputs from the GPS or loss of GPS signal can have grave consequences. If the alarm is missed out, the result can also be disastrous. Hence, is it vitally important to check the performance of sensors and to carry out frequent comparisons between the primary and secondary means of position fixing. Other inputs such as the GYRO, Ech sounder, NAVTEX etc, should be frequently verified independently to ensure smooth and safe operation.

3) Wrong settings: Feeding in wrong parameters for safety, more so critical settings such as the Shallow contour, Safety depth etc can give a false sense of safety as well. It is extremely important that the Master himself checks these settings each time they are changed. These settings should be password protected and every OOW should verify them each time, prior taking over the watch. Alarms should not be deactivated without strong reason and never just for the sake of avoiding frequent alarms. All the alarms in use should be properly documented and their switching ON and OFF should be controlled by a defined procedure. Proper safety settings are essential for an ECDIS display. Inappropriate settings have always led to grounding incidents.

4) Alarm Deafness: If alarms start going off too frequently, the OOW could end up in a dangerous situation called Alarm Deafness. This leads to the OOW acknowledging the alarm even without checking what it was. He will eventually run out of luck and an occasion will emerge where he might miss out a critical warning such as approaching shallow contour. Hence, alarms should be carefully chosen, always appropriate to the prevailing conditions. Every single alarm should be double checked and investigated prior to acknowledging.

5) System Lag: Modern ECDIS software have a lot of data to display. On top of that, as we already mentioned, ECDIS is connected with various equipment. This can slow down the system very easily leading to a system lag. The hardware needs to keep up with the software and frequent updates and necessary. A higher RAM and a higher graphics card are also recommended if not a must.

6) Different types. Navigation using paper printed charts was a skill which had to be mastered just once. It was the same thing every day in every ship. However, this does not happen with ECDIS. Different vessels will have different types of ECDIS equipment. Even of the essential features are the same, it still takes a lot of fiddling around until one gets comfortable with the machine. With today's busy schedule, it is not uncommon for navigators to take over duties at the gangway itself. Only option left is for his colleagues onboard to show him the specific features and differences this ECDIS might have. To overcome this problem, many flag states have made it mandatory for every seafarer to undergo type specific ECDIS training prior joining the vessel. Many companies have also decided to select a single equipment manufacturer to supply the company's fleet with ECDIS equipment. This should ease the training considerably.

7) Anomalies: It is a machine after all. OOW needs to be aware of the anomalies present in that particular equipment. It could be a simple use of the Scale Minimum function or something serious where certain depths or symbols might not be visible at a particular scale or appear differently. Complete familiarisation with the ECDIS equipment is a must.

8) Information Overload: Apart from the tons of data in display, it is common that OOW puts marks on the ECDIS such as: call Master, notices to Engine Room, Echo Sounder Switched ON, port control VHF channels etc. There is a chance information is missed. OOW should be careful not to mix things up too much and create a chaos in the ECDIS screen. Larger ECDIS screens could help.

9)Resistance to Change: This is more about the senior Officers, that do not put trust on a machine. Many of them have grown up in an era where paper charts were the only means of navigation. This is what they know. Not having there onboard could mean for them not having an aid on which they have relied all their lives. The transition might not be easy and this could create a mental block for many. Hence it is vital, that senior Officers embrace this new technology and go through the process of change as smooth as possible. Companies should encourage them to undergo frequent refresh courses.

Since ECDIS is not only an electronic version of a paper chart, but more comprehensive navigation and information system, complete mastery of its resources and knowledge of the system limitations is of crucial importance for safe navigation. Studies of maritime accidents, which mention the improper use of ECDIS as one of the causes shows that, although the system itself is not completely free of defects, critical mistakes are made by officers with their misure of ECDIS. The most important among them are mistakes related to the system of safety and alarms settings. Which is not entirely surprising since the transition from paper navigational aids to electronic system with its multiple aspects, poses a challenge to active seamen who have used paper chats throughout their active career. The conducted survey revealed alarmingly low level of use and knowledge about the capabilities of the ECDIS, which directly endangers the safety of navigation. The obtained results undoubtedly suggest that it is necessary to introduce appropriate changes in the training and to intensify the exercises of those segments of ECDIS usage in which deck officers showed the worst results. In addition, it is necessary to conduct the evaluation of acquired knowledge continuously, which would certainly be a guideline addressed to shipping companies, as they equally share the responsibility and are obliged to organize proper training of their seafarers.

11. IMPROPER USE OF ECDIS

ECDIS has become essential tool for watchkeeping officers on ships. Navigating a ship with an ECDIS is fundamentally different from navigating with paper charts. It is important that the Masters, navigating officers, and ship-owners are aware of the benefits of managing the chart display, safety settings, and alarm system of ECDIS.

ECDIS equipped vessels have been involved in a number of groundings which may have been avoided had it not been for failures in the setup and use of ECDIS safety settings and alarm systems. Inappropriate settings are likely to render the safety contour alarms meaningless. The use of ECDIS safety settings has often been overlooked by navigating officers duo to either ignorance or insufficient knowledge. Deck officers may be unfamiliar with the setup and use of ECDIS alarms thereby increasing the risk of grounding in shallow waters and causing other unwanted situations. The following cases are an example of the improper use of ECDIS than can lead a vessel to ground.

Case no.1)

During the early morning hours a tanker was transiting a heavily used waterway under VTS control at a speed of about 12 knots and using autopilot control. In the early morning hours there was a handover of OOWs. The new OOW was joined by the deck cadet who was assigned lookout duties. The intended route had been prepared using the ship's electronic chart display and information system (ECDIS) and the OOW selected the scale on the ECDIS display that closely aligned with the 12 nm range scale set on the adjacent radar display.

The safety contour had been left at the factory default value of 30m even though the vessel's draught was only 7.9m. The OOW then sat in the port bridge chair where he had a direct view of both radar and ECDIS displays. As the vessel approached the Varne Bank the deck cadet became aware of flashing white lights ahead but he did not identify the lights or report the sighting to the OOW. At approximately 04:17, the vessel passed close by the Varne Light Float; 15 minutes on the ship's speed slowly reduced until the vessel stopped when it grounded on the Varne Bank two minutes later. At this point, the OOW did not yet realise that the vessel was aground.

(The Varne Lightvessel marking the location of the Varne Bank in the straits of Dover in the English Channel)

Three minutes after grounding an engineering alarm sounded and the OOW placed both azipod control levers to zero. He then informed the Master of the alarm and also rang the engine control room to request they check the engines. Within a few minutes the engineer telephoned the bridge and informed the OOW that ahead pitch was available on the starboard azipod. Accordingly, the OOW moved the starboard azipod control lever to pitch ahead but the ship remained stationary. This led him to assume that there was still a problem with the ship's engines. A few minutes later, after having been contacted by VTS, the OOW zoomed in on the ECDIS display and realised that the vessel was aground. He placed the starboard lever back to zero pitch and called the Master, who came to the bridge.

During this period the general alarm was not sounded and the crew were not mustered, although ballast tanks were checked for internal leaks and a visual search was made around the ship for pollution. The vessel was refloated on the next rising tide and subsequently berthed at a nearby port to enable the hull to be inspected by divers. Some of the findings and lessons learned from the official report are as follows:

1. The passage plan had the vessel pass directly over an area of water with less depth than the draught of the vessel.
2. The passage plan was not properly checked for navigational hazards using the ECDIS ‘check-route’ function, nor was it verified by the Master.
3. When taking over the watch, the OOW did not check the ship’s intended track relative to any dangers to navigation that would be encountered on his watch. Additionally, the OOW monitored the vessel’s position solely against the intended track. Consequently, his situational awareness was poor.
4. Although the lights from the cardinal buoys marking the shallow water were seen by the lookout, they were not reported.
5. The ECDIS audible alarm was inoperative. Although the crew were aware of this defect, it had not been reported.
6. ECDIS training undertaken by the ship’s Master and deck officers had not given them the level of knowledge necessary to operate the system effectively; among others the route was not properly checked, inappropriate depth and cross track error settings were used, and the scale of ENC in use was unsuitable for the area.
7. The SMS bridge procedures provided by the managers were comprehensive and included extensive guidance on the conduct of navigation using ECDIS. However, the Master and deck officers did not implement the ship manager’s policies for safe navigation and bridge watchkeeping.
8. The serious shortcomings with the navigation on board the vessel had not been identified during the vessel’s recent audits and inspections. There is a strong case to develop and provide tools for auditors and inspectors to check the use and performance of ECDIS.
9. The ECDIS display for the voyage had the safety contour set at 30m, which was the manufacturer’s default setting. The preferred safety contour for the vessel should have been obtained using the formula in the vessel’s SMS ({Draught + squat} x 1.5, or about 13m in this instance). The ECDIS would then have defaulted to the nearest deeper contour on the chart in use, the 20m contour. This in turn would have given a much better indication of the dangers and hazards along the route.

Case no.2)

A self-unloading bulk carrier sailed in the morning after loading a cargo of aggregates. The pilot disembarked soon after unberthing, and the vessel proceeded at Full Ahead (about 12 knots) with the Master, 3/O and a helmsman manning the bridge. Visibility was good with a moderate breeze. Besides the two radars, the bridge team was using an ECDIS, on which, a safety contour of 10 metres (inappropriate, considering the was that the sailing draught was that of 10.63 metres), a cross-track deviation limit of 0.2 mile and an anti-grounding warning zone that covered a narrow arc ahead to a range of about ten minutes’ steaming had been set.

About an hour after departure, the vessel entered a narrow strait, where the Master instructed the helmsman to engage the autopilot on a heading of 290º and handed over the con to the 3/O. He then proceeded to the communications desk on the after port side of the bridge, increased the volume of a portable music system and busied himself with sending routine departure messages. A few minutes later, the vessel was approaching a planned waypoint requiring an alteration of 24º to starboard to 314º. At this time, the 3/O visually sighted an inbound sailing vessel about 3 NM on the starboard bow. After coming on to the new course on the autopilot, he decided to pass the sailing vessel to port and adjusted the course to 321º. Simultaneously, he observed another small vessel about a mile away, right ahead and coming head on, and altered more to starboard to 324º. The ECDIS anti-grounding warning zone alarm then activated on the display, but no audible alarm sounded, a deficiency not known at the time. As a result, the 3/O, who was monitoring the situation from the forward console, did not realize that the vessel was heading towards shoal ground. He also sounded two long blasts on the ship's whistle to alert the nearest vessel, which soon passed clear to port. Thereafter, the 3/O focussed his attention on the sailing vessel ahead, which was now about a mile away. Two minutes later, the vessel ran onto a charted shoal at full speed. The severe vibrations lasted several seconds. The Master ran to the ECDIS display and, recognizing that his vessel had run aground, instructed the helmsman to switch to manual steering and ordered the wheel to hard-a-port. The sailing vessel also altered course to port and the vessels narrowly avoided colliding. After he steadied the vessel on a heading to return her to the planned track, the Master discovered that there was water ingress in No 3(P) ballast deep tank. Further checks revealed no other damage, and a preliminary report was sent to the office.

Proceeding at reduced speed, tank soundings confirmed that the ship's pumps were able to cope with water ingress. Nevertheless, the Master ordered the breached compartment to be opened at sea and for a party consisting of the C/O, C/E and a seaman to internally inspect the damage. After they identified a 3-metre longitudinal fracture in the hull bottom plating, the inspection team safely vacated the tank and re-secured its access. With company's and class approval, the vessel continued on its short passage towards the discharge port, where, after unloading, she entered drydock to effect permanent repairs.

1) The vessel was fitted with two ECDIS units that were used as the primary means of navigation, thus removing the need for paper charts to be carried. All bridge officers, including the Master, had completed a generic ECDIS training course in their home country, but no training or familiarisation on the type of ECDIS fitted on board had been provided by the ship's management company;

2) Before reaching the waypoint, the 3/O wrongly assumed that risk of collision existed with the sailing vessel on the next planned heading and prematurely initiated a turn to starboard and then continued to alter course to starboard, illogically intending to pass between the sailing vessel and the steep-to shore;

3) After initiating the course alteration, the 3/O did not monitor the vessel's position and projected track on the ECDIS display, for over 15 minutes, and failed to notice that the visual grounding warning alarm had been activated;

4) Both the present and past crews were unaware that the ECDIS antigrounding audible alarm had been disconnected in the past for unknown reasons;

5) The vessel's ECDIS display was located some distance abaft the bridge front and orientated so that the OOW had to face to starboard to look at the screen. Had the ECDIS display been located on the forward console, the OOW would have been more likely to routinely consult it when monitoring the navigational situation and also been alerted by the visual grounding warning alarm;

6) A safety contour setting of 10 metres was inappropriate for the voyage as the sailing draft of 10.63 metres meant that the vessel would have grounded at a charted depth of 10.13 metres, before crossing the safety contour;

7) Despite having attended approved ECDIS training courses, the bridge watchkeepers lacked an understanding of the ECDIS equipment's safety features;

8) The 3/O remained confident in functioning as the sole navigator in restricted waters, but soon after the multiple small alterations of course, he became sufficiently concerned about the intentions of the nearest vessel ahead to sound two long blasts on the ship's whistle. The Master failed to react to this inappropriate signal and did not leave the communications console at the rear of the bridge to assess the situation or challenge the 3/O's actions;

9) Following the grounding, the bridge team failed to follow the company's emergency checklist or maintain a proper record of follow-up actions taken, as a result of which, some important responses were missed;

10) No risk assessment or consideration of potential consequences was undertaken prior to opening up and ordering entry into the breached ballast tank with the ship at sea and proceeding at near full speed.

12.RELAVANT INCIDENTS/ACCIDENTS

Muros

On 2 December 2016, the Spanish registered bulk carrier Muros (2,998 gross tonnes, length overall 89.9m, draft 6.16m) was on passage between Teesport, UK, and Rocheforst, France. At that time, night visibility was good and there was a southeast wind of 6 to 15 knots. The vessel's electronic navigational instruments, comprising of ECDIS, radar and BNWAS (Bridge Navigational Watch Alarm System), were operating correctly. However, the echo sounder had been switched off after leaving Teesport, and the BNWAS had been set to alert at three minutes intervals. At 02:48 (UTC+1) on the morning of 3 December, Muros ran aground on Haisborough Sand in the east coast of the UK. It had attempted to manoeuvre clear of the shallows by itself but was unsuccessful. Six days later, the ship re-floated with the assistance of a tugboat. The crew were not injured and there was no marine pollution. Subsequently, the ship was towed to Rotterdam for repair to damage on its rudder.

As a result of an investigation into this incident, the UK's Marine Accident Information Branch (MAIB) identified the following facts:

1. The vessel initially set a passage plan to cross Haisborough Sand. The voyage plan on ECDIS was revised by a second officer (2/O) three hours before the grounding. However, the revised plan was neither confirmed nor approved by the Master.
2. A visual check of the track on ECDIS, using a small-scale chart, did not identify that it was unsafe. A warning that shallow water is dangerous is automatically indicated by a function called "check route". This warning was ignored.
3. Although the 2/O was monitoring the position of the vessel using ECDIS, the 2/O took no action when the vessel crossed a 10m safety contour indicating shallow water.
4. The performance of the 2/O was not good at the time of the incident; their level of consciousness was low, and it seems that they periodically fell asleep.
5. After grounding, the 2/O changed the chart view from "standard" to "all".

Conclusions:

- The intended track over Haisborough Sand was unsafe and grounding was inevitable with the vessel's draught and the depth of water available.
- The route over Haisborough Sand was planned and monitored using ECDIS. However, system and procedural safeguards intended to prevent grounding were either overlooked, disabled, or ignored.
- The 2/O visual check of the revised route did not identify that the track over Haisborough Sand was unsafe, nor that it did not conform with the buoyage in the area.
- The revision of the passage plan conflicted with the 2/O watch-keeping duties.
- The Master did not check and approved the revised route.
- The 2/O monitoring of the vessel's position was probably impacted by circumstances which could have reduced their awareness and may have caused them to fall asleep for brief periods.
- Audible alarms and guard zones are meant to alert on-duty personnel of an imminent danger. Disabling these alarms removed the ECDIS barriers.
- The use of "standard" chart view limited the level of information displayed and the reliability of visual checks when passage planning was prone to error.

Sea Diamond

MS Sea Diamond was a cruise ship operated by Louis Hellenic Cruise Lines. On 5 April 2007, at around 16:00 EEST, the ship ran aground on volcanic reef east of Nea Kameni, within the caldera of the Greek island of Santorini, began taking on water, and listed up to 12 degrees to starboard before her watertight doors were reportedly closed[9]. After the 1,195 passengers were evacuated from the car ramp through the former car deck onto boats, but some passengers had to climb down rope ladders from the higher decks. The ship was towed off the rocks, and her list stabilized. Later it was reported that two passengers were missing. The large amount of

[9] A report which was later refuted when the wreck was examined.

water taken in board led to the ship sinking shortly before 07:00 EEST on 6 April 2007, only a few hundred meters from the shore.

(Sea Diamond)

Investigations carried out by the defense team of the Master of the Vessel and Louis Cruise Lines, after a lawsuit had been filed against them, included a new hydrographic survey of the area of the accident in Santorini. This survey was carried out by Akti Engineering, and discovered discrepancies between the actual mapping of the sea area and the official charts used by the Sea Diamond (and all other vessels) at the time of the accident. The detailed survey claimed that the reed, which the Sea Diamond strucked in, was in fact lying at 131 meteres from shore and not at a distance of 57 meters, as is incorrectly marked on the nautical chart. The official chart also shows that the depth of the waters at the area of impact varying from 18-22 meters, whilst the recent survey shows that it is only 5 meters. The findings obtained by Akti Engineering have since been passed on to the Hellenic Hydrographic Office of the Hellenic Navy and other responsible authorities, with the aim that the necessary changes to maritime charts should be made and similar accidents to be prevented.

RECOMMENDATIONS AND CONCLUSION

A principal priority, to avoid such accidents, is that the ECDIS system should become an integral part of the navigator's thinking. Watch officers need to thoroughly utilise the tools withing ECDIS and should not speedily navigate through the ECDIS screens like a video game. There needs to be a conscious effort for them to use the system and not perform their duties as if they were still only using paper charts. During the watch, frequent position checks by other means are also mandatory.

Radar confirmation continues to be a paramount importance, and good lookout by the OOW will also solve many of these problems. It is important to remember that the human eye is the most important tool for collision prevention.

All stakeholders, such as seafarers, companies, organizations and states, need to fully engage with ECDIS and a complete understanding and utilization of the system should be the best tool to meet navigational challenges. Shipowners, or rather management companies, need to prioritize establishing the navigation method using ECDIS for their own ships, thereby setting the standard for various parameters including the frequency of position fixing and verification, and the method and standard for formulating a voyage plan.

The introduction of ECDIS is of a huge benefit to navigation, equivalent to the introduction of radar, GPS and AIS. There is no doubt that ECDIS's contribution to safe navigation is already immense. ECDIS is here to stay, is a fantastic piece of equipment that since its implementation and use on board the navigation risk has been significantly reduced, ship grounding and collisions have been avoided, when used correctly, and so has earned all the compliments may done to it.

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