TECHNOLOGY IN SHIPPING

SHIPOWNERS
SECURITY FOR SMALL & SPECIALIST VESSELS

ECDIS AND THE MODERN NAVIGATOR

When discussing technologies in shipping, we often talk about the future changes that are threatening to disrupt the shipping industry and entirely alter the way the mariner operates, from autonomous shipping to alternative fuels and decarbonisation. However, it is easy to overlook the fact that the role of the seafarer has constantly changed, with evolutions in technology already having presented a range of challenges that they have had to learn to overcome. Perhaps the most significant of these challenges in recent years is the introduction of Electronic Navigational Charts (ENC) and, more specifically, the Electronic Chart Display and Information System better known as ECDIS.

ENCs are not a new concept, initially proposed theoretically to the industry in 1952, with subsequent introduction and utilisation on board military vessels by the 1980s. It was not until 1995 that standards for the functionality of ECDIS were implemented and the towards the abolition of paper charts commenced.

From January 2011, the IMO set requirements that all new built passenger vessels over 500GT and cargo vessels over 3000GT were to carry ECDIS, with retrofitting to take place on older ships in due course. This presented a challenge to mariners who, until this point may have avoided adopting the new technology and would now be required to learn or find their skills becoming obsolete. The ultimate demise of paper charts came in 2022, when the United Kingdom Hydrographic Office (UKHO), the largest distributor of paper charts, announced it would stop producing paper charts from 2026, following in the footsteps of its American counterpart the National Oceanic Atmospheric Administration (NOAA) a year earlier. Despite the extension of the deadline to 2030 and with further changes in the timeline being possible, the march towards digitalisation shows no sign of stopping.

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The Club's smaller and specialist fleet encompasses the full spectrum of technology adopters from autonomous innovators to traditional vessel operators each dealing with the new and possible challenges arising from the introduction of ECDIS which will continue to emerge as more and more vessels move to paperless navigation. In the latest article from our Technology in Shipping campaign, Captain Frederick Drummond-Hunt, Consultant Master Mariner at Waves Group, shares his views on the subject of electronic navigation.

Ian Grainger – Senior Loss Prevention Executive, the Shipowners' Club

ECDIS

As the world entered the 21st century a digital revolution began, impacting almost every aspect of life as we knew it, from the living room to the workplace and beyond. The world of shipping is no stranger to technological change, with the bridge interface constantly evolving to encompass new technologies. The art of navigation has transitioned rapidly from the paper chart to the use of ECDIS as a primary means of navigation. The ECDIS as we now see it has been the formulation of years of development and has resulted in the implementation of new methods of navigation and position monitoring.

While the implementation of ECDIS has improved the ability of a bridge team to maintain navigational awareness, it has had a pronounced effect on the way in which data is interpreted. Much of this is due to the interface and the method in which navigational data is purveyed to the navigator. ECDIS is designed to specific technical standards, which unfortunately exclude the most critical factor: the human element.

TRAINING

The introduction and subsequent implementation of ECDIS has resulted in the adaption in various forms to the training received by seafarers. Every watchkeeping deck officer sailing on a vessel with ECDIS must now have generic ECDIS training satisfying the requirements set out in IMO 1.27. Under this guise the officer in question will learn about the ECDIS as a fundamental piece of bridge equipment. The provision of generic ECDIS training is a positive development but, due to the nature in which ECDIS is type approved, there are multiple different user interfaces from a variety of manufacturers.

To cope with this list of type approvals the stipulation for type approved ECDIS training and familiarisation has been introduced. This comprises multiple forms including computer-based training, onsite courses at various training establishments and onboard training as part of a vessel's safety management system. This has led to a varying degree of competency and depends heavily on the ability of the officer to apply the knowledge ascertained.

The competency and knowledge question has remained despite the presence of ECDIS for over two decades. There has been a recognised trend between the use of ECDIS and a rise in groundings resulting from a lack of both knowledge, user competency and perceived complacency. This culminated in the study organised by the UK based Marine Accident Investigation Bureau (MAIB) and their Danish counterpart (DMAIB) into the use and application of ECDIS published in September 2021. This study involved the survey of more than 155 Deck Officers and Masters across 31 vessels of different types, over 4 months. The results of the study supported what many seafarers had felt for some considerable time. Overall ECDIS contributes significantly to the safe navigation of a vessel, by providing live positional information and subsequently reducing the

cognitive workload. However, challenges remain with regards to the automation and user interface designed to specific technical standards which do not match the end user expectations and application.

DATA OVERLOAD

Navigation had remained a static topic for hundreds of years. It is only recently, with the invention and application of satellite navigation, that change has begun to gather pace. Navigation was largely unchanged since its inception, with the use of the paper chart and position lines taking precedence. The introduction of radar helped reduce the ambiguity, but largely used the same principles devised in the centuries preceding it. The introduction of ECDIS has changed the navigational dynamic on the bridge. The ability to effectively adapt and customise the level of detail available to the navigator is unprecedented and has revolutionised the method in which data is available to the bridge team.

As with any technology, it has taken time to adapt to the new information available. A new methodology is required to interpret the data available to each navigator. Previously, a chart could be considered a static piece of bridge infrastructure, where pencil lines could be overlaid to eventually formulate a passage plan. Now, with the implementation of ECDIS, the display can be entirely customised depending on the end user preferences. The ability to define navigable water, customise route corridors and interrogate data has ensured that the most up to date and effective information is available. The ability to define alarms, including the grounding and look ahead sectors, has ensured that a vessel should receive ample warning prior to straying into danger.

However, therein lies one of the many issues that reside within the ECDIS interface. The automation available has resulted in arguably one of the biggest complaints: perpetual sounding of alarms. The alarms designed to highlight issues to the user and ultimately help avoid danger are specifically highlighted as a distraction. This is especially the case on port approach where a vessel will naturally navigate closer to hazards as it approaches its final destination. The continuous alarms result in the navigator becoming overwhelmed and effectively ignoring the alerts produced. It is not unusual during an average port approach to have more than 500 alerts during a 30-minute port approach. There are a range of methodologies available to help reduce this distraction, but arguably the key to minimise this is effective and efficient alarm management.

The ability to customise the display has added a new dynamic to navigation. However, this dynamic must be treated with caution and a change in tact when considering voyage planning. The ECDIS display, and information displayed must be incorporated into the voyage plan and assessed in advance of an upcoming voyage. This would particularly be the case for customisable features including the safety contour and look ahead sector. Often, the safety contour and look ahead sector would need to be specifically adapted for each leg of the voyage, depending on the depth and width of navigable water available and individual stipulations laid down in a vessels safety management system for variables including depth below keel and clearances. There are additional stipulations in areas where bathymetry data is limited and must be fully risk assessed in order to maintain a vessel's safety parameters.

This level of adaptability requires a certain competence of both the officer planning the voyage, and the Master (or other designated officer) carrying out the verification and second person check. Each must be fully versed and competent in the use of the ECDIS, and its various sub menus and options. Depending on the level of technical ability, this can increase the workload and is cited specifically as an issue within the MAIB/DMAIB report.

INTEGRATION

As we have seen, the method on which voyage planning is undertaken using an ECDIS has inherently changed. This also holds true for executing and monitoring the associated voyage. When plotting a position on a paper chart, this position was already 'old', with the vessel's position continually moving. With the introduction of ECDIS, a vessel's position can be seen live over the top of an electronic navigational chart. This has resulted in both a variety of benefits and challenges. Owing to the method in which ECDIS has been introduced across the industry, this integration varies vastly. From standalone ECDIS units to fully integrated navigation systems which include radar overlay and beyond, it poses a challenge to the navigator who must adapt to the bridge layout and bear this in mind when monitoring the voyage.

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Captain Frederick Drummond-Hunt

The paperless bridge is progressing at pace, particularly with the advent of the fully Integrated Navigation System or INS. This has brought about the introduction of software commonly referred to as a chart pilot, where radar information can be overlaid on to the ECDIS image, effectively providing a scope for continual position monitoring. Any mismatch between the radar image and ECDIS becomes readily apparent to the navigator and as such, adjustments and additional monitoring can be implemented as required. However, there are many bridges across the world where the ECDIS comprises a standalone unit, with little to no integration outside that of the sensor inputs. With this in mind, a different approach is required to ensure position integrity is maintained and typically includes the use of Lines of Position and associated ranges which can be transferred from a radar. This difference in application of knowledge, requires a degree of competency and confidence when navigating to ensure no critical issues are overlooked.

When considering data integrity during the scope of the MAIB/DMAIB study, it was found there was very rarely a positional error. However, given recent geopolitical events, it is critical that a modern navigator is aware of the possibility of a GNSS error, and is confident in the verification of the integrity of the sensors. It is also essential that the bridge team can cope and navigate confidently should the loss of position occur when navigating on a paperless bridge. This can be mitigated with proper risk assessment and ensuring a sensor management plan is in place should a particular sensor fail.

PAPER CHARTS

There are still vessels sailing utilising paper charts as their primary means of navigation with the ECDIS available as a backup or for 'training only.' The recent UK Admiralty announcement to phase out paper publications by 2030, has resulted in a mixed reaction across the seafaring world. For larger commercial

operators who already operate on the 'paperless' model, this is a continual evolution of this concept. However, for smaller stakeholders this can pose a challenge, especially where a typical ECDIS is retrofitted as a backup piece of equipment to help enhance navigational awareness. There is a consensus that there will be a large cost outlay for smaller operators to ensure a vessel becomes ECDIS compliant, which must include training and associated adjustments to the vessel's safety management systems along with the installation of the hardware/software to each concerned vessel. At the time of writing this, it is not apparent how this would affect smaller vessels, who use generic chart navigation systems to assist in navigation with the use of paper charts.

There is also a further challenge that seems to have slipped beneath the radar. Although the move to a full digital service from 2030 by the UK Admiralty maybe understandable given the current paperless bridge concept, much can be said of those who need access to navigational information shoreside. The ability to consult a paper chart for those shoreside so an operation can be planned is inherently less challenging than displaying the equivalent information on an ECDIS screen. Getting access to the ECDIS data shoreside, requires the user to jump through several hoops, and can be a laborious process. There appears to have been very little consideration for this ongoing issue so far, and it will be interesting to see how this develops going forward.

THE FUTURE

There is no doubt that the future resides within ECDIS, and the navigational information it can provide. However, the reality is laid bare in the MAIB/DMAIB study. The effectiveness of ECDIS depends heavily on the navigator's ability to configure it efficiently. There is a trend between a lack of knowledge on the application and use of ECDIS and navigational incidents. It is critical that every endeavour is made to ensure a navigator is confident with what they see on the ECDIS screen to ensure a vessel can undertake a passage safely. This necessitates a different approach to that previously seen with respect to navigation and requires a more proactive and dynamic input from the navigator.

Implementation of new technology needs a certain period in which adjustments are made to incorporate the software into the workplace. However, as is evident from various commentaries across the merchant world, there is a distinct difference between the design of the ECDIS software to meet specific technical standards, and its use onboard as a critical tool for navigation. This must be considered when undertaking voyage planning and monitoring and must be incorporated into the training structures across the industry.

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