The ECDIS Mindset

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The move to ECDIS has been firmly underlined as a means to further increase safety. A number of investigations presented to IMO in the last few years have shown that this is the expected result. But, in practice, will ECDIS further contribute to the overconfidence of some OOWs, resulting in an even greater narrowing of safety margins?

In fact, the safe operation of ECDIS necessitates the development of a new user mindset, which in many ways is quite different to that needed when using paper charts. The makings of a good mindset have to be instilled in users as a major component of basic ECDIS training and must not be obscured by an over-emphasis on rote learning the specific operation of any one particular ECDIS. A firm grip of the fundamentals is essential; it not only helps instil the correct mindset but allows much easier familiarisation when transferring between ships with different ECDIS on board.

ECDIS weaknesses

The ECDIS mindset fully appreciates the strengths and weaknesses of using an ECDIS-based system. Let's start with its weaknesses. The most important of these is that ECDIS is an entirely electronically based system. It can therefore fail outright and can also develop faulty operation. In recognition of its vulnerability to failure, IMO has always required vessels to carry a backup to the main ECDIS unit. Although this could be a paper chart system, it is not a sensible choice for most ships for numerous operational and financial reasons. In general, the most suitable backup is a second ECDIS. To avoid familiarisation complexities this ideally needs to be identical to the main ECDIS.

A user with a proper ECDIS mindset ensures that the backup ECDIS is always efficiently involved in the ongoing navigational process, for example, by showing a different scale view to that displayed on the primary equipment. As well as the improved situational awareness that results, regular reference to the backup ensures that the system is immediately ready to become the primary, should the main system fail. It also helps to identify any developing faults in either system. In particular, it helps to ensure that the backup is properly loaded with the current route and up-to-date ENCs.

The data standards for ENCs and ECDIS equipment are highly detailed, making it by far the most complex system on the bridge of a ship. From time to time, unexpected issues are uncovered. OOWs must always be aware that such problems can exist, together with the methods that are used to indicate these problems, which may include temporary procedures to be followed. Of course, the detail of the company's Safety Management System must fully support this need.

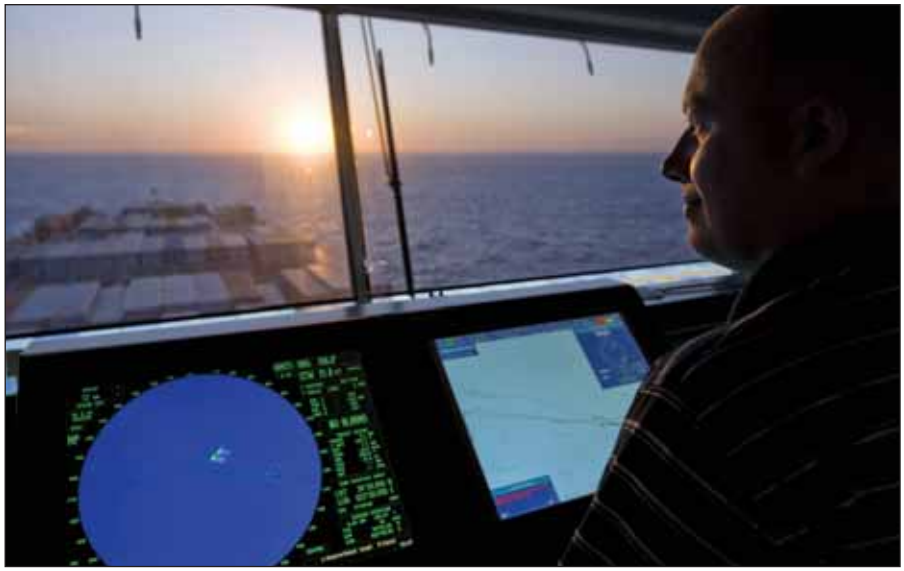
In general, issues that arise from incorrect data coding of ENCs are quickly resolved by the hydrographic office that has compiled the data – although this can sometimes take some weeks. For a number of reasons, it generally takes rather longer for manufacturers to satisfactorily resolve equipment anomalies, which generally necessitate ECDIS software updates. The user needs to be aware of the software status of the equipment in use, including any unresolved issues. Unfortunately, many shipping companies do not yet appear to have latched onto the issues connected with software updates for navigational equipment, despite firm guidance from IMO, such as that given within MSC.1/Circ.1389, issued in December 2010.

However, it is easy to be unduly anxious about ECDIS anomalies. In practice, their number has been relatively small and they can all easily be kept in mind by a well-informed user, provided good procedures are in place and the user mindset is completely switched on to the fact that such issues can exist. Their significance to safety on a correctly used ECDIS is likely to remain of a relatively minor nature but, nevertheless, they could lead to accidents if ECDIS is ignorantly used.

Display size and user interface

A significant weakness of ECDIS is the size of the chart display. Compared to a paper chart this can be minuscule – the standards allow the display area to be as small as 270 x 270 mm. Unless used sensibly, ECDIS can create a tendency for the user to develop 'tunnel vision'. It must therefore become natural to not only be regularly zooming in and out and scrolling the chart but also to retain a good mental image of the general layout of the area in which the ship is traversing. As previously noted, the backup ECDIS is potentially useful here.

The ECDIS mindset also has to work with the changes in displayed detail that occur when zooming. Although this is



▲ It is vital to correlate ECDIS with other input, such as radar

essentially the same issue as working with different scale paper charts, the effects can be more subtle. To the unaware user, this can lead to inappropriately scaled images being used in critical situations. The chart must be regularly scrolled ahead of the vessel, using the largest scale data, to identify potential hazards in good time. When properly set up, ECDIS should give automatic warnings of charted hazards on the immediate route. If these warnings come as a surprise to the user then it is their own monitoring that is at fault.

Despite the comments on screen size above, ECDIS displays are getting larger all the time. However, of more importance is the display resolution. In general, a 60 inch display has the same number of pixels as, say, a 20 inch version and so trying to view a full scale paper chart image on such a large display would just result in an unreadable blur. Unfortunately we must wait for affordable high resolution displays to become available before ECDIS rivals the area of a paper chart. This could be a long wait.

The last main weakness of ECDIS is that the user interface, such as the controls, menu structure and the detailed layout of the display, are not rigorously standardised. This is similar to the case for radar and other navigational equipment but is magnified by the complexity of the system. A user new to the particular equipment must therefore become properly familiarised with the system on board before undertaking a watch.

This requires an additional element of training. It makes great sense for this training to be computer or tablet-based. The ECDIS mindset should be ready for this, understanding that while the satisfactory completion of a course complying with the IMO ECDIS Model Course requirements is a statement of competence to use ECDIS, this is only the case provided there has been appropriate familiarisation with the actual fitted system to be used onboard ship.

ECDIS strengths

The weaknesses of ECDIS are dwarfed by its strengths compared to the use of paper charts, many of which lie outside the scope of this article. Again, users need the right mindset if they are to use these strengths to their fullest extent, and avoid the perils of misuse.

Perhaps the most important strength – and the one most prone to misuse – is the built-in continuous display of the ship's position on the chart. Conversely, on a paper chart plotting position from a Global Navigation Satellite System such as GPS is tedious and prone to error. However, the ECDIS mindset knows that much of the time saved in plotting the position should be readdressed to assessing the integrity of the displayed position. Integrity assessment is much easier with ECDIS than when using paper charts, not only because the position is continuously displayed but also because ECDIS is generally installed close to the main conning position.

Therefore, in coastal waters, it is generally very easy to correlate the GNSS derived position with the view from the bridge windows, as well as with information from other prime navigational aids, particularly radar. In fact, every time the OOW looks at ECDIS, they should make a mental correlation with these other sources, seeking to identify any possible positional errors. The use of course-up or head-up mode can be particularly beneficial when making the correlation with the outside view, bearing in mind that a subtly different mindset is required in maintaining overall awareness compared to using a North-up paper chart.

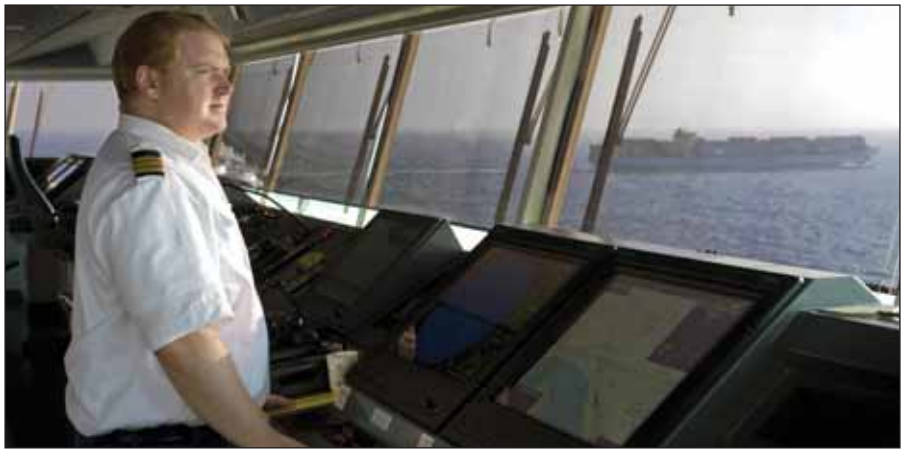
In addition, visual and radar derived Lines of Position (LOPs) in coastal waters should be input into ECDIS at appropriate intervals. On a well designed bridge, single LOPs, including radar ranges, can be rapidly made and transferred to the ECDIS in order to confirm that they pass very close to own ship's indicated position and therefore provide an excellent check on GNSS accuracy, especially with the low overall latency that can be achieved. Of course, consecutive bearings should be chosen such that they are as far out of alignment as possible.

Furthermore, the ECDIS mindset knows that subsequent single LOPs can be automatically combined by the equipment to form a positional estimate. ECDIS takes into account the time at which each LOP was applied and uses DR/EP techniques to perform the merger. The real beauty of this functionality is that it stores the input LOP data together with the derived position for future reference. This replaces the 'cocked hat' positional checks on paper charts so beloved of port state inspectors when assessing whether the position given by the GNSS position is being appropriately verified.

It is good to see that the ePelorus proposed by The Nautical Institute is now available for fitting to ships. A simple press of a button sends the data of gyro-referenced visual LOPs to the ECDIS, complete with the time reference of the measurements. This considerably eases the task of applying visual sights and further reduces latency. It should be borne in mind that a software upgrade to the ECDIS may be necessary to connect to an ePelorus.

Navigational integrity

The view from the bridge windows and information from ECDIS and radar jointly establish the best overview of the complete navigational situation – not just position. A



▲ The view from the window is also important

user with a good ECDIS mindset is constantly checking all this information for consistency. Any inconsistency provides a warning that all is not well and that extra care or understanding is needed.

When independent sources of information agree, avoiding hazards becomes much more straightforward. However, care must be taken to ensure that radar is always used as the primary collision avoidance aid and ECDIS as the primary charting aid. Despite the increasing overlap of data than can be displayed on both systems, fundamentally neither is the equivalent of the other.

If there is only one source of available data, for example a target's AIS return from an area navigationally significant to own ship, great care is needed. Has it been missed by radar because of clutter or poor equipment set-up? Has it been missed visually because of poor visibility? Are there GNSS or gyro problems? Is the AIS signal in error? Is the signal a spoof, perhaps pirate initiated? Any decision must obviously take into account all such questions, and may ultimately require a very wide safety margin.

The user must also know how ECDIS can be useful in establishing positional integrity in ocean waters. The automatic DR/EP facility is invaluable in keeping a check on GNSS gross errors over long periods. Celestially fixed position can also be plotted onto ECDIS as an additional check on GNSS. In the event of a complete GNSS failure the inbuilt ECDIS facilities are invaluable in maintaining a DR/EP fix over an extended time, whether in coastal or ocean waters, assisted as appropriate, by visual and radar sights or celestially derived position. How often do we hear the highly erroneous statement that 'ECDIS cannot work without an electronic position fix system'?

Use of these alternative methods in the regular confirmation of GNSS positional integrity maintains the skill base needed to use them under emergency situations. In addition, it is essential that there are regular drills that mimic complete loss of GNSS, ensuring that the onboard procedures for such a situation are workable and fully understood by all.

Information display and route planning

Another huge advantage of ECDIS over paper charts is the control that the user has over what is displayed. When well set up, ECDIS shows all the charted information relevant to own ship and is far from creating any information overload. In particular, safe water areas (and vice-versa) can be very clearly depicted. However, to do this the user must be fully conversant with the role of safety contours and depths, setting the display detail and knowing what procedures to apply when having to enter waters less deep than the available safety contour, perhaps to enable port entry. If ECDIS is not properly set up then real problems can occur.

A skilled user is mindful of the embedded information facilities of ECDIS, particularly the 'Pick Report', which can be used to gain detailed information about any point on the chart. For instance, if they do not understand a particular symbol then a simple operation will display all known information at that point. The user with an ECDIS mindset knows how to rapidly find the required information and will not be phased by all the other information displayed that is also relevant to that point. In general, the visual experience of using ECDIS is very different to that of paper charts, forming an important part of the new mindset.

Having an ECDIS mindset also means being very knowledgeable about the route planning process. It is easy to design a route from scratch on ECDIS or to use a previous route as a basis. It is very important, however, that the route is manually checked and refined using up-to-date ENC data before each use, supported by all the traditional planning information, whether in paper or digital form. This especially needs to include the latest Temporary and Preliminary Notices to Mariners.

When undertaking this check, the largest available scale chart must be used for all portions of the route. Once a manual check has been performed it is highly beneficial to run the automatic safety check. This independently rechecks the route but needs to be carefully set up to prevent it coming up with a host of over-cautious warnings. A user with a good ECDIS mindset will recognise that the auto check facility is not infallible - but neither is a check by a human. Performing both reduces the probability of an error. Even more importantly, the manual check gives the planner an invaluable awareness of the complete route.

By far the greatest challenge to the ECDIS mindset is in overcoming the tendency to a false sense of security. The problem is that ECDIS often appears to be highly accurate and it is all too easy to assume that this is true 100% of the time. At best, its accuracy is limited by the quality of the underlying ENC data – which may have been taken from surveys made 100 years ago or more. (But, of course, the correct mindset always checks the current CATZOC status.) At worst, a combination of errors can make it highly inaccurate. If ECDIS is to really improve safety, all users must have a mindset that can determine the likely integrity of the perceived situation and use this as the basis for establishing the optimum navigational decision.

Finally, the company must also have an ECDIS mindset which should particularly be reflected in their Safety Management System. Migrating from paper charts to ECDIS implies detailed changes in such areas as risk assessment, emergency preparedness, operating procedures, drills and exercises, training and familiarisation. Without this action, the requirements for a good user's ECDIS mindset cannot be fulfilled.

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