Notes

The IHO ECDIS Colours & Symbols

Mike Eaton, ex-chairman IHO Colours & Symbols W.G.

The IHO Colours and Symbols for ECDIS aim to provide a clear, unambiguous and accurate presentation of the chart on the ECDIS display, and to ensure that the mariner has the means of selecting the chart information he needs with nothing superfluous, to avoid clutter. This paper describes what the IHO Specifications do, outlines how they evolved, lists some of the guiding principles used, and describes current controversies and some future considerations.

Introduction

The ECDIS is a real-time ship-handling display, used primarily for navigating ships safely in confined waters and particularly in bad weather. It is a formidable new navigation tool which makes it possible to use the extraordinary accuracy of DGPS, and is probably second only to radar in significance as an advance in navigation over the past fifty years. Although ECDIS is based on the chart, to look on it merely as an electronic version of the paper chart grossly underestimates its impact. In fact, because the ECDIS / DGPS combination is so accurate in fixing the ship and also projecting its position for the next few minutes, and because the display is so easy to comprehend, visual fixing will probably die out except when on a transit line ('range') in good visibility, or for a gross error check. Add to that the increasing acceptance and low cost of computer systems and it becomes conceivable, even likely, that in thirty years the only paper charts will be those in HO archives and the foyer of the IHB.

The power of ECDIS lies in its display - 'a picture worth a thousand words' - with its ability to convey the situation to the mariner clearly and instantly. As the master of a 200m bulk carrier once said to me as he manoeuvred alongside a wharf considerably shorter than the ship "Now that I have got used to this thing, I don't know what I would do without it". And that was on a clear, calm day. The design of that display is the job of the IHO Colours & Symbols Working Group.

This is a personal account of how and why the IHO Colours & Symbols evolved as they are.

Design of the ECDIS Display - the IHO Colour & Symbol Specifications

The IMO Performance Standards for ECDIS (IMO PS) state in section 8.1 that IHO recommended colours and symbols should be used to represent SENC (i.e. chart)

information and in and 8.2 that IEC colours and symbols should be used for navigational symbols (i.e. own ship and associated vectors, planned route, etc.). This dual responsibility is one example of how ECDIS responsibilities are divided, making good liaison between the many groups involved vital.
The requirement in IMO 8.1 reflects three basic points:

- The right and the corresponding responsibility of the data producers to ensure their data is displayed correctly and appropriately
- The long experience of the HOs in reproducing the chart in a format acceptable to the mariner
- The need to have one, uniform (but progressive) symbolisation so that mariners will instantly recognise the meaning of the chart information they see on the ECDIS display

The IHO design for the chart display is specified in S52 Appendix 2 'Colour & Symbol Specifications for ECDIS' (C&S Specs.) and its annex A 'Presentation Library' (PresLib). The C&S Specs. describe the display requirements and the basic principles used and give a general overview of S52 App.2 together with some specifics. These Specs. also describe colour monitor calibration procedures, required in order to be able to transfer proven colour tables between different makes of CRT and also between CRTs and other types of screen such as flat panel LCDs. The PresLib gets down to the details of decoding and symbolising the IHO S57 chart data. It consists of a digital version containing the 'elements' (components) of a display generator, and a hard-copy version, the Manual, which contains the 'elements' in readable form and explains their structure and use. The Manual can be used as a stand-alone PresLib.
The primary 'elements' are the symbol library, the colour tables and the look-up tables that link every conceivable S57-coded object to the appropriate colour and symbol (defaults are provided in case an HO produces inconceivable objects). Additional 'conditional symbology procedures' (logic flow diagrams which the manufacturer has to code) given in the Manual are used to allow the mariner to choose his own safety contour, etc, and to handle extensive object classes such as lights. All objects are assigned draw priorities to ensure important information appears on top in case of overlaps and the IMO category ('Display Base' etc) is also given, together with viewing groupings, which manufacturers may use to help the mariner select the features he wants to see. The Manual also includes instructions on how to symbolise features which cannot be described digitally such as the IMO scale bar and north arrow, manual updating, etc., in a standardised manner so that the mariner familiar with one type of ECDIS will recognise what appears on a different model. There is also a graphical ECDIS Chart 1 and mariner's colour test diagram, software to process colour calibration, etc.
From the start CIRM and then IEC agreed that in order to require only one reference document for symbolising ECDIS, the 'Mariners' Navigation Objects' ('Navigational Elements and Parameters' of the IMO PS) would be carried in S52 App.2, and they are currently defined as 'non-standard S57 objects' in Part 2 of the PresLib. and symbolised in the same manner as chart objects through the look-up tables, conditional procedures, symbol library, colour tables, etc. PresLib Part 2 section 1.1 makes it clear that IEC is the governing authority for these features, which IEC may wish to 're-patriate' under their new TC80/WG13.

The PresLib provides three main benefits for the mariner:

1.) A consistent symbolization of any SENC, so that a mate or pilot will see the same picture of the same waters whatever make of ECDIS he looks at
2.) A good presentation, based on mariners' requirements, giving a clear, unambiguous display under all but the most hostile ambient lighting (e.g. full sun on screen)
3.) A performance model for any manufacturer's ECDIS to meet

It is left to the ECDIS manufacturer who chooses to use the PresLib directly to assemble these elements in his own display generator. Alternatively, the manufacturer may develop his own elements independently to give the same results as the PresLib. However, the PresLib is designed to be easily upgraded when required by improved technology or new user demands on the barely adolescent ECDIS, and independent

manufacturers need to be aware of this and avoid 'hard-wiring' elements that might require flexibility for upgrading. Some manufacturers have found that using the PresLib directly has saved them much development of details, as was hoped, while others, particularly the pioneers who were developing systems at the same time as the PresLib, prefer to use their own approach.

History

The IHO set up the Colours and Symbols Working Group in 1988, but the work had actually started six years earlier, when the Canadian Hydrographic Service (CHS) started an Electronic Chart Testbed project in Halifax. Based on Mort Rogoff's 1970's prototype, which had most of the features of the eventual ECDIS, Hugh Astle of Universal Systems Ltd. (now CARIS) put a CARIS GIS onboard a small ship, eventually with radar overlay, and with this we explored both the performance characteristics and the data requirements of an electronic chart in Halifax Harbour. This programme lead to participation onboard the 'Lance' in the ground-breaking Norwegian Hydrographic Service 'North Sea Project' demonstration cruise which toured European ports in October 1988. The outline of findings from the CHS testbed formed the basis for the first draft of S52 developed at The Hague in January 1987, under Admiral van Opstal of the Netherlands HO, and S52 in turn formed the basis for the IMO PS when the HGE started work a year later.

When in 1990 the Colours & Symbols WG issued the 'Provisional Presentation Standard for ECDIS' we based it on a 'chart-like' colour table plus a black background night table from the TNO Human Factors Institute in the Netherlands. We had instructions from the IHO to model the symbology on the paper chart 'With which the mariner is familiar' and which will be important for some years while the mariner has to go backwards and forwards between the ECDIS and the paper chart or its image in raster form.

Guided by where the expertise lay, we then went to the Hamburg sea school 'SUSAN' (now 'ISSUS'), where ex-mariners Gert Buettgenbach and Kersten Gevers (who later founded SevenCs GmbH) had just completed the first version of the Object Catalogue for ECDIS (the basis of the S57 data coding system which we had to use), and began a colaboration, funded primarily by the Canadian Hydrographic Service and Coast Guard, which, after simulator tests followed by sea tests in 1992 on the Hamburg-Harwich ferry using prototype BSH data, resulted four years later in the first draft of the PresLib.

Buettgenbach realised that the object coded geographic data could never be unambiguous (unlike the Morse code, where 'dot-dash' is unquestionnably 'A'), and that to ensure correct and consistent symbolisation of the HO data the C&S Specs had to decode the ENC by specifying how every real-world object should be symbolised. First he investigated available technology and then he designed the Presentation Library in consultation with others particularly Hugh Astle of Universal Systems Ltd. to achieve this. Many other necessary functions were added as well (e.g. enabling the mariner to select his safety contour and highlight it, specifying draw priority, and so on). This robust, flexible and necessarily complex system has amply proved its designer's foresight, and has been further vindicated by the similarity of the portrayal specifications now being developed by ISO TC211.

By the November 1994 meeting of the Colours & Symbols WG, held during sea-tests onboard the Helsinki-Travemunde ferry 'Finnjet' , we were ready to issue the first operational editions of the 'Colour and Symbol Specifications' and the 'Presentation Library', in a form very similar to the present one. At that stage the maintenance work was moved to Universal Systems Ltd. in Fredericton, Canada, where Hugh Astle had been keeping in touch with progress at SevenCs. The second edition of the PresLib was published the following year with the help of Sherry Munn of Universal Systems. In 1996 PresLib maintenance extended to Nautical Data International in St. Johns, Newfoundland, with Kent Malone and Maxine Gregory. There we undertook the exacting work of adapting to edition 3 of S57, which made considerable extensions over the more ECDIS-oriented edition 2 in order to cover the entire content of the paper chart. The corresponding edition 3 of the PresLib was published in July 1997.

This extensive development was funded primarily by Canada, but with considerable contributions from the BSH, where most of the C&SMWG meetings were held, and also from Australia, the USA and the UK.

Mariners were deliberately involved in this work from the start. For instance it was mariners on the Steering Committee of the EC Testbed in the mid-'80s who insisted there should be a 'minimum display for safe navigation' as a permanent base for the display, and this translated into the IMO 'display Base'. And we once had a session in which a number of mariners were invited to work out their own colour schemes; everyone had a great time, but even the mariners agreed that this was not the best way to select a colour scheme. Without some expert input, problems like grey bridges disappearing over the black deep-water depth shade are liable to occur.
Later, in Hamburg, mariners helped with simulator tests, and mariners were extensively consulted during ferry tests in the North Sea and Baltic in the early '90s, which used BSH test data. At that stage we ran into the problem that the S52 PresLib is tied to S57 data and can use no other format, so there was a gap in our sea-testing from 1995 until early 1998 when S57 chart data became available in Canada together with S52-capable ECDIS, and sea-testing resumed on the St. Lawrence Seaway and the Great Lakes.
The mariners' needs were given top priority throughout the development. For example, in addition to the obligatory IMO categories and draw priorities, each object in the look-up tables is assigned to a 'viewing group', a heirarchy which helps the mariner to select the information he needs on the display and avoid dragging in other uneccessary information. And the mariner is given the capability of adding manual chart corrections and also his own information to the SENC (ECDIS database). Two of the strongest colours, red and orange, are used for mariners' information.

Industry members outnumber HO members in the IHO C&SWG, which is unique for that reason among IHO WGs, and their views have always been considered. Also, as chairman of C&SWG I attended all but one meeting of IEC TC80/WG7. The industry contractor/partners who developed the Pres. Lib. with the Canadian Hydrographic Service (SevenCs, followed by Universal Systems Ltd and then Nautical Data International) were invariably consulted over the impact on manufacturers of any change in the Specifications and we had helpful feedback from ECDIS manufacturers, particularly from Hannu Peiponen of ASPO. We kept in mind that without industry there would be no ECDIS, and we did not ask industry to do anything we had not already done ourselves.

Human factors expertise was used from the start. The Netherlands HO contracted Jan Walraven of the TNO Netherlands Perception Institute for the first colour tables. We got valuable help from the German FGAN-FAT institute in Bonn while working in Hamburg, and Roy Kaufmann and Sharon Mc Fadden of the Canadian DCIEM in Toronto have been advising us on symbols as well as colours since 1987. Among many other contributions, Sharon helped us set up a 'field' test which demonstrated that in bright sun the important information is more distinguishable on a white background display than on a black background display (and incidentally that a black cotton watch coat is effective in getting rid of annoying screen reflections from smart white uniform shirts). We also got strong technical support from consulting electronics engineer Matt Cowan, including the valuable 'Black-adjust' symbol to ensure the mariner does not lose screen information by mis-adjusting the controls at night.
This professional input has been essential in ensuring that ECDIS has an optimised colour set which exploits the full 'gamut' (field) of colour available from the CRT screen, and also can be transformed to any make of CRT or other type of screen (Plasma, LCD, etc.)

Members of the **Hydrographic Offices** (HOs) have participated relatively little in Colours and Symbols, with the exceptions of Germany, Australia, UK and Canada, and initially Norway and the Netherlands. It has always puzzled me that while HOs take great care over how their paper charts appear they seem to have given up responsibility for how their ENC looks on the ECDIS display. To my thinking this takes away a fundamental part of their professional satisfaction leaving them as mere data producers rather than chart makers.

HOs take a closer, if restricted, interest in the database standard. In an ideal world, mariners experienced in using electronic charts would perhaps have specified what they needed to see on ECDIS and how, then the symbology would have been be designed, and resulting from that the database characteristics would have been specified. In the real world the IHO Database W.G. (now TSMAD) appeared to base S57 primarily on GIS principles applied to their data management needs, with limited concern for user requirements. However, they did sometimes respond to our appeals, as, for example, in providing 'line depth areas' for cliff contours.

Additional navigational information would obviously be appearing on the ECDIS display, and realising that the available supply of colours and simple symbols and patterns would quickly be snapped up, we kept close liaison with IEC working groups over Mariners' Navigational Objects including Radar, ARPA and AIS and we also discussed symbology with the IALA sub-group on VTS information and reserved colours and patterns for VTS and for a simplified representation of ice conditions.

Guiding Principles

Many of these are given in the first sections of the 'Colour and Symbol Specifications', which include more rationale than most such documents to aid in future updating and also to add a bit of motivation.

In general:

- Ensure the display is clear and unambiguous; the mariner should be in no doubt of the meaning of what he sees on the display. This requires standard symbolization, with the minimum number of symbols to be learned. We have to establish an accepted pattern for ECDIS presentation that becomes familiar to mariners so that features can be recognized instantly without confusion
- Ensure the display is correct; the mariner should see the information that the data producer intended
- Ensure the mariner has control over everything that appears on the display (except the display Base) so that he can control clutter on the screen
- Keep the software simple. For example, we do not change lineweights for different colour tables, as this would require a conditional symbology procedure

Display design:

- Contrast is needed to carry information; this may be colour contrast or luminance contrast, or contrast from differing linestyles or symbol shapes. All these inter-relate with each other
- Design for the worst case; fit the rest in afterwards. For the ECDIS this means setting up the display for bright sunlight, when all but the starkest contrast will disappear, and for night when so little luminance is tolerated that area colours are reduced to shades of dark grey (maximum luminance is 2.4 candelas/sq m compared with 80 cd/sq m for bright sun) and only fine lines can be bright
- Ergonomic specialists point out that, to avoid ambiguity, important features, such as those in the display Base, should be redundantly coded. (For example the own-ship safety contour has a sharp change in the colour of the depth shade and also a thick line; the planned route is red and is the only heavy dotted line on the display). This serves to improve the visibility of important features on the route monitoring display and it also helps to distinguish these features in bright sun or at night

Colours:

- When planning colours begin with the background colours - the area fills for depth zones and land. Then work on the foreground lines and symbols, making sure they have good contrast with all possible backgrounds. Obviously these large area background colours have to be very dark at night to reduce light emission that would compromise night vision
- To make the details stand out clearly, use washed-out ('unsaturated') colours for background area shades (deep water, built-up land etc.) and deep ('saturated') colours for foreground features. At night use luminance as well as colour to highlight the detailed features

- Use prominent colours (black, red, magenta, orange) to emphasise important features such as ownship, plannned route, isolated dangers, safety contour
- Use colour systematically to identify both type and source of information. For example grey is generally used for marine features but important features are black and dangerous features use magenta as well (of course black becomes white on a black-background display); brown is generally used for shore features but conspicuous landmarks are black; radar and ARPA use green, their colour on the early radar screens; orange is used for information added by the mariner
- Use scientifically developed colour tables, specified by 'human factors' experts and tested with mariners, in order to take full advantage of the 'gamut' (colour-capability) of the screen and to maximise colour/luminance contrast, both against the background area shades and between between the different foreground features on the display
- The importance of this will increase as more non-chart information is added
- Screens must be calibrated in order to replicate a successful colour scheme

Symbols:

- Symbols should be either familiar or intuitively obvious whenever possible. For example the familiar octagonal shape of the 'Stop' sign plus an 'X' is used for the isolated danger symbol
- The prominence of a symbol should be proportional to its importance to the safety of navigation. Important symbols should be redundantly identified by a prominent symbol in a strong colour
- Do not invent new symbols unless absolutely essential. Mariners will only recognise symbols they see regularly, and unfamiliar symbols will cause irritation and confusion
- Human factors experts quote a minimum requirement that symbols and characters subtend 20 arc minutes at the observers eye (for example, a symbol viewed from 70cm for route planning should be about 4mm in size, 1.5 times the size of a normal chart symbol. Two times chart size is a good general rule.) Symbols and characters important for route monitoring may have to be significantly bigger
- For clear representation, symbols require a minimum number of screen units (pixels), depending on their complexity. A simple chart symbol should extend about 12 pixels (that is about 4mm for an IHO standard screen)
- Since buoys and beacons are a potential hazard as well as an aid to navigation, simplified buoy and beacon symbols have been designed which are more compact and more prominent than the paper chart symbols, particularly at night
- Areas are difficult to symbolise on an ECDIS, for reasons given in the Colour & Symbol Specifications and can become very confusing in a heavily regulated harbour displayed at large scale. The PresLib therefore provides, as a mariner's option, symbolised area boundary linestyles for use on large scale displays. These make the areas easier to figure out than the plain linestyles recommended for small-scale displays (on which symbolised lines would cause clutter)
- The 'indication of scale and range' required as part of the display Base by IMO PS appendix 2 is intended to give the mariner an immediate appreciation of (a) how close to his ship are hazards seen on the display, and (b) how much time he has to decide on any necessary avoiding action. To achieve this, one-mile scale bar is provided for a large-scale display and a ten-mile latitude scale for a small-scale display to indicate roughly how close features are. And an emphasized six-minute marker is provided on the course and speed made good vector to illustrate the time element

Text:

- Text is difficult to read and tends to cause clutter. It should be kept to a minimum on the route monitoring display, and it should not be shown automatically when the object it applies to is on the display. The mariner should control the display of text

Software:

- The ECDIS is a display system, not a data processor. It is a real-time system running on a small processor, with no possibility of quality control. The processing requirements should be kept as simple as possible, both to speed the re-draw of the chart as the ship moves and to minimise the dan-

ger of software error causing a crash. As Capt. J. Pace of Canada Steamships Lines said "If the ECDIS fails there is chaos on the bridge"

Controversies

Colour calibration: probably the most unpopular feature of S52 App2 with manufacturers is the unfamiliar process of colour calibration, which, unfortunately, is the only way of transferring colour specifications accurately. Progress was made in IEC TC80/WG7 when John Holcroft of Racal chaired a sub-group on the issue and Barco of Belgium demonstrated the sorry results of not calibrating. But calibration remains a problem, particularly under the uniquely ECDIS requirement to control colours adequately on the very important low-luminance night display. However colour calibration is becoming commonplace in many computer appplications, even computer games! and ways of making it simpler are being worked on.

Too detailed, too complex: perhaps the most frequently heard criticism is that the PresLib is too detailed and too complex. It is probably true that no other navigation system, including GPS or ARPA, is specified in such detail, but it is also probably true that none is as complex as ECDIS. Any ECDIS manufacturer would have to develop much the same elements as are contained in the PresLib; the PresLib provides a standard system that will be continuously improved for the common good.
The reason for this complexity is that you either specify the decode and symbolisation of the S57 ENC or you don't. You can't half specify it. Merely producing a set of colours and symbols does not satisfy IMO PS 8.1; you have to tie those colours and symbols to the S57-coded ENC. Like any object-coded geographical data, S57 has inevitable ambiguities and if manufacturers did not follow the official decode in S52 there would be significant differences between displays of the same ENC on different ECDIS.
Both variations in data-interpretation and variations in symbolisation through too liberal an interpretation of the 'slight deviations' allowed by the C&S Specifications can lead to the dangerous situation that pilots and mates viewing an unfamiliar display will mis-interpret what they see on the screen.
There is nothing superfluous in S52 App.2. I believe that the issues that should be left to the manufacturer have been left to the manufacturer, such as how to provide the mariner with chart feature selection; how to organise cursor-pick reports; etc.

Government versus industry standards: there are obviously as many capable people, as deeply committed to producing a first rate product in industry as in government. But the circumstances are different. Government is ultimately responsible to the community as a whole and to ECDIS users in particular, whilst industry is ultimately responsible to the bankers or shareholders who enable them to stay in business.
Industry standards tend to be general, to allow the manufacturer plenty of room for manoeuvre. The following example occurred in Colours and Symbols: the lighthouses that generate the extraordinarily accurate sector lights which lead through the narrow inner passage along the coast of Norway may be located several miles from the channel which the sector defines, so they often lie outside the large scale display window of the ECDIS. This makes it slightly awkward to draw the sector limits on the display. But the mariner must be able see these so that he can turn into the safe sector and then stay within it. I proposed a specification to draw the sector lines at any required distance from the light, but the manufacturer majority of the Colours & Symbols WG preferred the less demanding: "It should be possible for the mariner to be informed, on demand, of the sector-colours and sector-limits affecting his ship which are outside the display window".
However this example is an extreme case. Generally, I believe that standards set by government with strong industry input are the best solution.
To do justice to the mariner, the fledgling ECDIS must adapt to new operational requirements and technological opportunities, and innovation is the hallmark of industry. But the competitive nature of commerce means that innovations may not always be shared for the common good. Nor will extensive improvements always be taken in hand by one company for all to share. However a regulated system is notoriously slow to change, and to keep IHO Colours & Symbols up to date the IHO Colours & Symbols WG must be watchful and keep experimenting, and must pick up innovations from the un-regulated ECS market.

Maintenance

ECDIS is barely adolescent and has to be capable of adapting to sea experience; to new mariners requirements as they develop their operational procedures; to new charting requirements (for example current Spanish concern over danger from tunny nets); to the opportunities of new technology (e.g. flat screen technology) and so on. Unless S52 App.2 is regularly updated it will quickly become ineffective and lose credibility.

If S52 App.2 is not maintained at all, the mariner will soon begin to be confused by different interpretations of the S57 ENC and by major deviations in symbolisation as the ECDIS manufacturers pick up the slack. The type-approval process will no longer be supported, and the IHO will no longer be fulfilling its responsibility under IMO PS section 8.1.

But we must also remember that ECDIS manufacturers and the type-approval system depend on a degree of stability. Except for immediate amendments for matters affecting navigation safety, changes are issued as 'deferred amendments' which can be implemented as convenient to the manufacturer at any time before the next new edition is brought into force, probably at a five or six year interval.

Future

Software: bear in mind that ECDIS is a real-time navigation system, running on a relatively small computer system with no possibility of quality control (except after the accident). It is simply not practicable to test the ECDIS software to the extent that, say, a bank computer system would be tested. Yet ECDIS will be used to operate super-tankers close to hazards, where a software failure could be catastrophic, because nothing can replace an ECDIS in a close-quarters situation except another ECDIS - with different software. So the message to remember when planning future developments is to keep processing as simple and reliable as possible:

- To speed the screen draw
- To reduce the danger of software failure

Information overload: we planned ECDIS with a radar overlay from the start and the Electronic Chart Testbed was interfaced to radar. Later we worked with IEC TC80/WG7 to include ARPA and AIS symbology and with WG 5 of the IALA VTS Committee to develop ways of overlaying VTS information on the ECDIS. Now, with ice information, more detailed real-time tidal streams, and probably other other 'Marine Information Objects' on the horizon there will be a cascade of visual information descending on the bridge. Since visual (as opposed to spoken or written) information is easiest to assimilate this trend is welcome, but it brings dangers because as Swedish pilot Sven Gylden wrote in 1966 "Even the most experienced and well-trained navigators can make a mistake when forced to handle too much information at the same time." IEC TC80 have done well to recognise the opportunities and the problems by setting up a new general Display WG13 that cuts across the present more specialised interest groups, and I hope the matter will be thoroughly researched, with full use of those practical and knowledgeable people, the human factors specialists.

As far as ECDIS is concerned all these additional features are covered under IMO PS section 6 'Display of other navigational information' which gives clear precedence to chart information. But fighting over display territory will not help. It is difficult to merge information from two separate displays mentally, even if they are on the same scale and orientation and have clear matching points. I think there will have to be one 'Prime Display', which carries the critical information to avoid collision and grounding. For this display the important principles are:

- Only essential information to be shown
- The mariner to have complete control over what appears on the display
- All information must be clear and unambiguous; the same symbology must never be used for two different purposes
- The mariner should be able to determine the source of any information easily

User Interface: one challenge for the future is to standardise the user interface to the extent that a mariner can bring up an operational display on any make of ECDIS no matter how unfamiliar. I remember one mate telling me of the frightening occasion when, because of a scheduling change, his bridge team had to take a new ship to sea, in fog, and of the problems they had in operating an unfamiliar radar. We once held a mariner / industry / government workshop on the human interface for ECDIS; we agreed on the problem, but we were short on practical experience and everyone was too busy to take on the responsibility of trying to solve the difficulties. The deluge of visual information which is now threatening the bridge brings an urgent need to take on the man-machine interface challenge. The mariner has to be shown what is available to him and he has to have effective control over selecting what appears on the 'Prime Display', and this control has to be standardised for all ships' bridges.

Future displays: the display itself may evolve, moving away from an exact chart-like representation into something more like a navigational diagram or poster, with the important features of immediate concern highlighted and less significant or more distant features subdued. One step in this direction is the 'fish-eye' perspective displays currently being developed in Canada and elsewhere, with the display scale being an inverse function of distance from the ship.

Conclusion

The IHO Colours and Symbols provide a clear, unambiguous and effective display of the chart information on the ECDIS, standardised so that there is no problem in going from one make of ECDIS to another. While not warmly welcomed by all manufacturers, particularly pioneers with their own display systems and those who want to compete for customers by the looks of the display, the IHO Specifications are accepted and used by other, often newer, entries to the market, and also by those mariners who are able to see the IHO display on a colour-calibrated screen. To remain effective, the Specifications must be upgraded to continue to contribute in the development of ECDIS as an outstanding contribution to marine safety, but the rate of change must be handled so as to avoid problems in ECDIS production and type-approval.

Biography

Mike Eaton spent the first twelve years of his working life in the British Navy, seven of them at sea surveying. Looking for a cool climate, he emigrated to Canada and spent six years on Arctic surveys, eventually developing helicopter-towed sounding methods. Later he got a degree in physics and spent the following twelve years developing positioning systems for surveying, ranging from Loran-C to UHF, before the Electronic Chart bug caught him in 1982. He chaired the IHO Colours & Symbols working Group from 1989 to 1996 and is now retired, more or less.