Is getting rid of Paper Charts really a bad thing?

THE HONOURABLE COMPANY OF MASTER MARINERS

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Preamble

On 26 July 2022, the UK Hydrographic Office (UKHO) released a statement, confirming that from late 2026, paper charts will no longer be manufactured. This has sparked considerable debate within the maritime industry, with people on both sides of the argument.

One of the biggest arguments against the removal of paper charts is overreliance on ECDIS (Electronic Chart Display Information System), the fact that it is electronic and, therefore, prone to malfunction and perhaps even hacking, presenting a real risk to seafarers.

Environmentally, paper charts are a huge waste, as is the ink required to make them. In a world in which we are more environmentally conscious, perhaps we should be doing everything we can to minimise paper usage.

ECDIS v Paper Charts

Function	**ECDIS**	**Paper Chart**
Updates	Quick and Easy	Laborious process.
Ordering	Simply select the Cell and unlock or use a Pay as you Sail system.	Have to wait for the chart to reach the ship.
Navigation	Instant position information in real time.	Necessitates manual position plotting, increasing workload. Prone to human error.
Environmental	Uses plastic and other non-renewable material to make, which is environmentally unfriendly.	A considerable amount of paper and ink is used to make, which is environmentally unfriendly.
Security	Potentially hackable, could be interfered with.	Not possible to 'hack'. Sound from a security point of view.
Backup	Must have adequate backup, see MSC.1/Circ.1503/Rev.1.	No backup required. If the chart is damaged or destroyed, a new one must be ordered.
Layering	Multiple layers, so possible to miss critical data at small scale.	Chart has no layers, but closer scaling may be available on larger scale charts.
Data Retention	Ease of use means that chart information may not be retained in the individual's memory.	Manual processing and planning imprints a more sustainable mental image in the user's mind.
Coronal Mass Ejection (CME)	Can seriously interfere with all electronics, communications and navigation system data.	Does not affect paper charts but may require reliance on historical navigational practices.
Spoofing	Capable of taking ship out of position without realising it – unless frequently cross checked.	Paper charts cannot be interfered with, but electronic position fixing, if used, can have a similar impact.

Analysis

Updates

The difference between updating ECDIS and paper charts is stark. Updating a paper chart involves downloading the updates and manually plotting them onto the chart, or using tracing paper, then logging the update both on the chart and possibly in a record book. A single update can take 15 minutes, and if a ship has a world portfolio of charts, updates each week can take many hours. Thus, it is very labour intensive, which may be problematic if the crew has been reduced to minimum safe-manning levels. Generally, minimum safe-manning allows no capacity for emergencies or back-up in an emergency.

Updating an ECDIS is much easier, the user simply has to download the updates from an email, transfer to a USB and then upload the files onto an ECDIS. In less than 10 minutes, an entire world portfolio of cells can be updated. Of course, there are security concerns which will be addressed later. Overall, however, on updates, ECDIS wins hands down.

Ordering

Traditionally with paper charts, when needing to order new charts, a user would be required to follow a long and laborious procedure. A chart catalogue would need to be consulted, and each required chart identified and ordered. It would then have to be delivered to the ship, added into the portfolio and, depending on the edition, corrected retrospectively for several weeks of updates. Electronic navigational chart systems offer several different ways of acquiring charts. A user can often select a chart simply by clicking on the cell and having the permit electronically transferred to unlock that cell.

Navigation

Although it is accepted that an ECDIS is an aide to navigation, and should always be cross-checked frequently, using conventional navigation methods such as parallel indexing, radar ranges and bearings, and visual gyro bearings to name but a few. ECDIS does allow users to monitor the ship's position in real time, as opposed to relying on frequent (or indeed infrequent) manual plotting on a paper chart. This function of ECDIS can significantly reduce the risk of ships running aground. In addition, ECDIS has the ability to set various depth and safety contours, highlight 'no-go' areas, and provide both audible and visual alarms when pre-set parameters are breached or are about to be. Cross track limits are monitored in real time with ECDIS and look ahead sectors positively contribute to safe navigation by adding additional layers of situational awareness.

Environmental

Producing paper charts is expensive and not considered environmentally friendly. In the 21st Century, climactic concerns have led to the philosophy of minimising natural resource usage, including reductions in paper and ink consumption. ECDIS is viewed as an eco-friendly alternative. Although

it should be pointed out the manufacturing of ECDIS units may not seem the most environmentally friendly of operations. On balance, it is considered that the environmental impact of manufacturing ECDIS units has, in itself, been addressed, such that printing the potentially millions of paper charts ordered from the Hydrographic Office each year, outweighs the natural resource consumption. Raw material recovery from defunct ECDIS units also saves scarce and expensive resources. By way of corollary, it is worth noting the need to produce large amounts of plastic navigational plotting equipment - such as chart weights, parallel rulers, dividers, etc. – constitutes a further reduction in raw material usage, arguably diminishing the financial burden on ship operators and owners.

Security

A notable, and concerning, weakness with ECDIS is cybersecurity. In the modern world, there is an ever-increasing risk of hacking by states or state sponsored individuals. Many companies now have stringent cyber security policies which govern casual or reckless security interventions, including USB usage and (potentially malicious) data transfers between operational hardware units. The principle safeguard is training and awareness, but this is dependent on the onboard operators adhering to stringent, and often irritating or inconvenient policies.

The IHO (International Hydrographic Organisation) Data Protection scheme prescribes security protocols that must be followed by both data clients and data servers to ensure piracy and reckless (unintentional) hacking or intervention protection. This may include selective user access and repeated operator authentication.

Currently there are two IHO security schemes, the S-63 (which replaces the older S-57 standard) and is used for ENC's (Electronic Navigational Charts) and ECDIS and the S-100 scheme which is currently in the testing phase. However, these security measures are not infallible and there is a real risk of software virus', worms and malware being passed to ECDIS terminals through updates received in emails or through software which is then transferred from a PC via a USB stick, infecting a vessel's ECDIS. It should be noted that cyber interference is not limited to ECDIS. Indeed, the University of Miami successfully hacked into a superyacht autopilot system and sent it off course as a test demonstration - unbeknown to the ship's crew.

The manual input and continual mental reinforcement of position and orientation awareness that comes from historical navigation practices associated with paper chart use, implements a natural level of cross-checking. Consequently, experienced paper chart users were much less likely to encounter these issues.

Backup

Another key concern with ECDIS is the required backups. Backup requirements are detailed in MSC.1/Circ.1503/Rev.1. For ships using ECDIS as their primary means of navigation, an additional and independent ECDIS must be provided as backup. The independent backup system should be connected to a secondary, uninterrupted power supply (UPS) so that connected systems offer

continuous position-fixing capability. When the ECDIS is being operated in RCDS (Raster Chart Display System) mode using RNC (Raster Navigational Chart) data due to a lack of available ENC data, then an appropriate portfolio of up-to-date paper charts must be carried and maintained where only raster chart coverage is available. This will, inevitably, become the norm - with separate units having individual power supplies. For ships that operate multiple units (passenger ships regularly have more than 7 units) should the master unit become infected with malware, secondary and backup units risk being automatically contaminated and operationally compromised. This could potentially manifest itself as a major problem in the not too-distant future. It would, therefore, seem reasonable that internal firewalls and fully independent position fixing systems – that cannot be compromised through operator or service engineer intervention – would be an appropriate measure.

For paper charts, there is no such issue. Though, should a paper chart be damaged to the point of illegibility (a cup of coffee split over it for example) then one has to wait for another chart to be delivered to the vessel, there is currently no requirement to carry a backup of each chart.

Conclusion

Clearly, with this very basic analysis, and the whole premise, raises multiple sub-themes. That said, it is clear that each pathway (paper versus pure electronic) offers both significant advantages and disadvantages. Whilst there is a compelling argument in favour of getting rid of paper charts, notably from the cost, environmental, and operational functionality perspectives, and for simple ease of use, the full transition to ECDIS around the world would be significant step for the maritime industry – a step that offers benefits, but clearly has its own risks. Consumption of natural resources would, it seems, be significantly diminished and the workload reduction for officers onboard would be significant. Overall, and with the proper awareness of the risks, and appropriate mitigation measures in place, I believe the positive safety advantages are likely to prove significant.

Finally, there are undoubtedly, very real security concerns, particularly with the increased efficiency and complexity of hacking by state sponsored players and opportunistic individuals. The full scope of risks that they represent have yet to be fully realised, as are the methods that will be needed to protect all aspects of INS (Integrated Navigation System) from predatory abuse. Overreliance of ECDIS has repeatedly been demonstrated as a causal factor leading to significant maritime casualties.

Only time will tell if this transition is truly a positive step for the industry. Vigilance and caution must always be the watch words throughout this transition. Just because it works and may prove cheaper and more reliable in the short term, does not mean that it will always be so. Familiarity breeds contempt, and contempt can lead to abuse, recklessness, and carelessness.