



Ship technology and human questions

The co-existence of new marine technologies which aim to improve safety and stubbornly high counts of human errors among the causes of maritime casualties and incidents suggests that 'more of the same' will be an inadequate response in seafarer training to the rapid advance of shipboard technologies.

Work at the IMO to establish how far SOLAS and the Collision Regulations can apply to autonomous ships will crystallise in a non-mandatory code by 2024, with a mandatory code due by January 2028, but few believe unmanned vessels will be part of workaday operations in the short term. However, for an increasing number of seafarers, the technologies whose rapid development appears to pave the way to fully autonomous ships and which has driven legislators to act are already part of lived experience.

Due to the age of IT systems onboard many existing vessels and previous limitations on connectivity at sea, shipping has been a relative latecomer in realising the potential of the Internet of Things (IoT), but data is now a decision-making benchmark for everything from carbon intensity and periodic surveys, to voyage planning and maritime risk.

Furthermore, available shipping aids already include solutions which fuse data from GPS, radar, camera and digital twin technologies to deliver situational awareness as augmented reality that purports to go beyond what even the best-trained look-out could see.

For seafarers, the relationship with technology is therefore increasingly intense, as automation and data-driven decisions cut across a growing number of activities previously preserved for the professional mariner.

Where technological developments continue to pull ahead of safety regulation, formalized seafarer training is likely to lag still further behind. For some, there is a temptation to attribute rises in any kind of accident numbers to a resulting knowledge gap; another group apportion more blame to creeping over-reliance on technology, not to mention backsliding on 'the basics'.

Few, however, would dispute the significant progressive contribution that has been made to ship safety by technologies that, today, we take for granted. Radio, the gyro compass, radar, ARPA, global navigation satellite systems (GNSS), the electronic chart, AIS and ECDIS - each represented a leap forward for technology.

AI anecdotes

A recent report from satellite service provider Inmarsat provided anecdotal evidence to suggest seafarers see similar safety gains emerging from the adoption of artificial intelligence. *The Future of Maritime Safety Report 2023*¹ suggested: "Many demonstrated a broad acceptance and faith in the promise of new technologies, including greater automation and artificial intelligence (AI). Bachala Shankar Rao, 4th engineer, said: 'Embracing advanced technology (automation) will reduce human error [and] remote monitoring system[s] to track the vessel conditions.'"



Latest figures from *Allianz Global Corporate & Speciality*² covering a decade of total losses appear to validate the conventional wisdom that advancing technology walks hand in hand with improved safety. In 2022, AGCS counts 38 total losses of vessels over 100 GT, against 59 in 2021, with the number down 65% since the 109 losses recorded in 2013.

Figures recently published by Lloyd's List Intelligence in its *Maritime safety trends 2012-2022*³ report also indicate that – as part of wider casualty figures - the number of collisions steadily declined from around 400 in 2016 to around 250 in 2021, before rising above 280 in 2022 as shipping reactivated post Covid 19. The number of incidents involving ships striking harbour walls and other static objects hit a high in 2014, at 245, before slipping steadily back to a low for the period of 157 in 2022.

Human in the mix

But the 'good technology' narrative requires considerable caution. Marine casualty and incident figures from the 2022 report of *EMSA*⁴ (European Maritime Safety Agency) indicate that 2021 actually represented a very average year. The 2014-2021 yearly average reported by EMSA for marine casualties and incidents amounted to 2,647. The number reported in 2021 was 2,637.

EMSA's analysis also indicates that human action was the main accident event type, with 68.3% of all contributing factors, with 'system/equipment failure' a long way back in second place at 18.8%. Furthermore, for the period 2014 to 2021, EMSA also identifies 'human behaviour' as the category's main contributing factor (at 53.8%).

One consequence, as EMSA also notes, is that the focus for 45.1% of the safety recommendations and actions taken covering human factors are in the subcategory 'training, skills and experience'. Where safety recommendations have been made and actions taken 2014-21, EMSA reports 'owner/company' as the main addressee - at 54.5%.

AI, the advent of automated ships and the challenges they pose for determining liability under the Hague Rules for maritime casualties formed the substance of an address made by Sir Nigel Teare in an address to the Association of Average Adjusters as 2022-2023 chairman. Sir Nigel also stressed that electronic charts had not eliminated the necessity for proper passage planning.

"The UK Government's Marine Accident Investigation Branch has urged navigating officers not to rely solely on the data embedded in a computer-based system but to consult all sailing directions and notices to mariners just as they would when passage planning on paper charts," he said. "There is evidence that not all navigating officers understand the limitations of electronic charts.

"In circumstances where the decision of the Supreme Court has so clearly resolved the issues of law, the debate in the future is more likely to concern the adequacy of the plan on the electronic chart, the significance of any defects and the adequacy of the training of officers to use electronic charts safely."

Training for life

Training must surely be a central issue. Digital tools enhance consistency, which should be a conduit to improving maritime safety. However, other factors may also be in play.

After all, the relationship between new generation seafarers and technology is lifelong: they are not simply digitally literate but have no recollection of a world before smart phones, let alone the internet. Even those convinced that greater automation is really the precursor for de-skilling or replacing seafarers or replacing them must concede that – today - digital connectivity is a clear welfare and mental health gain.

What may not be so clear, considering the relationship of modern seafarers with technology and the master mariners preparing their training courses, is whether 'more of the same' is the tonic. Lack of common understanding between senior officers on ECDIS has been a feature of several marine accidents over the past decade, for example. There may be reason to suppose that younger mariners have an edge over trainers whose greater experience may still rest with paper charts.

Whether the retirement of older officers will coincide with a decline in ECDIS-related incidents remains to be seen, but the development and use of new technologies should surely not overshadow wider welfare concerns which continue to define the state of maritime safety.

The 2021 paper *Investigating the Role of the Human Element in Maritime Accidents using Semi-Supervised Hierarchical Methods*⁵, for example, offers an analysis focusing specifically on the disconnect between the technological advances assisting safety and merchant shipping's intractable high rate of accidents.

Stress, pressure and error

Summing up from casualties and incidents collected by type into 11 'clusters', authors conclude: "Findings point to poor education and training of seafarers combined with lack of monitoring as common issues in maritime accidents. Hardware, software and personnel deficiencies are confirmed as the underlying factors behind human errors and violations. Furthermore, the human factor turns out to have a prevalent role in collision, grounding and work accidents."

"Human factor-oriented measures" as applied in maritime transport remain the basis for making the most useful safety interventions, authors conclude ("such as tailored training programs for crews or improved communication tools").

Further study is surely to be recommended, The research paper *Human error in marine accidents: Is the crew normally to blame?*⁶ offers a variety of causes in 264 maritime casualties, for example, while still attributing a consistent 75% of these accidents to human error.

Although fatigue and poor technical training (or inexperience) were the error categories given in numerous cases (respectively, in 18 and 20 cases), the leading three explanations were 'navigation error due to misjudgement' (36 cases), 'navigation error due to overconfidence' (30) and 'lack of planning of manoeuvre planning' (24). 'Navigation error due to misuse of vessel equipment' was also given as a cause in 20 other cases, without further explanation.

As the Lloyd's List Intelligence report cited earlier observes incontrovertibly: "The safety of any ship is only as strong as its weakest link".

"While technical systems might be installed onboard, the hull might be stronger than the previous generation of ships, the engine more powerful and with improved manoeuvring ability, it is the crew – together with the systems – who must keep the venture safe," its author concludes. "The trinity of competencies: the human element, organisational systems, and technology will ensure safety when deployed in combination rather than any one of them in isolation."

The question remains whether improved technology, a seafaring demographic more conversant with its use and better training will be sufficient to improve safety, or if a concerted focus on crew welfare and better conditions of service is required to reduce the abiding human factor in casualties at sea.

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