INSIDE: ARTIFICIAL INTELLIGENCE / COASTAL BLUE CARBON / MARINE MAMMAL CAREERS

MARINE PROFESSIONAL

Issue 3 2022

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COVER IMAGE: PETRMALINAK VIA SHUTTERSTOCK

WELCOME TO MARINE PROFESSIONAL

It passed by with relatively little fanfare, but the muted coverage should not undermine the importance of a call for a global 'Blue Deal' to spur economic recovery and sustainable growth. Put forward by an UNCTAD-led coalition, the proposed Blue Deal strives to put the world's oceans at the heart of post-Covid-19 recovery plans – and take advantage of an ocean economy that is expected to double in size by 2030.Writing in this issue, UNCTAD senior economist Diana Barrowclough explains how a Blue Deal concept brings together different ways in which ocean-based goods and services can lead to a more sustainable recovery – building on an 'Ocean Pillars' approach. Oceans sustainability needs to be a priority in rebuilding economies.

If we are to achieve the UN Sustainable Development Goals, action is needed now

Finance is undoubtedly needed for a Blue Deal to work, and UNCTAD's suggestion of a 'blue bank' as part of the deal is a sensible one and complements the strides the industry has made installing and supporting green banks. And the criticism that there is no money to finance a Blue Deal is disputed; redirect fossil fuel and fishing subsidies for a start – this will give the industry a good start on the Blue Deal journey, UNCTAD says.

But there is no time to waste. If we are to achieve the UN Sustainable Development Goals, action is needed now. With the support of the marine industry, a Blue Deal might just be attainable. But only if we make noise and move today.

Carly Fields, editor

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Sustainability and skills

BY ALASTAIR FISCHBACHER

By the time you read this, we will have had the 2022 IMarEST Annual Conference. Once again, this year it was a virtual conference as, despite the relaxation of restrictions and the increase in business travel and tourism, an in-person event was not yet possible. But the experience of the past few years enabled a full week of online speakers on the theme of 'In Pursuit of Maritime Sustainability', with a broad range of topics for everyone covering the spectrum of IMarEST membership.

It is this range, covering the whole of the marine sector, that gives the IMarEST an unparalleled multidisciplinary composition with a breadth and depth, of skills, knowledge and expertise. But also, importantly, it provides a variety of viewpoints that can bring together those disciplines, give greater insight and understanding of the issues, challenges and potential solutions, and offers the opportunity to communicate that internally and externally. Our conference provides a unique forum for cross-sector inspiration and learning, which will hopefully accelerate progress.

Sustainability solutions

This year's theme of sustainability is timely. From being on the sidelines – a distraction perhaps – sustainability has now become mainstream. In the shipping industry in particular, the number of groups and organisations established to address this in some way is expanding and there is a lot of choice. Some are all talk, others are highly focused on one aspect, while others are very general.

The IMarEST is already well resourced and positioned to lead in many areas across the spectrum covered so well by our membership. We have the forums through our Special Interest Groups and Branches,

TAVARIUS VIA SHUTTERSTOCK

Go to almost any careers fair and... you will struggle to find mention of marine engineering, technology or sciences

and indeed our conferences and events, where we convene that wealth of knowledge for practical advancement of the sector towards a long-term sustainable future. We are actively looking at ways in which this can be enhanced further and I would like to take this opportunity to remind you that these groups are open to all to join and benefit from.

One aspect that was mentioned a number of times during the Annual Conference was the human resources needed. The recurring comment was that there is increasing demand for relevant skills and expertise so that demands on organisations themselves can be met. With work on sustainable developments and solutions accelerating in the marine sector, there is increasing recognition that not enough people are entering the disciplines, either at the outset or transferring across.

In part this is no doubt due to the invisibility of the sector – go to almost any careers fair and stands will consist of the usual suspects; you will struggle to find mention of marine engineering, technology or sciences. Likewise, many schools and colleges have little information on these careers. This needs to change and quickly if we are to maintain progress and achieve goals we set – or are set for us. We have heard this before, lamented it and have made efforts to inform and increase visibility, but this is a reminder of the need to increase those efforts now if we are to attract more new talent.

That being said, I attended several student events recently and we also had students among the presenters at the conference and I was impressed by the quality, knowledge and skills. We are developing the right people; we just need more and the challenge is how to enthuse others looking for interesting and satisfying careers to meet demand. We must surely all help in getting the word out there and in advocating the amazing opportunities and careers within the sector. ■

Alastair Fischbacher is president and trustee of the IMarEST.

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In Depth

Beneath the surface of maritime industry trends

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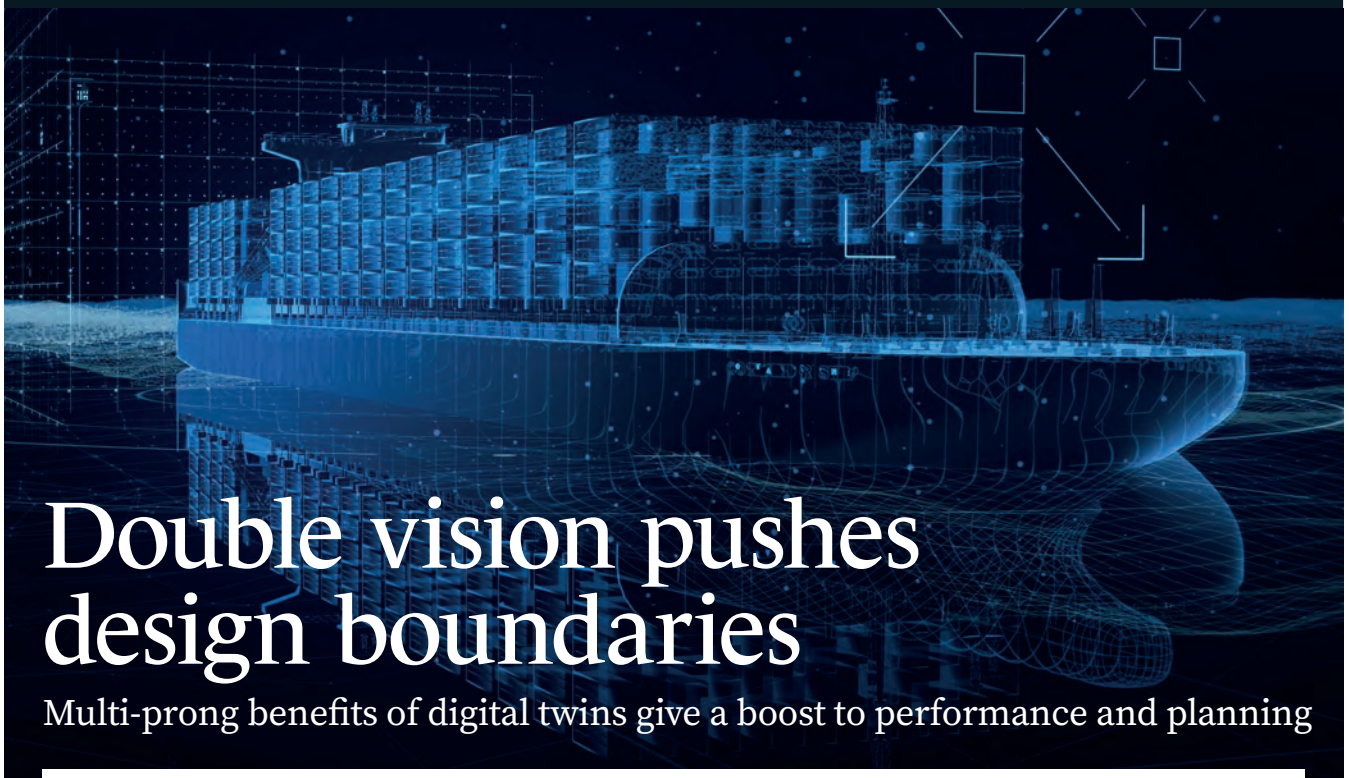


KEYFAME VIA SHUTTERSTOCK

Double vision pushes design boundaries

Multi-prong benefits of digital twins give a boost to performance and planning

BY FELICITY LANDON

Whether operating and optimising current ships, or designing the ships of the future, the challenges and ambitions of digitalisation and decarbonisation go hand in hand.

There is an increasing emphasis on digital twinning as a tool for both 'phases' – to analyse and improve the performance of current ships, and to gather data and technical evidence that can feed into and inform new designs.

However, that might sound easier than it is. "One of the challenges we see is ships already built or being built that are not designed for digital twinning," says Capt Pankaj Sharma, who heads up Columbia Ship Management's (CSM's) Performance Optimisation Control Room (POCR).

"If we want to have ships ready for tomorrow, then we need to incorporate digital twinning – but we find we have to do a lot of installation work after a vessel comes into service. We have to upgrade systems or add sensors that could easily have been incorporated or added during construction. That presents a challenge in that the ship has not been designed for elements of data catching, and we are limited to what can be done with the existing design."

CSM recently announced that it had "pushed industry boundaries" by creating a totally "smart" and fully digitised jack-up barge under its management, as part of a digital twinning process designed to "massively optimise vessel performance".

One step ahead

Using IoT technology through a wireless ecosystem with full machine-learning capability, the connected vessel benefits from machinery health monitoring, as well as enhanced

"We are focusing not only on sensors and the new generation IoT applications, but also investing into AR and VR applications"

engine diagnostics, says CSM. "Transforming the smart vessels into an effective digital twin, the process was one step ahead of pre-existing, often fragmented, ship-to-shore connectivity solutions."

CSM's POCR was set up in 2018 when the concept of having a centralised monitoring system was limited to shipowners or large carriers, says Capt Sharma. The first focus was on end-to-end vessel optimisation in terms of speed, vessel safety, reliability, etc. "In this learning, we realised we have to go further into predictive maintenance, information exchange and so on," he says. "We see ourselves as a trendsetter and keeping ahead of the industry, so we are focusing not only on sensors and the new-generation IoT applications, but also investing into AR and VR applications to make this experience very holistic and as realistic as possible."

Future ship design

Shipowners should think about the digital twinning aspect at the design and technology phase, Capt Sharma believes. Costs can be reduced if sensors and other equipment are incorporated from the beginning, rather than considering installation later.

What CSM is finding now is feeding into future ship design, he says. What does he predict? "Five years from now, we will see many more ships doing unmanned or automated voyages. I won't say it will be all over the industry, but there will be many more such projects. We will move to semi-autonomous shipping, and elements of digital twinning will be of extreme importance.

"You can create the bridge/navigation system – but what about the rest of it, and the support? When the need comes to take corrective action or intervention, that is the time when a digital twin will be key."

CSM's digital twin application is a two-way track, he adds, enabling its use for training, interviews and even inspection using VR, with a virtual 'Post-it' note and/or video left on the digital twin's machinery, visible to control rooms, technical superintendents and owners, who can see exactly what work has been done.

Engaging the industry

'Digital Twin for Green Shipping' (DT4GS), a European Commission coalition, was launched in June this year with a focus on applying digital twin technology to the entire life cycle of ships.

Led by Belgian R&D specialist Inlecom, DT4GS will create realistic digital representations of different types of ships, which will then be tested and validated in 'Living Labs', looking at navigation/route, machinery and hull optimisation energy management, and so on.

The three-year project aims to significantly contribute to achieving a 55% CO_2 emissions reduction from waterborne transport by 2030.

Takis Katsoulakos, Inlecom director, recalls that he first worked on research projects into AI in shipping nearly 30 years ago – "but now the whole world is seeing a digital transformation and it is taking place in shipping as well".

The project has 21 partners, including shipyards and four shipping companies – Belearia, Danaos, Euronav and Starbulk

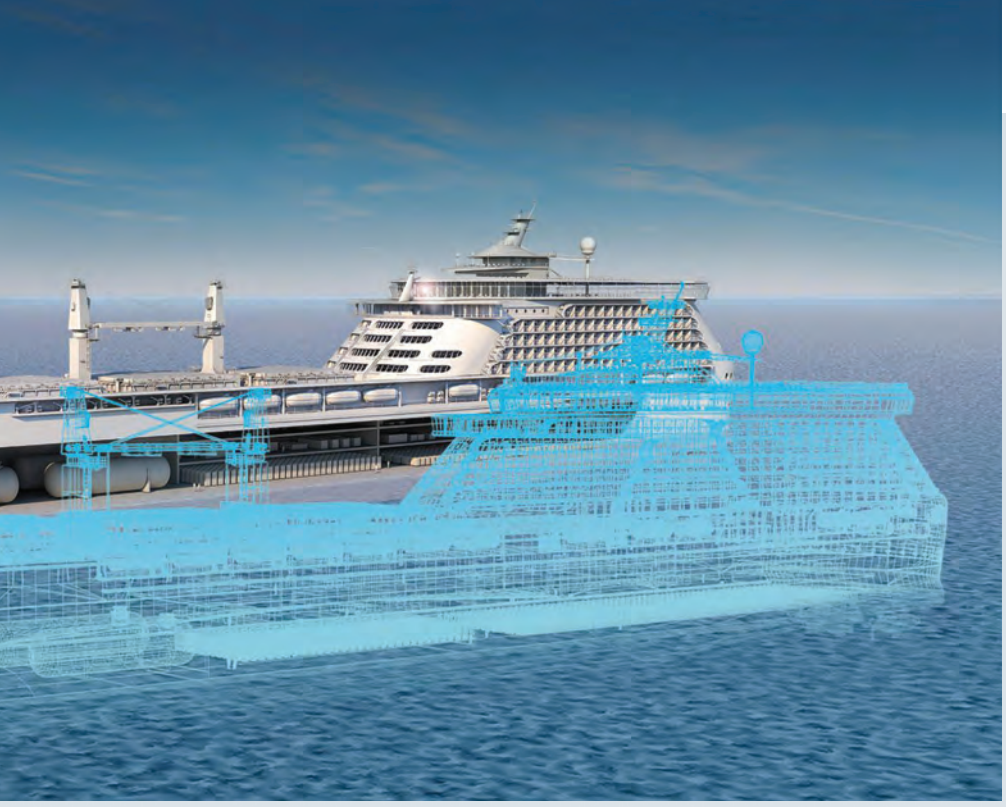
Columbia Ship Management's Performance Optimisation Control Room

– to cover the major sectors. Katsoulakos says shipping companies that are leading the way on decarbonisation are exploring, investigating and testing all different types of options to see which will work for them, and this was an important motivation for those joining DT4GS.

"We are particularly hoping that we will prove the benefits and advantages of digital twinning and try to engage the whole industry. One of the main aspects of the project is to create an open digital twin framework for green shipping – it will create a lot of resources the industry can use, including ship operators, shipyards and developers," he says.

Four ships have been selected for installation with digital twin technology, which will be tested for a year to prove it works well and delivers the benefits. "Then we will invite the broader sector to participate, so a much larger core group of companies will be using this technology by the end of the project."

Ultimately, the technology will predict how a voyage should run, identify any deviation that needs adjustment, and continuously optimise ship performance, thereby reducing CO_2 emissions, says Katsoulakos.



He says eventually, DT4GS will become an industry association, providing access to an open framework of software and models, while continuing with development. The open framework would enable a shipping company to produce a digital twin for each of its ships and its own fleet – and, it is hoped, they would also provide data to be gathered into a common data space to continue to refine the model.

The next generation

How does all of this translate to the 'next generation'? "We are aiming to support the shipping industry in the decarbonisation transition, which we then split into three phases," says Katsoulakos.

"First, short term to 2026, these types of systems can be applied and used to optimise operations and achieve something like a 15% improvement on CO_2.

"Second, in line with European strategy is to try to achieve a 55% reduction by 2030. For that, we will be developing a decisions support system, which would enable every shipping company to consider green fuels, hydrogen, ammonia, wind-assist power and many different technological options that would facilitate this improvement in the medium phase; this is by retrofitting.

Shipyards will design and construct these types of ships... so the digital twin will be linked to the construction process

"Third, by 2050, we want to have zero-emission ships. For that, we are developing a decision support system, a digital twin specifically for the ships of the future; we are looking at new overall ship designs, new propulsion systems based on hydrogen, fuel cells, etc, and autonomy and autonomous vessels. A combination of automation, decarbonisation and technologies will come together."

Shipyards will design and construct these types of ships, he adds, so the digital twin will be linked to the construction process, "automating the production process of the new vessels, and also then automatically they will become part of the monitoring and optimising after it operates – so the full life cycle of the vessel will be managed by these digital twins". ■

FIND OUT MORE

Visit IMarEST TV to learn more about innovation in construction and design techniques.

NAVAL SHIP DESIGN A 'MOVING TARGET'

'Well-defined' requirements for future naval ship design are now a moving target that design teams need to understand and translate into measurable parameters – currently referred to as adaptability and modularity, says Neil Young, engineering and technology director at Babcock.

"The adaptability is achieved through enough margins that allows the allocation of different equipment, installations and assets without compromising the main compartmentation of the ship," he says. "In off-board assets or for some energy storage systems, the adaptability can be achieved by the use of modular systems in standardised sizes such as ISO containers.

"All this changing technology is adding complexity to the design process, but it is creating opportunities for innovative concepts that could challenge the status quo of naval ship design and navies' concept of operations."

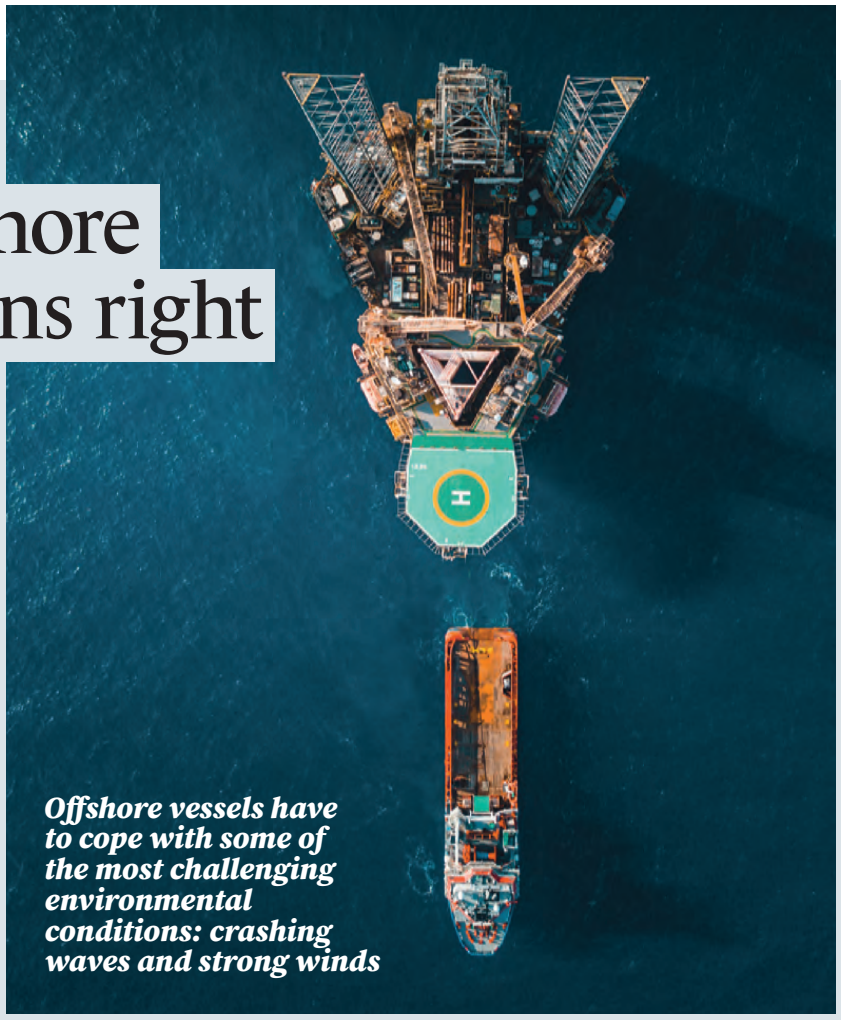
Designing a naval ship is and always has been a challenge, Young points out. "Naval platforms are complex ships, with complex integrated systems. Traditionally, the design starts with a well-defined set of requirements that allows to size and shape the ship in several iterations of the design spiral. Current changes in technology are modifying this process."

Babcock has identified three main areas that are changing the way of approaching optimised ship design: the requirement for multipurpose ships that can be deployed for different missions with different aspects, therefore being easily reconfigurable; the requirement by navies to be able to deploy and recover several different crewed and uncrewed off-board assets; and net zero environmental targets.

Getting offshore configurations right

Slashing specification times for optimised dynamic positioning capabilities systems

BY PETRA STOLTENKAMP AND NORBERT BULTEN



Offshore vessels have to cope with some of the most challenging environmental conditions: crashing waves and strong winds

M.AFIQSYAHMI VIA SHUTTERSTOCK

Specifying exactly the right thruster configuration and power requirements to ensure that increasingly large and complex offshore vessels can remain firmly in position demands vast experience and knowledge of hydrodynamics and computational fluid dynamics (CFD). To maximise the benefits of the outstanding hydrodynamic performance of thrusters, individual unit performance needs to be translated into an integrated system of thrusters, switchboards and gensets.

Offshore vessels have to cope with some of the most challenging environmental conditions: crashing waves, powerful currents and strong winds. Achieving the power and precision to ensure they can perform their work safely and efficiently demands high-performance dynamic positioning (DP) capabilities delivered by a carefully balanced and optimised propulsion configuration.

Maximising DP performance

Using CFD capabilities, we can now accurately predict the complex interactions between thrusters and, for example, a vessel's hull or other object such as a wind turbine tower or oil platform.

For example, Wärtsilä's OPTI-DP Engagement Tool can simulate the real 360° performance of thrusters depending on their azimuth angle and location on the vessel in combination with the full range of environmental operating conditions. Verified by DNV Maritime, the tool allows multiple thruster configurations to be modelled to specify the safest and most efficient set-up for the vessel and its operating profile.

The thrust allocation logic identifies the optimum allocation for both normal operation and for failure cases, the latter of which can be based on single thruster failures or power supply failures in switchboards, gensets or engines. In all cases, the focus is on maximising the vessel's DP performance while minimising capital expenditure and operating expenditure.

Tools such as these take every detail of thruster performance into account and utilise full-scale CFD simulations to ensure accurate results. It also allows an unlimited number of forbidden zones to avoid unwanted thruster-thruster interaction and minimise the negative impact of thruster interaction with objects such as the legs on jack-up rigs. Azimuth thrusters, tunnel thrusters, propeller-rudder combinations and even waterjets can all be implemented in the tool.

Get in early

The outcome is a set of clear polar plots and diagrams that make it simple for vessel owners and designers to compare and evaluate thruster configurations early in the design phase. Through early engagement, this type of tool can, for example, be used to optimise the number of thrusters without changing the total power, saving costs while expanding the operational window in which the vessel will be able to maintain its position.

Another benefit is the possibility to specify a larger number of smaller thrusters in place of fewer larger ones, which can save valuable payload, cut capital expenditure and improve vessel manoeuvrability. ■

Petra Stoltenkamp and Norbert Bulten are product performance managers at Wärtsilä.

Oversight comes of age

Moving from scepticism to acceptance of outsourced machinery maintenance

BY MICHAEL GREY

It was at a marine propulsion conference in Copenhagen some years ago that I was introduced to the concept of what we now describe as contracted machinery maintenance. I was sitting between a ship manager and a technical superintendent and feeling somewhat out of place as somebody whose origins were in the deck department.

My companions, both apparently exhausted and world-weary, spent much of the conference multitasking. The ship manager was sorting out the endless demands of his fleet on the keyboard of his BlackBerry, while listening with one ear to the various speakers. The superintendent spent much of the meeting muttering into his mobile as he reacted to the crises that were emerging constantly from his office in Greece. You had to wonder why they had bothered to come to the conference at all, until I realised that practically every other delegate was multitasking, too, as they focused on their tiny screens while vaguely listening to the speakers.

Maintenance subcontracting

But I noticed both of them listened intently to one specific presentation from a major engine manufacturer, who wished to introduce the technical folk present to the attractive possibilities of subcontracting all of their machinery maintenance to his estimable company. He offered complete oversight of the machinery that his company would supply, even placing a staff member on the ship to ensure that everything worked well, and all scheduled maintenance was undertaken. What was not to like?

DUSAN PETKOVIC VIA SHUTTERSTOCK

An engineer repairing a ship engine

It was a convincing performance, but I have to say that it went down like a lead balloon among this gathering of sceptical marine engineers. The questions following the presentation were plentiful and could be divided into two categories: those revolving around the likely (and probably outrageous) cost of such an arrangement; and those of a more practical form.

Was this not just a cunning plot to ensure that an engine, once supplied under such an arrangement, became a 'gift that went on giving' to the manufacturer, with the on-board representative spending all his time ordering unnecessary spares and loading the owner with additional costs? What would be the status of this on-board representative – would they outrank the second, or even have parity with the chief?

I spoke to the speaker afterwards, but he didn't seem to be even slightly bruised by the negativity radiating from his audience. It would take time, he said, but sooner or later these sceptics would come around to the realities of maintaining increasingly complex machinery outfits and the difficulties of sourcing capable and competent engineers. Besides, it really would make sense, if downtime was minimised and the reliability increased, while the real value of a ship was enhanced.

Michael Grey MBE is an honorary IMarEST Fellow and a former editor-in-chief of *Lloyd's List*

Coming to fruition

That conference was about 20 years ago, but as this speaker suggested, it didn't take that long before the notion caught on. The big breakthrough, some might suggest, was when one of the world's largest cruise companies signed up for maintenance oversight on a staggering number of engines and auxiliaries. Then other major operators did the same.

It was a gradual process – which of course has been facilitated by digitisation and the arrival of amazing communications, which enable somebody ashore to be appraised in real time of the state of a ship's machinery, on the other side of the world. There are still reservations, with technical superintendents worrying about whether the contract is too one-sided or whether the recent repairs were really justified. I would suggest that the new battle (or perhaps one that has never gone away) is whether the increased amount of shore-side technical oversight justifies even smaller engine-room staff aboard a ship.

I would have loved to ask those two delegates at the Copenhagen conference what they thought about the way this has all developed. They are, I would guess, long retired, along with BlackBerries. ■

Three failures and a fire

Wight Sky's engine catastrophes could have been prevented with better technical oversight

BY JOHN BARNES

The roll-on/roll-off (ro-ro) passenger ferry *Wight Sky*, built in 2008, is one of three vessels operated by Wightlink Ltd on the UK's Lymington, Hampshire, to Yarmouth, Isle of Wight, service. Each is 62.4m long, with a gross register of 2,546 tons, and is powered by four Volvo Penta six-cylinder, in-line D16 MH main engines, two in a forward engine room, and two in an aft one. The engines are rated at 478kW at 1,800rpm, and drive two, five-blade Voith Schneider propellers, one forward and one aft.

On 12 September 2017, *Wight Sky* suffered a catastrophic engine failure during the vessel's approach to Yarmouth, which resulted in an engine room fire and caused serious injuries to an engineer officer. RK Marine Ltd, a local Volvo Penta dealer, had recently overhauled the engine ashore, after which it was rebuilt in the vessel's engine room. The engine ran for less than six hours before it failed. Volvo Penta's investigation concluded that a big end bearing's lubrication supply had probably been blocked by debris that had been allowed to enter the engine's oil channels during the rebuild.

SHIP DETAILS

The vessel *Wight Sky* is a ro-ro/passenger ship that was built in 2008 (14 years ago) and is sailing under the flag of the United Kingdom. Its carrying capacity is 2,546 gross tonnage and its current draught is reported to be 2.1m. Its length overall is 60m and width is 20m.

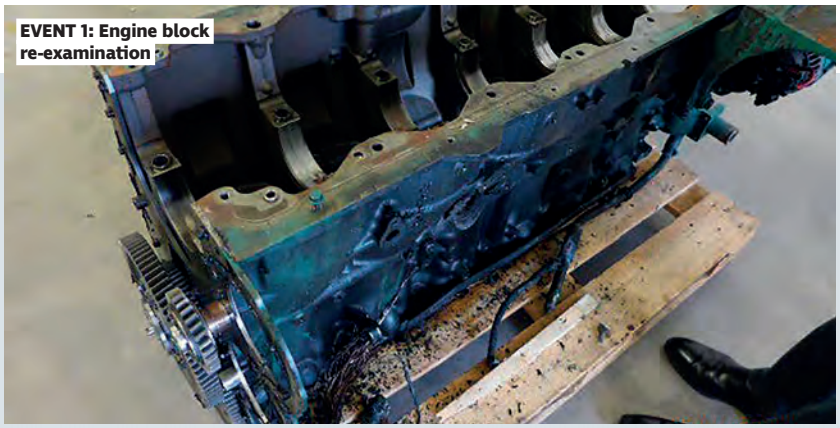
Then, on 26 August 2018, the ship suffered a second catastrophic main engine failure as it prepared to enter the Lymington River. *Wight Sky*'s machinery monitoring system identified a loss of lubricating oil pressure in one engine and initiated a shutdown. Within two seconds, the engine failed, causing internal engine components to exit through the crankcase into the engine room. Oil and vapours released from the crankcase ignited and created a fireball that activated the fire-detection system alarm on the bridge. The master took immediate action to ensure the engine had declutched and stopped, and activated the engine room's water mist fire suppression system, which extinguished the fire. The failed engine was the replacement for the previously failed unit.

On 14 December 2018, there was a third catastrophic main engine failure. On this occasion, the failed engine had been in operation for just 389 hours. Initial inspection of the engine room identified that the unit's number four connecting rod and gudgeon pin had been ejected through the side of the engine crankcase into the engine room. The engine room was unoccupied at the time and there was no evidence of a fire.

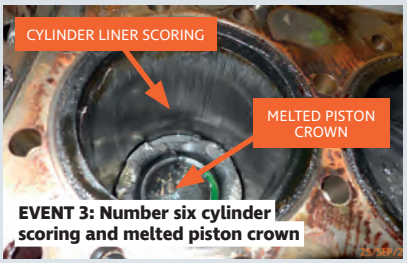
Frequent engine problems

The subsequent investigation found a history of engine problems, amounting to 23 incidents across the Wight Class fleet, dating back

GENI VIA WIKI COMMONS; MAIB


EVENT 1: Engine block re-examination

EVENT 2: Main journal bearing cap number seven



EVENT 3: Number six cylinder scoring and melted piston crown

EVENT 4: Cylinder head valves

to 2010. The result was a long and detailed technical investigation that comprised forensic examination and testing of five of the failed engines and their components, a full review of the vessels' system design and operation, and the safety management, planned maintenance and condition-monitoring procedures, together with manning and technical oversight.

In May 2019, the Marine Accident Investigation Branch (MAIB) published an interim report of its initial findings and a final report in April this year.

Although *Wight Sky*'s catastrophic three engine failures had similar consequences, the complex circumstances that led to them differed. However, many of the underlying factors that contributed to the *Wight Sky* and other Wight Class engine failures were similar and included insufficient technical oversight of engine-operating parameters, maintenance management, quality control and engine component and auxiliary system design. This was exacerbated by a lack of engine maintenance and condition-monitoring ownership, which resulted in long-standing reliability issues that were either unidentified or unresolved.

Some of the many problems identified included:

- Four of the five catastrophic engine failures investigated in detail failed suddenly because of a loss of lubrication supply to the engines' crankshaft journal bearings and crankpins.
- Up to 20% of the lubricating oil circulating through the engines was unfiltered because of a duplex filter bypass valve design fault. This significantly increased the risk of bearing wear and engine damage due to oil contamination.
- The debris and sand particles found in the engine sumps, oilways and bearing faces were either introduced during maintenance or not removed at build.
- The inability to immediately declutch and therefore stop an engine when a shutdown signal was given significantly increased the severity of engine damage and the likelihood of explosions and fires.
- Engine misalignment due to assembly error, incorrect location of engine mounts and condition of flexible mounts was likely to be another significant factor in some of the engine failures.
- Some aspects of the maintenance work carried out by RK Marine Ltd did not meet the standards set by Volvo Penta and those expected by Wightlink. Assembly errors had been made during overhauls, basic levels of workshop cleanliness were not always met, unapproved repairs were carried out and used components regularly switched from engine to engine.

Within two seconds, the engine failed, causing internal engine components to exit through the crankcase into the engine room. Oil and vapours released from the crankcase ignited and created a fireball

Improved performance

Wightlink Ltd and others have now taken several actions following their internal investigations and in response to recommendations made in previous MAIB reports. Since December 2018, the ferries have operated without any further engine failures. RK Marine Ltd, the local service centre contracted to undertake most of the Wight Class ferry engine overhauls, has had its authorisation as a Volvo Penta Centre dealer removed by the engine manufacturer.

Recommendations aimed at addressing specific issues that remain unresolved by the actions already taken have been made to Wightlink Ltd, Volvo Penta, Lloyd's Register and RK Marine Ltd.

The full MAIB report detailing the many problems identified in this case can be downloaded from assets.publishing.service.gov.uk/media/6267cc85e90e071690c1b679/2022-4-WightSky-Report.pdf ■

Revolutionary hydrogen ship design

Green energy drive prompted partnership on novel vessel project

The C-Job Naval Architects and LH2 Europe liquid hydrogen tanker

BY RAJESH MADUSUDANAN

C-Job Naval Architects, in partnership with LH2 Europe, has developed an initial design of a liquid hydrogen tanker, which it claims will revolutionise the renewable energy market, particularly in Europe. C-Job Naval Architects is an organisation known for its architectural innovation, and its specialists are keen to utilise their previous experience with future fuels such as ammonia-, solar- and battery-powered ferries.

LH2 Europe aims to set up a sustainable supply chain of green liquid hydrogen to markets in Northwest Europe and is setting up a green hydrogen supply chain from Scotland to Germany. It is expecting to expand the supply chain to other parts of Europe based on the demand. Currently, there is no option available to transport bulk liquid hydrogen via sea – an acknowledged gap that paved the way for the LH2 Europe collaboration with C-Job Naval Architects.

Details of the design

This initial design of liquid hydrogen tanker comprises three liquid hydrogen cargo tanks, each with a capacity of 12,500 cubic metres. LH2 Europe estimates that the total capacity of 37,500 cubic metres will be able to provide fuel for 400,000 cars or 20,000 heavy trucks.

Speaking to *Marine Professional*, LH2 Europe CEO Peter Wells said that the project has been years in the making. "When we started the project some years ago, one of the guiding ambitions was to develop a green end-to-end hydrogen supply chain. This would require liquid hydrogen with a hydrogen-fuelled liquid hydrogen tanker to transport it. The second guiding ambition was that the project should be commercially viable. For this, the supply chain had to be at a large scale from the outset.

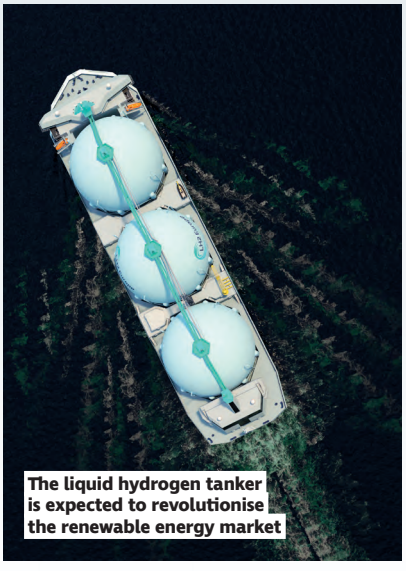
"When we started the project some years ago, one of the guiding ambitions was to develop a green end-to-end hydrogen supply chain"

"These requirements led to the specification of a hydrogen fuel cell-powered tanker capable of carrying 37,500m of liquid hydrogen in three spherical storage tanks following the tried-and-tested tank technology used by NASA."

Piet Ruijtenberg, deputy chairman and deputy CEO at LH2 Europe, knew C-Job Naval Architects' CEO Job Volwater from sailing, and was aware that Volwater and his team at C-Job were keen to develop green ship designs and already had experience in designing a hydrogen-fuelled ship similar in size. "Following a meeting in 2021, LH2 and C-Job rapidly developed a close working relationship and C-Job produced the first phase design, which met the requirements and exceeded expectations on power requirement, making the ship more economical to run than had been expected."

Cargo concerns

Further partnerships will be central to the success of the project, going forward, with Wells looking out for off-takers of the hydrogen in Germany and/or the Netherlands – such as port operators, operators and manufacturers of large trucks and truck fleets, synthetic fuels producers, industrial users of green hydrogen such as refinery operators, natural gas utilities, railway train operators – as well as strategic partners and investors.



The liquid hydrogen tanker is expected to revolutionise the renewable energy market

Volwater said: "Liquid hydrogen provides unique challenges in ship design and engineering. As a comparison, LNG tankers use ballast water to compensate the loss of weight following delivery to ensure enough draft. As liquid hydrogen is high in volume but 20 times lighter than LNG, this required a unique solution. We have created a trapezium-shaped hull design, which creates enough deck space to fit the tanks without the need for ballast."

The liquid hydrogen tanks will have a low amount of boil-off compared with other liquefied gas cargoes, which are currently transported by ships. The remaining boil-off will be used directly in hydrogen fuel cells, providing power to the vessel's propulsion systems, resulting in emissions of water only. The vessel will have zero greenhouse gas emissions during operations. The vessel is expected to be ready and commissioned six months before the first delivery of hydrogen in 2027.

The layout of the vessel is close to conventional vessels operating today. The main difference is in the machinery equipment for generating the electric energy, which will be done through large fuel cells. In addition, C-Job has designed a hydrogen system to create the right amount of fuel from the vessel's cargo.

The lightness of the liquefied hydrogen called for different design thinking. "Liquefied hydrogen is a very light cargo in comparison to other types of energy cargo, such as fuel oil or LNG. This means that conventional ship design is not suitable for the hydrogen mission. This resulted in a very challenging design, taking into account the vessel's balance in operation and energy efficiency," Volwater said. "Next to this, it is not yet [proven] to carry this amount of LH2 on a sailing vessel. The set-up of the vessel's cargo tanks has never been seen before."

VESSEL PARTICULARS – LH2 EUROPE

Length (m): 141.75
Rule length (m): 135.75
Breadth (m): 34.90
Depth (m): 8.75
Draught design (m): 5.80
Speed (kn): 14
Installed power (kWe): 5,000
Research deck area (m²): 1,750
Cargo tank capacity: 3 x 12, 500m³
Accommodation: 14 crew

"Liquefied hydrogen is a very light cargo in comparison to other types of energy cargo, such as fuel oil or LNG"

Prioritising safety

The cargo containment system consists of double-walled tanks and the vacuum space between the walls is designed to lower the heat ingress as much as possible to limit the amount of boil-off gas to a minimum. As with any design, the priority is with the safety of the crew. Potential threats and hazards related to the cargo systems were assessed for all modes of operation (filling, emptying, sailing) together with all potential causes of loss or containment of cargo. For each of the scenarios, the risks and consequences are analysed to be able to design the safety features.

"Hydrogen will be essential to the future of energy. It is up to us how quickly we can make that happen," said Wells. "This tanker design is a key step in providing the infrastructure to make that clean energy future a reality. Current vessels in operation are not able to deliver hydrogen at the scale we expect will be required to meet the needs of the market," he concluded. ■

Rajesh Madusudanan BE MSc FIMarE(I) MIMarEST MRINA is a marine surveyor and consultant, based in India.

Q Can marine renewable energy development reach commercial viability in a sustainable time frame?

Rachel Hoyland
senior associate, Hill Dickinson

"There are difficulties, but there is every reason to think it can. Availability of renewable energy at commercial scale is an issue for all industries. Availability of renewable electricity, needed for many applications (including to make green hydrogen and ammonia, and provide shore power), is particularly limited. A difficulty for marine is that it is just one customer in the global queue. However, marine can support its own cause by developing ambitious policy and regulation, driving the transition to and uptake of renewable energy, and so creating a clear demand signal to which the providers of production and supply infrastructure can in turn respond."

Dimitrios Fafalios
chairman, INTERCARGO

"Certainly, the shipping community, and in particular our own dry bulk sector, is fully committed to making it happen. However, the responsibility for developing such solutions is within the direct control of other stakeholders and not shipowners. It will require a drastic and urgently needed acceleration in the commercial development of the required technologies, fuels, propulsion systems and related infrastructure. This must be paid for, and we were sorry to see that the industry's proposals to create an R&D fund for new and alternative technologies was rejected by the IMO's Marine Environment Protection Committee meeting earlier in June. INTERCARGO will support the drive to finding new ways to develop such a solution."

Dr Winston D'Souza
lead technology qualification and marine energy specialist, Lloyd's Register

"Energy harnessed from the oceans, through marine energy renewables, is critical to sustainable development of a 'blue economy'. Commercial viability is a factor of economics, policies and legal frameworks that must support feasibility and efficiency, and address negative externalities dynamically. Feasibility relies upon resource availability and the cost-benefit ratio. Efficiency is based on the marginal net benefits that must include the discounted value. Negative externalities of non-renewable energy sources also contribute towards the case for marine energy. The positive externalities, such as socio-economic opportunities to countries with coastal areas along with the plethora of technologies now available, enhances the case for commercial viability for marine energy."

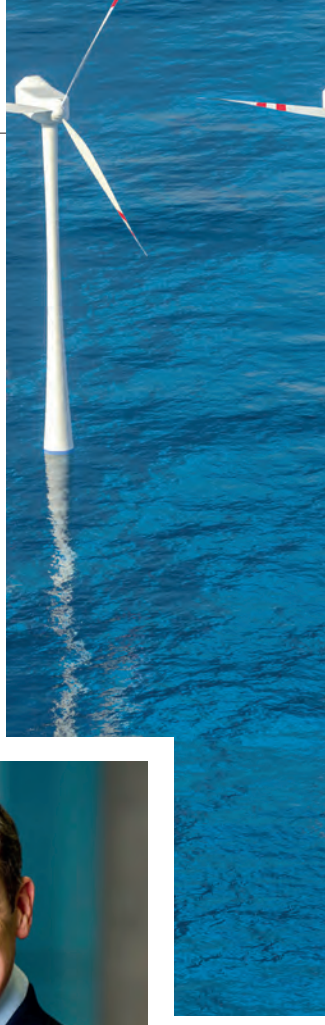
"The responsibility for developing such solutions is within the direct control of other stakeholders and not shipowners. It will require a drastic and urgently needed acceleration in the commercial development of the required technologies, fuels, propulsion systems and related infrastructure."
Dimitrios Fafalios, chairman, INTERCARGO

NEXT ISSUE'S QUESTION

"Should global defence lead the way for sustainable nuclear power in the civilian maritime sector?"

If you would like to contribute, please email marineprofessional@thinkpublishing.co.uk

Blurred lines of tomorrow's energy mix



Why business is pushing ahead of regulation on decarbonisation to overcome the challenges of a renewables-only mindset

BY CHARLIE BARTLETT

A strange new dynamic is emerging in the marine sector regarding decarbonisation.

As with the airline segment, shipping is not bound by the provisions of the COP 21 Paris climate accord. This does not, however, leave the maritime industry content to continue with business as usual. The IMO, made up of Member States, has targeted a 50% decrease in CO_2 emissions over 2008 levels.

But many in the industry hold that this is simply not enough. Indeed, CO_2 'equivalent' (CO_2e) emissions in 2008 stood at 794 million tonnes; to put this into perspective, in 2008, the entire UK emitted 628.3 million tonnes in CO_2e from its manufacturing, transport, offices and homes. In 2019, it emitted 454.8 million tonnes.

To hear the International Chamber of Shipping (ICS) tell it, the IMO is failing to lead the charge on decarbonisation. It has upended the traditional dynamic, Guy Platten, ICS secretary general, told *Marine Professional*. "We want to see net zero by 2050, we have a lot more ambition that way," he said. "You can't build all your ships at once, so we are going to have to start that process now. A big shipowner asked me today: 'If you get to a situation where the industry is ahead of its regulator, how does that happen?'

"Usually, you have a situation where the industry is trying to stop the regulator declaring all sorts of things, but here we are with shipowners saying: 'I'm for more regulation' – I can't imagine many business leaders doing that."

However, Platten did touch on one notion of why decarbonisation is in shipping's clear self-interest. "Shipping is going to be part of the solution, because a lot of these clean fuels are going to be manufactured in developing nations, and somehow we are going to have to get those fuels from where they are manufactured to where they are going to be needed.

"We want governments to understand that it is not only about shipping per se; rather, shipping will be an enabler, to make decarbonisation happen for everyone."

Silver lining

As economies decarbonise, there will indeed be an enormous new market for shipping. Evidence

Guy Platten, ICS secretary general

suggests that the economics behind pure hydrogen (H2) carriers do not stack up, as it requires a monumental amount of space; cooling hydrogen gas to the point where it forms a liquid requires temperatures below -252.8°C, calling for a continuous input of electrical power. Not very much hydrogen can be carried on even the largest tankers. This has not stopped ship designers from trying, however, with outlandish and futuristic designs from Kawasaki and C-Job.

The most likely vector for transporting hydrogen in bulk will take the form of e-fuels: e-ammonia or e-methanol, which can contain far more hydrogen in one place than the alternative, and allow for storage in more sensible volumes. The world's largest container line certainly seems to think so: Maersk this year placed orders for 12 16,000 TEU green-methanol-powered container ships, as well as six major agreements with suppliers to source some 1.2 million tonnes of bio- and/or

An offshore hydrogen production facility

ICS, AUDIO UND WERBUNG VIA SHUTTERSTOCK

e-methanol every year for bunkering its vessels. Maersk CEO of fleet and strategic brands Henriette Hallberg Thygesen described green methanol as "the only market-ready and scalable available solution".

The consensus appears to be that specialised tankers will soon be needed to transport huge volumes of hydrogen, in whatever form, to advanced economies from the global south, which crops up more and more in discussions of decarbonisation. Here, there is massive opportunity to generate renewable energy, and transport it to consumers in the global north. This is because the former economies use less energy overall, but a wealth of renewable energy resource lies in this direction. The Patagonia region, shared by Chile and Argentina, sees wind speeds higher than anywhere else in the world, buffeted by breezes averaging 12 metres per second.

Hydrogen production

In a presentation in 2020 by Dr Daniel Chatterjee, Green & High-Tech Programme of Rolls-Royce Power Systems, it was calculated that it would be much cheaper to generate both land-based and offshore wind energy in South America, transport it to Europe on vast hydrogen carriers and burn it for energy in Europe than it would be for Europe to generate it domestically.

Given that the UK's North Sea territory contains three times as much wind energy resource as is needed by the nation's power grid, this is a staggering finding. But the assumption is partially based on the like-for-like replacement of today's transport infrastructure with electric vehicles, explained Dr Stefan Ulreich, professor of energy economics at Biberach University in Germany. "There will not be much energy left for hydrogen production [in Europe], in my opinion," he said. "We have rather interesting plans to use electricity for heating, for public and private transport… we will still have to replace coal and gas, the lion's share of energy production in Europe, which is already a challenging task."

"We want to see net zero by 2050, we have a lot more ambition that way. You can't build all your ships at once, so we are going to have to start that process now"

Dr Ulreich's research indicates that by 2050, the spread of renewable energy will be between €156.40/MWh in the northern hemisphere, and €72.60/MWh from developing countries.

He calculates that shipping's decarbonisation alone will require 3,000 terawatt hours (TWh) of renewable energy by 2050, to succeed. For the wider world to decarbonise by 2050, an 18-fold increase of renewable energy production would be necessary.

Shifting sources

It is impossible to ignore that the phrase 'economic opportunities in the global south' comes laden with political baggage, and whether the world is on the eve of a new period of green colonialism is a necessary question. "I would be very optimistic with regard to China, Australia and the Arabian Peninsula, that they will be able to build up the hydrogen production facilities, and also the export/import business, because that is what they know," Dr Ulreich said.

"In most countries in South America, they have stable governments and functioning administrations. In countries like Chile, Argentina or Brazil, it should be possible. In Chile particularly, the population is very open to renewable energy projects, and they have strong ideas about protecting the environment – in this country it would be very easy to do something.

"But it is not only a matter of having the resources to create hydrogen – solar, wind and water – but also to have a stable political and legal framework, and to be blunt… this is missing in many countries of the global south."

A fleet of Maersk methanol-fuelled containerships

To properly understand the emerging paradigm, a line must be drawn between 'green' and 'blue' hydrogen – a distinction that industry commentators and, in some cases even governments, are unprepared to make. This is because a sector of the hydrogen economy will be reliant on using conventional fossil fuels in conjunction with carbon capture; something Saudi Arabia, Australia and Norway are all gearing up for. But not everybody is on board. At the Green Hydrogen Global Assembly in Barcelona in May, Australian iron-ore magnate Andrew Forrest was quoted in ReCharge News as calling the fossil fuel industry "liars" in relation to blue hydrogen, which he branded "a great fudge".

"We will march against the hideous propaganda which the fossil-fuel sector is still putting out, and we will instead invest our taxpayers', our public's, our own investment into saving the planet and a better future and a better standard of living than this train crash we will be on otherwise," he was quoted as saying.

The threat, if blue hydrogen is implemented in bad faith, is that it will provide an excuse for ever-greater exploration and utilisation of fossil fuel resources, on the vague promise of an unproven technology: carbon capture. As long as fossil fuel companies pledge to implement carbon capture at some point in the future, the thinking goes, they will have carte blanche to continue with business as usual.


Dr Stefan Ulreich, professor of energy economics, Biberach University

Patience wearing thin

Indeed, there is evidence to suggest that fossil fuel companies are still not acting in good faith. Together, oil and gas interests spent at least $119m on lobbying the US congress in 2021; that Koch Industries came top will surprise no one, but Shell, BP and Equinor – major proponents of carbon capture – were also represented among the top contributors, according to data from watchdog OpenSecrets.org.

Dr Ulreich's research found that blue hydrogen will most likely have an essential role to play in decarbonising shipping, as not even exorbitant scaling of renewables will be enough on its own. "Saudi Arabia will no longer be selling just oil and gas; it wants to do some more sophisticated products. It has the money, it has port infrastructure, it has knowledge of international trading, and it is able to build up. So for them, it's a natural way [forward]."

Dr Ulreich would prefer for the public to be less scornful about how decarbonisation is achieved, so long as it is. "The thing with these… carbon mitigation measures is that you need social acceptance for it… public acceptance of these CO_2 removal technologies is given, provided that the public sees that the industry has made some effort to reduce CO_2 before, and is not using these technologies as an easy way out. If you look at some of the green political parties, they do not seem very interested in solutions."

Indeed, in the wake of the war on Ukraine and the economic sanctions placed on Russia, the German government is said to be reassessing its decision to phase out nuclear power, which provided almost 30% of grid energy until former chancellor Angela Merkel pledged to put a stop to it after the 2011 Fukushima disaster. Germany's three remaining nuclear reactors, which provide around 10% of its energy, are set to close by the end of this year.

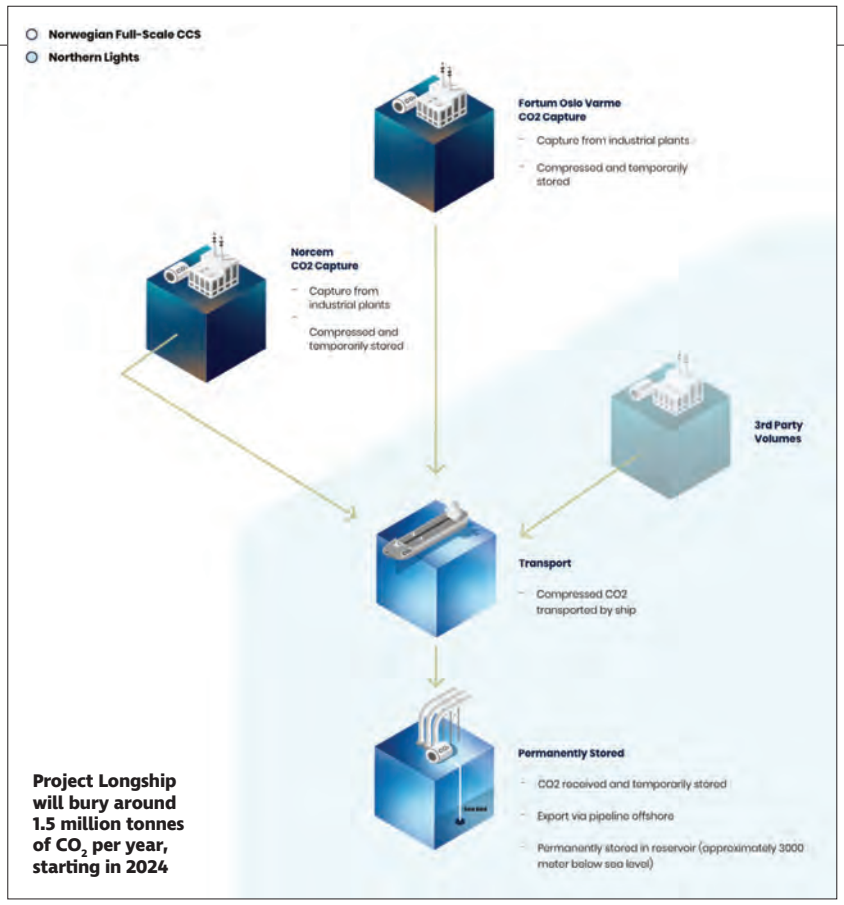
Getting it done

Carbon capture will afford its own growth market for maritime, since ships will be needed to transport CO_2 as well. Off Norway, 'Project Longship' is scheduled to begin operation in 2024, when it will begin burying around 1.5 million tonnes of CO_2 per year – a drop in the ocean, but a necessary first step. Northern Lights, the project's transport and storage component, is being handled by a joint venture of Equinor, Shell and TotalEnergies.

The project will require CO_2 to be transported in specialised tankers to

MAERSK, NORTHERN LIGHTS

To properly understand the emerging paradigm, a line must be drawn between 'green' and 'blue' hydrogen – a distinction that industry commentators and, in some cases even governments, are unprepared to make



Project Longship will bury around 1.5 million tonnes of CO_2 per year, starting in 2024

the burial site. Two 7,500m^3 liquid CO_2 carriers have been ordered from China's Dalian Shipbuilding Industry Company for the purpose. In June, ABB was contracted by Aker Solutions to handle the electrical, automation and safety systems.

Per Erik Holsten, head of ABB Energy Industries in Northern Europe, said: "The ability to capture and store industrial CO_2 emissions, which cannot currently be prevented, is critical if the world is to reach net zero by 2050, with a global capacity of 1.7 billion tons of CO_2 capture required by 2030."

"In the end, we cannot avoid these technologies, because the problem is just too big to solve with renewables alone, unfortunately," Dr Ulreich concluded: "So we will need these technologies, but first we will have to prove we did the other things, we did something, and it was not sufficient." ■

Critical role of lubrication in alternative fuel future

The energy transition is prompting an evolution in lube manufacturing

BY MARCUS SCHAERER

The development of alternative fuels is critical in facilitating the industry's energy transition. However, it will undoubtedly impact the lubrication needs of shipowners.

Future fuels will not alter lubricants' core role, but will increase complexity. How do you develop the right products when you do not yet know the required specifications?

A significant step forward today is that shipping must work together to review its lubrication strategies. This will ensure that it can meet ambitious targets while maintaining profitability.

The secret to adapting to a mosaic of future fuels will be collaboration. To develop effective new products, we need to understand how shipowners and operators are adapting to the challenges they face and how we can develop solutions to boost engine performance and lower costs.

Likewise, only by working closely with original equipment manufacturers (OEMs) can we formulate fluids that thrive in the most demanding of engine conditions. For example, the Shell Alexia 40 XC cylinder oil has received a full No Objection Letter from MAN ES for engines operating with VLSFO and LNG.

Clearly, collaboration throughout the value chain – including customers, OEMs and lubrication manufacturers such as Shell – will be vital for securing shipping's decarbonised future.

Within this discussion, we cannot afford to overlook another key stakeholder group – the crews

To develop effective new products, we need to understand how shipowners and operators are adapting to the challenges they face

that operate each vessel. The optimisation of marine operations is essential and an important way to drive this is to bring crews on board by making their roles easier by removing burdensome challenges with technology.

For instance, effective lubrication product and monitoring can have a marked impact on maintenance. Not only can it reduce downtime, but it can also ease the burden on crews to keep their vessels running smoothly as they get from A to B as efficiently as possible.

Navigating complexity with intelligent monitoring

It is not just the lubricants themselves that offer a technological advantage. With 45% of machine failures on a vessel attributed to poor oil condition monitoring, some automated tools are becoming a critical part of the modern operator's toolkit.

The right engine-monitoring programme can enable proactive, detailed decision-making with real-time updates on oil and component health – offering the ability to establish baselines to help operators to drive efficiency, save time and reduce costs.

For lubricant manufacturers, our job does not really change so much as it evolves. Lubrication still performs the same primary role, but the formulations need to provide superior cleanliness and performance.

This means working with OEMs and shipowners to develop solutions that can unlock efficiencies in the latest engine technologies, while also standing up to the harshest operating demands.

Shipping must treat lubricants as a key element in its decarbonisation, especially as we explore the needs of future propulsion. This will enable it to prepare for its decarbonisation journey, no matter which fuels emerge as priorities from the increasingly diverse mix. ■

Marcus Schaerer is general manager technical and services at Shell Marine.

SHELL

Regulatory patchwork no fix for fouling

Industry standard on proactive hull cleaning to help tackle biofouling

BY RUNA A SKARBØ

Better biofouling management of the global shipping fleet is associated with considerable economic and environmental benefits. A new international effort, the Clean Hull Initiative (CHI), initiated by international environmental NGO Bellona Foundation, aims to develop a standard for proactive hull cleaning together with industry and public sector stakeholders to tackle the global biofouling issue.

The build-up of marine life on ships' hulls – biofouling – is an age-old problem for ship operators and the shipping industry. Fouling slows the affected ship and can increase its fuel consumption by as much as 40%, boosting already high CO_2 emissions. The added fuel costs alone amount to more than $33bn yearly at today's high fuel prices.

The accumulation of marine life on hulls also spreads invasive aquatic species in environments they're transported to, affecting biodiversity, ecosystem health and the livelihoods of coastal communities across the globe. Foreign aquatic species cause hundreds of millions of dollars in socioeconomic costs for coastal states. Scientists estimate that about 60%–70% of aquatic invasive species are spread via biofouling on ships. It's something that regulators, ship operators, port authorities and conservation bodies are increasingly concerned about.

Proactive hull cleaning

The most common way of managing biofouling on hulls is through use of coatings containing biocides. Removal of biofouling can be necessary if the antifouling system fails. Removing at an early stage, known as proactive hull cleaning, is a measure to remove fouling and prevent the formation of macrofouling. It can be performed in an environmentally sound manner without capture when in combination with a suitable coating. Proactive hull cleaning is an emerging technology, which is currently listed as a recommended practice for light microfouling in the latest revision of the IMO biofouling guidelines (currently under revision until 2023). Proactive hull cleaning has a much lower biosecurity risk than reactive hull cleaning and has a large potential for fuel and emissions savings.

The build-up of marine life on ships' hulls – biofouling – is an age-old problem for ship operators and the shipping industry

Setting a standard

There is currently no international regulation or standard for hull cleaning of biofouling. With the increasing awareness on biosecurity worldwide, port authorities are introducing their own preventative measures, including legislation that arriving ships must comply with.

To reduce the regulatory barriers and increase the uptake of emerging proactive hull-cleaning technology as a preventative tool, the CHI was launched by the Bellona Foundation earlier this year. The collaborative project brings together a growing number of stakeholders in both the private and public sectors, and aims to develop an industry-wide recognised and accepted standard for proactive hull cleaning. The standard is an important means to establish proactive cleaning as part of the biofouling management toolbox, and will also level the playing field between cleaning providers and drive innovation. It will also ensure higher-quality cleaning services to ship operators and drive the market for commercial proactive hull-cleaning solutions.

BELLONA FOUNDATION

The initiative currently has 28 stakeholders involved, with an additional seven contributing to the working group to develop the proposal for an ISO standard. Members and contributors represent global shipowners, operators, regulators, port authorities, environmental and water quality regulators, cleaning technology developers and service providers, test facilities and the scientific/research community. The initiative is currently looking for input from more stakeholders in the port sector and shipowner/operator industries. ■

Runa A Skarbø is senior advisor maritime to the Bellona Foundation, based in Norway. To learn more or to contribute, contact Runa on runa@bellona.no

Digital collaborations a necessity, not a luxury

With data-driven performance accelerating at pace across the industry, companies and organisations are uniting to improve digital quality, effectiveness and standardisation

BY DENNIS O'NEILL

While digitalisation has enormous potential to radically enhance the operational efficiency, safety and environmental performance of a multitude of maritime assets, cross-industry digital development continues to take place in a fragmented, often siloed, fashion with little coordination yet achieved on data-infrastructure reliability, data quality or standardisation.

Ships may be becoming 'smarter' – packed as they are with an increasing array of sophisticated sensors – but central on-board servers are still gathering data from components and systems that tend to feature different types of data infrastructure.

And the absence of properly effective standardisation means digital data cannot yet be combined in any meaningful way across the industry, leading to lost opportunities to learn and optimise, and a growing lack of trust in basic protocols for data transfer and security. Fortunately, though, moves are now beginning to take place to tackle these pressing issues.

"The data landscape in our industry has changed, which means reporting needs to change as well"

Improving noon reports

A new industry working group, Impact Today, has, for instance, been set up to encourage the industry to move to a new proposed data standard for noon reports (information prepared daily by a chief engineer to record a ship's position, condition and performance).

A global network coverage map showing oil tanker connections

Marine chief officer checking digital information

AUUSANAKUL/KARDASOV FILMS VIA SHUTTERSTOCK

Made up of 14 shipowners and operators, data specialists, emissions experts and optimisation organisations – including ZeroNorth, EuroNav, FedNav, Q88, Ultrabulk, Teekay Tankers and Siglar Carbon – Impact Today has, it says, identified several types of data that should be gathered daily from vessels in order to improve ship data quality. This could then be shared via a clear data standard to generate efficiencies across the entire supply chain while reducing the need for crews to deliver multiple reports to different stakeholders.

"Shipping currently faces a data challenge and noon reports lack the standardisation and sophistication needed to generate optimisation recommendations," argues Søren Meyer, CEO of ZeroNorth. "The data landscape in our industry has changed, which means reporting needs to change as well. Data quality is a critical factor in underpinning voyage and emissions optimisations for vessels in the global fleet. To ensure reliable, useful output from digital platforms, it is critical that the data we collectively input is high quality, standardised and interoperable. A shared common data standard would also be an important statement of intent in the maturity and development of shipping's data landscape – particularly as it relates to multilateral collaboration and partnerships to achieve decarbonisation goals."

Classification challenges

Classification societies, meanwhile, are also doing their best to navigate their way through the consequences and implications of shipping's rapidly evolving digital environment.

Bureau Veritas has begun working with Laskaridis Shipping and smart tool specialist METIS Cyberspace Technology to develop and apply a new notation covering the use of augmented data in ship operations – including ship-to-shore connectivity, remote decision support and remote operations – in order to provide consistent and uniform standards for 'smart' techniques used to monitor and improve fleet performance.

"Collaboration is essential in progressing new technologies and supporting the industry's digital transition"

"Digitalisation is transforming the maritime industry and bringing new challenges and opportunities with it," explains Paillette Palaiologou of Bureau Veritas Marine & Offshore.

"Collaboration is essential in progressing new technologies and supporting the industry's digital transition. These new notations will help advance shipping's journey towards more digitalised and autonomous ships."

DNV is also now moving on the digital front, having recently approved digital infrastructure projects being developed by COSCO, Kongsberg Digital and Samsung Heavy Industries, which, it believes, will improve data verification and strengthen vessel and system designs.

The classification society's new data-collection infrastructure and vessel connectivity (D-INF) class notation, it says, sets out the requirements for complete data collection – including on-board data servers, data-relay components and remote data servers.

"Data standards and infrastructure technology are developing rapidly," explains Kim Evanger, vice president maritime partnerships at Kongsberg Digital. "And it's a trend that's likely to

accelerate even more over the next decade. Greater standardisation of maritime data infrastructure will provide the industry with a platform to cooperate across systems, vessels and logistic chains, while an increase in the availability of high-quality and trustworthy data will help enhance the industry's drive towards improved maintenance, fuel consumption, safety and more efficient end-to-end logistic chains."

"Collecting data in a common infrastructure is a major step forward – especially in the case of large fleets," adds Jarle Coll Blomhoff, head of cyber safety & security at DNV.

"It means the infrastructure only has to be verified once for many different uses and will allow data from multiple sources to be shared with stakeholders and systems across all operations. It will also become a powerful enabler of data analytics for enhanced vessel and fleet management and performance."

Virtual modelling

In the emerging field of artificial intelligence (AI), maritime technology specialist DeepSea Technologies recently published research which, it claims, sets out a new way of verifying the accuracy and effectiveness of

Søren Meyer, CEO of ZeroNorth

a ship's AI-generated virtual model in real-world conditions. Until now, according to DeepSea, there has been no benchmark for evaluating AI competence within a vessel model – a crucial missing step, it says, because the more accurate the virtual model, the more efficient a ship can be made, and vice versa.

The few models that currently provide an estimation of their accuracy all do so based on testing with data obtained from the same distribution (i.e., representative of similar conditions and containing similar biases) as the data used to train the model.

"This new research is an important step in helping the shipping community understand the true power of an AI-based approach"

So, if the model is trained on data from the vessel's historical behaviour, in a narrow range of well-experienced wind speeds or drafts, it is also tested on data with those speeds and drafts. Therefore, the tests performed cannot tell if the model is reproducing the biases in the training data or if it will work as well in different, never-seen-before conditions.

Measuring maritime data

"This new research is an important step in helping the shipping community understand the true power of an AI-based approach while alleviating its limitations," explains Dr Antonis Nikitakis, DeepSea's AI research director, who headed up the research team. "Coupled with the daily real-world impact we're seeing on fuel consumption and efficiency, we believe this information will be key in popularising this incredible technology throughout the industry."

DeepSea has released details of its new approach in the hope that researchers around the world will use it to spark greater transparency and common standards across the industry.

However, data-focused research and monitoring in the maritime realm is no longer limited to engineering assets. Following a series of disastrous collisions and major mishaps in recent years, the US Navy has now set up a specialist group to measure and analyse seafarer data. Data is now taken from wearable devices that monitor, among other metrics, how much sleep a seafarer has had and whether they're fit to stand watch or take part in training or tasks.

"Data-informed prioritisation has shown us that, while sailors are given time to sleep, they aren't always well rested. The retrieved data therefore allows us to rework or postpone their schedules and work," explains Bud Couch, the US Navy's director of operational safety. ■

An engineer checking the loading of containers on a cargo freight ship

TOTOJANG1977 VIA SHUTTERSTOCK, ZERONORTH

Unexpected safety risks of digital bridges

Effective training is urgently needed to reduce knowledge gaps of ECDIS use and functionality

BY CHRISTIAN DWYER & DONAL KEANEY

The digitalisation of ships' bridges, while providing essential operational efficiencies and benefits, is creating safety risks for vessels, crew and cargo.

While everyone recognises the benefits that ECDIS brings, there have been incidents caused through the misuse or misunderstanding of the technology. This is a serious industry concern, one that urgently needs rectifying, not just for ECDIS, but for the broader digital transformation that is already occurring on-board ships – so-called Maritime 4.0, where the industry exploits opportunities in digitalisation and automation.

Effective and safe use

The long-term efficiency, safety and sustainability of shipping is reliant on the realisation of Maritime 4.0 and the delivery of digital and data transformation. However, to date, progress has been modestly incremental with the increasing use of solutions such as ECDIS, ballast control systems, voyage-optimisation technologies and engine data logs.

The current fragmented nature of technology often seen on-board vessels is a threat to its effectiveness, and the lack of a standardised, systematic and fully informed approach to the use of some of these technologies is, at times, potentially introducing greater risk than it is reducing. This view is supported by research released in 2019 by the Seafarers International Research Centre at Cardiff University. The study revealed that in accidents involving collisions, the ineffective and inappropriate use of technology were the leading contributory cause in nearly a third (31%) of cases.

ECDIS display in operation

Preventing human error is therefore a critical part of ensuring that systems, like ECDIS, are used effectively and safely. This is true for navigation and also relevant to passage planning. ECDIS is increasingly being used by bridge teams to prepare and check passage plans, and a lack of adequate training or understanding of the relevant ECDIS system could have very serious consequences if plans are defective.

Applying ECDIS

There is still a significant gap between the minimum standards for training and the capabilities of modern ECDIS. A thorough understanding of ECDIS and its route-planning functions is vital to ensure passage plans are safe. As a system can only be as effective as its users, this demonstrates that enhanced training is required, and that it should go beyond ticking off a software provider's manual checklist. It should build better understanding of the broader implications of applying these technologies as part of the wider operational ecosystem.

Ultimately, the human element of shipping's digitalisation isn't yet keeping up with the speed of technology, which creates liability. Training gaps for Maritime 4.0 and increasingly autonomous ship operation are already starting to gain attention. The industry needs to urgently rally to collaborate more closely and create a platform for standardising approaches to tech applications to mitigate these risks and realise the full potential of digital bridges. ■


Christian Dwyer is global head of Admiralty and Donal Keaney is senior marine manager at international legal and professional services firm Ince, incegd.com

ANATOLY MENZHILIY VIA SHUTTERSTOCK

IN THE HIGH COURT OF JUSTICE **CR-2022-001261**
BUSINESS AND PROPERTY COURTS OF ENGLAND AND WALES
COMPANIES COURT (ChD)

IN THE MATTER OF AGF INSURANCE LIMITED

- and -

IN THE MATTER OF CATALINA LONDON LIMITED

- and -

IN THE MATTER OF CATALINA WORTHING INSURANCE LIMITED

- and -

IN THE MATTER OF PART VII OF THE FINANCIAL SERVICES AND MARKETS ACT 2000

Notice is hereby given that on 13 July 2022 an Application was made under section 107 of the Financial Services and Markets Act 2000 (the **Act**) in the High Court of Justice, Business and Property Courts of England and Wales, Companies Court (ChD) in London by AGF Insurance Limited (**AGF**) and Catalina London Limited (**CLL**) (together the **Transferors**) and Catalina Worthing Insurance Limited (**CWIL**), for orders:

(1) under section 111 of the Act sanctioning a scheme (the **Scheme**) providing for the transfer to CWIL of the entire general insurance and reinsurance business written and/or assumed by each Transferor; and

(2) making ancillary provisions in connection with the Scheme pursuant to sections 112 and 112A of the Act.

Each of AGF, CLL and CWIL are UK-authorised insurers in run-off. AGF was formerly known as the Employers' Mutual Insurance Association Limited, N.E.M. Insurance Company Limited and NEM Insurance Company Limited and acquired the business of the National Employers Mutual in 1989. CLL was formerly known as American Re-Insurance Company (UK) Limited, Aetna Re-Insurance Company (UK) Limited, The Imperial Fire & Marine Re-Insurance Company Limited and Alea London Limited. CLL also acquired the business of KX Reinsurance Company Limited and OX Reinsurance Company Limited. CWIL was formerly known as Hartford Financial Products International Limited and in 2015 acquired the business of Excess Insurance Company Limited, a portfolio originally written by London & Edinburgh Insurance Company from Aviva Insurance UK Limited and the business written by the London branch of Hartford Fire Insurance Company.

A copy of the report on the terms of the Scheme prepared in accordance with section 109 of the Act by an Independent Expert (the **Scheme Report**), a statement setting out the terms of the Scheme and a summary of the Scheme Report, and the Scheme document may be obtained free of charge by contacting the Transferors and CWIL using the telephone number or addresses set out below. These documents and other related documents, including sample copies of the communications to policyholders, are also available at www.catalinaworthing.co.uk/PartVII.html. This website will be updated for any key changes to the proposed transfer.

Any questions or concerns relating to the proposed Scheme should be referred to the Transferors and CWIL by email to PartVIITransfer@catalinare.com, by telephone at +44 1903 836804, or in writing at Part VII Enquiries, Catalina Services UK Limited, 1st Floor, 1 Alie Street, London E1 8DE, United Kingdom. When calling the helpline number, please leave a short message stating the nature of your query and your contact details and we will endeavour to return your call within 48 hours (excluding Saturdays, Sundays and public holidays).

If you are in any doubt as to whether your insurance policy is included in the proposed transfer please contact the parties at the contact details set out above.

The Application is due to be heard at the **High Court of Justice of England and Wales, 7 Rolls Buildings, Fetter Lane, London, EC4A 1NL, United Kingdom** on **18 November 2022**. Any person who thinks that he or she would be adversely affected by the carrying out of the Scheme, or objects to the Scheme, may attend the hearing and express their views, either in person or by a representative. It is requested that anyone intending to do so informs the Transferors and CWIL (using the contact details set out above) as soon as possible and preferably before **11 November 2022** to set out the nature of their objection. This will enable the Transferors and CWIL to provide notification of any changes to the hearing and, where possible, to address any concerns raised in advance of the hearing.

Any person who objects to, or considers they may be adversely affected by, the Scheme but does not intend to attend the hearing may make representations about the Scheme by giving written notice of such representations to the Transferors and CWIL at the address provided above or by calling the telephone number provided above, in each case as soon as possible and preferably before **11 November 2022**.

The Transferors and CWIL will inform the UK's Financial Conduct Authority and Prudential Regulation Authority of any objections raised in advance of the hearing, regardless of whether the person making the objection intends to attend the hearing.

If the Scheme is sanctioned by the Court, it will result in the transfer of all the contracts, property, assets and liabilities of the Transferors to CWIL save where otherwise specified in the Scheme, notwithstanding that a person would otherwise be entitled to terminate, modify, acquire or claim an interest or right or to treat an interest or right as terminated or modified as a result of the transfer of business effected by the Scheme. Any such right will only be enforceable to the extent the order of the Court makes provision to that effect. Subject to the sanction of the Court, the Scheme is currently anticipated to be effective at **23:59 GMT** on **30 November 2022**.

5 August 2022

Norton Rose Fulbright LLP, 3 More London Riverside, London, SE1 2AQ, United Kingdom

Solicitors acting for AGF Insurance Limited, Catalina London Limited and Catalina Worthing Insurance Limited

Ref: RAXH/1001168254

POPTIKA VIA SHUTTERSTOCK

Making the case for AI

The tide is turning on understanding and uptake of artificial intelligence for marine applications

BY MATT KENNEY

Artificial intelligence (AI) may be in danger of becoming an overused and often misappropriated buzzword. However, for an industry like merchant shipping that is famous for its inaccessible vocabulary, accepting new terms can be quite unsettling. Perhaps this is because AI is someone else's jargon – that of computer science. Despite its steady rise to infamy, AI is still in the nascent phases of widespread commercial adoption in shipping.

This could be surprising considering its seemingly limitless sophistication and broad range of potential maritime applications, but AI has had its work cut out convincing the shipping industry of its virtues. At nearly every level, the global ocean freight economy requires human beings that can apply instinct, common sense and even moral reasoning, all of which fall outside of the AI playbook. The benefits of AI and machine learning have been difficult to decipher and even harder to justify to cautious and often cash-strapped operators.

But the tide is turning. Pilot programmes are returning impressive results. AI-driven tools are being used successfully by early adopters and the presence of AI at sea is beginning to precipitate changes to global regulation.

AI adoption and investment

Data from the Thetius intelligence platform shows open investment in maritime AI looks set to approach the $3bn mark within five years – and that doesn't include what organisations might be investing behind closed doors. Shipowners and innovators are seeing opportunities for AI across the board, from bridge decision support, virtual commissioning and remote diagnostics to digital health management, autonomous navigation and voyage optimisation. AI will become an omnipresent-enabling technology within a few short years, whether the industry is ready to adopt the term or not.

Vessels that are equipped with AI won't look any different to those that aren't, but they will be more efficient and potentially more profitable for their owners.

AI will become an omnipresent-enabling technology within a few short years, whether the industry is ready to adopt the term or not

The safe manning certificate will likely look the same, but the bridge team will navigate with support from powerful and sophisticated decision support systems, giving them a clearer situational awareness. Technical departments may experience more automation as AI-driven engine management systems control input from assistive wind propulsion or similar energy-saving devices.

AI-equipped ships will be running more on time, using less energy in more efficient ways. Their owners are likely to enjoy steady competitive gains by asking AI to do a lot of the thinking for them.

Contrary to belief, AI does not hail a dystopian age of unmanned drone ships. It will complement the skills and talents of a happier and more contented seafaring workforce, liberating them from the repetitive tasks that computing is better able to handle. What is beyond doubt is that investment in AI looks set to soar. ■

Matt Kenney CMarTech MIMarEST is head of research and intelligence at Thetius, thetius.com

The marine view from above

How Earth observation technologies can help solve marine environment issues

BY CLÉMENCE LE CORFF

Using a variety of continuous monitoring sources, Earth observation (EO) data can be expansive, but sometimes difficult to manage and exploit. Today, EO represents an important source of information in an unsteady and unpredictable world. Growth in the marine environment is currently facing significant challenges that need to be understood and overcome to prevent the destruction and disappearance of an ecosystem vital to human life and the planet.

There are several sectors at the intersection of EO and the marine and coastal environment. These include marine resources, design, installation, management and maintenance of marine renewable energy installations, fisheries management, deployment, operation and maintenance of aquaculture, adaptation of coastal zones to climate change and maritime transport.

EO technologies are one of the most available, feasible and cost-efficient technologies to explore, monitor, control and study the exploitation of the oceans and their resources. In addition, EO technologies are suited to environments such as oceans, since they have wide coverage, the installation of in situ infrastructure is not easy and solutions can be replicated.

EO data today mainly comes from satellites. However, other technologies are able to provide secure and reliable data such as stratospheric balloons or aerial drones.

Stratospheric balloons can be used as an alternative to satellite

ANDREY ARMYAGOV; SFIO CRACHO VIA SHUTTERSTOCK

EO data today mainly comes from satellites. However, other technologies are able to provide secure and reliable data

environmental monitoring and algae bloom development.

Drones represent an alternative as well, as they can efficiently fly over several tens of kilometres. These can control large areas by day and night, collect data over long distances, provide a comprehensive and accurate picture of a crisis situation (such as accidental maritime pollution or coastal floods) and are a fast, accurate and productive method for monitoring coastal conditions in the face of marine erosion.

Introducing Space2Waves

Technologies in the EO sector are quite mature and have great potential to overcome the identified challenges. The issue is now to match the right technology with the needs, which the Space2Waves project aims to do. It is EU-funded and brings together European clusters from France, the UK, Portugal, Greece and Italy, with experience in the blue economy and space sectors.

New value chains are expected to be developed in this emerging industry. The capability for the European EO industry to grow is based on its capability to export its services. But, in this relatively new sector, the companies are generally small and not able to deploy significant commercial focus abroad or obtain knowledge on needs from end users at an international level. To address this, the Space2Waves project has implemented an internationalisation programme to enhance the technology potential of EO and the European skills necessary to develop new business and alliances overseas. The Space2Waves project is coordinated by French maritime innovation cluster Pôle Mer Méditerranée.

The programme has already undertaken a number of steps; first is the selection of 30 European small- to medium-sized enterprises (SMEs) working in the use and/or development of EO data for the maritime sector.

Second, the internationalisation programme has now been implemented. This programme delivered online training packages and individual consultancy, enabling the creation of a Space2Waves community and the sharing of experiences and best practices for internationalisation. A number of international missions have been organised both digitally and physically in Australia, Canada, South Africa and the United Arab Emirates – the four target countries that have demonstrated needs in terms of use of EO data applied to the maritime sector. During these missions, SMEs have visited key partners and infrastructure organisations in the target countries and met with companies and potential partners for business opportunities.

Also, six clusters partners – Pôle Mer Méditerranée, Aerospace Valley, MSE International, Distretto Tecnologico Aerospaziale, Corallia and Fórum Oceano – have initiated a number of collaborations to develop cooperation and relationships that will, going forward, support the protection of the marine and coastal environment through the use of EO technologies. ■

Drones are an efficient tool for data collection over great distances

imagery for the observation of specific areas in oceans and seas. The advantages of such balloons are the lower costs, good resolution and a short response time. The combination of maritime and space-based technologies also allows the launch of equipment into near space with potential applications like accident response or marine traffic monitoring. It is also interesting for research on marine life migration,

Clémence Le Corff is EU project manager at Pôle Mer Méditerranée.
Space2Waves is funded by the European Union's COSME Programme under agreement number 951122.

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International support for greater diversity

The IMO's launch of a global day for women in the sector sends a clear message to the industry

BY CARLY FIELDS

In recognition of work to be done to improve gender diversity in maritime, the IMO launched an International Day for Women in Maritime this year.

Introducing the day, International Maritime Organization Secretary-General Kitack Lim celebrated the achievements of the many women who contribute to the success of the maritime journey, but acknowledged the journey that is still ahead.

A joint IMO-WISTA global survey on women in maritime published this year exposed the gender gap in shipping. The report found that women account for just 20% of the workforce in the maritime authorities of Member States and 29% of the workforce across sub-sectors in the maritime industry – although these numbers are significantly higher than those at sea, where women make up as little as 2% of the workforce.

We can – and must – do better, Lim said, recognising that women bring creative thinking that will help in the industry's transition to a more sustainable, more diverse and more inclusive and green future.

IMO hosted a symposium on the inaugural day to discuss what type of training supports a barrier-free working environment for women in maritime; how to enhance visibility for women in the workplace/environment; and recognition in the work environment of women's contributions to maritime.

The panellists highlighted the importance of compatibility between professional life and personal life; mentorship and coaching programmes to encourage women into maritime and support them once in the sector; visibility; recognition; a culture of gender diversity and gender inclusiveness; and tearing down barriers.

"Every year, we welcome more female delegates from Member States, NGOs and IGOs"

Celebrating the inaugural International Day for Women in Maritime

PHOTOS BY INTERNATIONAL MARITIME ORGANIZATION

Taking stock

The IMO sees the International Day for Women in Maritime as an annual opportunity to take stock and identify areas where improvement is needed – both on a sector-wide scale and within individual organisations.

Lim points to direct changes at the IMO itself – many of the UN body's meetings are chaired by technically skilled and capable women, including three of the five committees, something that he noted was unlikely 25 years ago. "Every year, we welcome more female delegates from Member States, NGOs and IGOs," he said.

Collaboration is a key word and, moving forward, the marine sector needs more diversity champions and allies, and more professional networks to mentor and support training and other opportunities.

The IMO may have set this date as an annual one-day celebration of women in maritime, but it is the work being done on the other 364 days that will really make progress towards a more inclusive future for maritime.

The IMarEST Women's Network supports female members on their marine industry journey and engenders a more inclusive environment within the IMarEST. It offers support for women who are significantly under-represented in their particular workplace. ■

To join the IMarEST Women's Network, visit imarest.org/special-interest-groups/join

The importance of contingencies

When the initial plan to refloat the *Ever Forward* failed, salvors switched to Plan B

Evergreen Marine Corp owns both the *Ever Given* and *Ever Forward* vessels

PHOTO BY PETTY OFFICER 3RD CLASS KIMBERLY REAVES, SMIT

BY HEMANT PHUL

When marine incidents make it to the mainstream media, the world is intrigued by the challenges that are ahead for any responder. The most recent and arguably among the most prominent cases that garnered the world's attention happened in March 2021 when the *Ever Given*, a mega container ship, ran aground and blocked the Suez Canal, one of the busiest trade routes connecting Asia and Europe, for six days. *Ever Given* is 400m long with a width of 59m, capable of carrying more than 20,000 TEU. The ship's bow and stern stuck in the sticky clay on either side of the canal, blocking off all shipping movements within the canal.

A sticky situation

Ever Given refloated on 30 March 2021, assisted by powerful tugs, ingenious weight transfer and a high tide. Before the refloating, extensive planning, coordination and engineering were undertaken, contributing to the operation's success. There was also a 'Plan B' and 'Plan C' as a contingency, should 'Plan A' not be successful. In the case of *Ever Given*, Plan B was not activated, which is not always the case, as experienced during the more recent event of the grounding of the *Ever Forward*.

Ever Forward is 334m long and 49m wide, with a maximum cargo carrying capacity of 11,850 TEUs. On 13 March 2022, *Ever Forward* was heading outbound in the Chesapeake Bay en route to Norfolk, VA, when it ran aground outside the navigation channel. There was

To free the ship, the salvage team concluded that in order to refloat the vessel safely, a minimum of 6,800 metric tons of ballast water needed to be retained

no traffic disruption to and from the port, as the ship ran aground outside the navigation channel.

Even though *Ever Forward* was not fully loaded, it still had a mean draft of 12.7m. The seabed at the grounding area consisted of a mixture of silt, mud and soft and stiff clay. The ship was aground along the vessel's length, comprising an area of around 8,500m^2. Soundings of all the tanks post-grounding confirmed there was no water ingress in its tanks or void decks. The stability and stresses on the vessel were also within the margins. The first estimation indicated that the ground reaction was about 20,000 metric tons. The ground reaction is calculated based on the draft reading pre- and post-groundings. This ground reaction relates to the weight one needs to remove or overcome for the vessel to refloat again.

Donjon-SMIT was appointed salvage responder to the incident. One of the first objectives of any project is to understand the environment (including drawing information of vessel, weather, sea and subsea) as well as the stakeholders involved. The next step is to look for resources available in the region capable of delivering in the salvage operation. The two are then combined into a risk assessment to draw up a salvage plan, which is presented to all stakeholders involved in the operation. In the case of *Ever Forward*, the stakeholders also involved the US Coast Guard and other agencies related to the event.

When a plan comes together

Reducing the ground reaction became the priority for refloating. Plan A aimed to reduce the ground reaction by dewatering and dredging around the vessel. This was the fastest way to free the vessel. *Ever Forward* had more than 11,000 metric tons of ballast water on-board. On regular voyages, this ballast water aided the ship's trim and helped stability. Now, to free the ship, the salvage team concluded that in order to refloat the vessel safely, a minimum of 6,800 metric tons of ballast water needed to be retained. The excess ballast water was pumped overboard.

The second action included dredging around the *Ever Forward*. Dredging helps to reduce ground reaction and reduce the suction when undertaking a refloating attempt. A trench surrounding the vessel was dredged to enable this reduction. The stability and design parameters of the vessel were not compromised at this stage. However, without leaving anything to chance, sensors were installed along the vessel's length to measure and monitor the stresses on the frames.

The last step was to work towards a date when tides were high and pulling power was available (by means of tugs) to make the refloat. Two initial refloating attempts were unsuccessful.

Finally free

The contingency of the initial plan was then activated. The engineering and resource planning of possible contingencies commenced as soon as we got working on the salvage plan and included additional pulling power and weight reduction from the ship. Following the calculations based on the container distribution plan, it was established that 500-plus containers needed to be offloaded (mostly from the starboard side of the vessel). With this, the salvors could also de-ballast 2,800 metric tons of additional ballast water.

This resulted from asymmetric loading of containers, causing a significant amount of ballast water to be kept on-board, on the vessel's port side. For a controlled refloating, the salvors had to first ballast tanks with water of similar or more amount to the weight of the cargo that will be offloaded. This additional ballast was to be removed once the vessel was ready for refloating, governed by the tides. The container recovery operation commenced on 9 April and was completed on 16 April.

Pulling capacity in the form of two pulling barges was deployed at site to provide additional pulling force during the refloating attempt. With a combination of dredging works, the lightering operation of the containers, pulling barges and six powerful tugs, the *Ever Forward* was successfully refloated on 17 April, 35 days after running aground.

This article is a testimony to the hard work of the salvage team from Donjon-SMIT and the excellent cooperation with all who worked relentlessly to deliver a successful closure to the challenging operation. ■

Hemant Phul is general manager – Asia-Pacific for SMIT.

New cranes, old docks

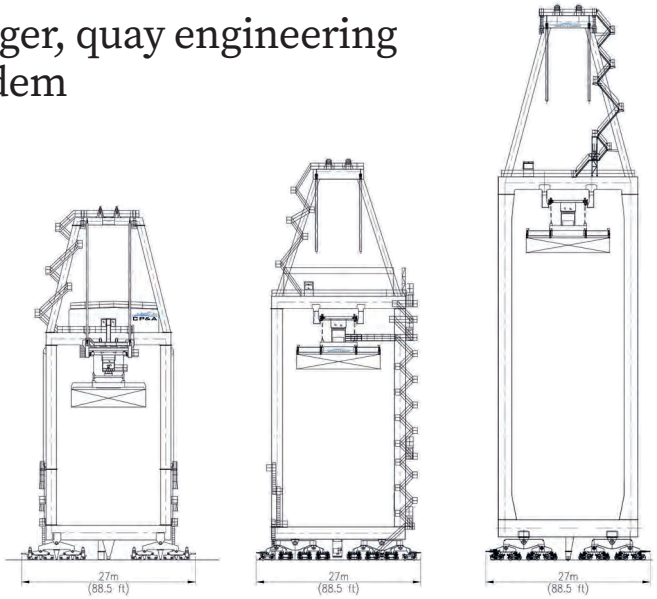
As quay equipment gets bigger, quay engineering considerations grow in tandem

BY RICHARD PHILLIPS

The progress of the container crane industry has been remarkable in many ways. One of the most astonishing progressions of the industry has been the increase in size of equipment and facilities, with no obvious limit in sight. The race for lower costs has encouraged shipping companies to procure larger, more efficient vessels. The only factors limiting ship size are water depth and any bridges between the port and open sea. Taller cranes with longer outreaches are needed to service larger vessels. However, bigger cranes weigh more and put larger loads on the dock.

Designing cranes with longer outreaches and larger lift heights while minimising wheel loads is not easily accomplished given the cantilevered nature of dockside container cranes. A cantilever is structurally inefficient because of the need to balance its own weight. Waterside wheel loads dramatically increase as outreaches and lift heights increase.

One physical dimension that has remained constant is the 12m hatch opening on container ships. Terminal productivity demands a standard industry practice to work adjacent cranes on every other hatch. This means the total crane width as measured from bumper-to-bumper along the dock must not exceed 27m regardless of crane outreach and height. This limits the effective length of the dock that can be used to support each crane. This limitation, coupled with cantilever inefficiency, longer outreaches, increased load capacity, increased lift height and higher storm winds



Crane heights have grown, but the out-to-out dimension has remained constant. Left crane is c. 1995; centre crane is c. 2000; right crane is c. 2020. The approximate 27m crane width limits the effective length of the dock that can be used to support each crane

loads, has caused dock loading to increase from about 70t per metre at the turn of the century to 130t per metre – and growing.

The importance of dock strength

Dock designers may make conservative decisions during the design and construction process that can lead to the dock having reserve strength. The published dock strength is normally considered a reliable minimum; it may be possible to find additional capacity from an existing dock design.

Original design-safety factors may be unnecessarily conservative. When selecting a safety factor, the design engineer considers the probable accuracy of the applied loads. The crane loading can be determined to a very high degree of certainty if the crane is physically measured. Often, a dock-safety factor less than originally specified can be rationally justified.

Dock designers may make conservative decisions during the design and construction process that can lead to the dock having reserve strength

The crane design engineer also has an important role. By exercising skilful attention to minimising weight during the design phase, they can minimise wheel loads. Engineering expertise is required to achieve minimum structural weight, but this extra effort can often pay for itself with reduced steel costs and lower demands on the dock. ■

Richard Phillips is a mechanical engineer with Casper, Phillips & Associates Inc (CP&A). CP&A has developed a parametric crane wheel load estimation tool for ship-to-shore cranes. This tool can study different outreaches, lift heights, rail gauges, wind speeds, lift capacities and their effects on the dock. This tool can help the crane owner specify appropriately sized cranes for their dock and operational requirements.

Mangrove forests at Phang Nga Bay in the Andaman Sea, Thailand

STEPHANE BIDOUZE VIA SHUTTERSTOCK

Planting for an ocean drawdown

Coastal blue carbon systems look more and more attractive as the price for carbon increases

BY SAMANTHA ANDREWS

Sitting in a room of the National Marine Aquarium in Plymouth, UK, Melissa Hobson carefully opens a small hessian bag and adds some sediment and tiny seedlings. She closes the bag and pops it into a tray with water. Then she restarts the process. Again, and again, and again.

Hobson is part of a team of volunteers recruited by the Ocean Conservation Trust for an ambitious project to restore one of the UK's most threatened marine ecosystems: seagrass meadows.

"Seagrasses are a bit of an underdog," says Hobson. "When we look for opportunities to help with conservation, we often look abroad. But right on our doorstep is one of the most important marine habitats, and it needs our help."

Seagrasses form vast meadows, providing a home to myriad marine animals and other plants, nurseries that support an estimated 20% of the 25 'most landed species' in the world, support small-scale fisheries and even clean polluted waters.

Researchers estimate that at least 39% of the UK's seagrasses have been lost since the 1980s – higher than the global average of around 29%. This loss doesn't just represent a loss for the UK's marine wildlife, fisheries or water quality. Seagrass can store vast amounts of carbon. With the climate crisis deepening,

these natural coastal 'blue carbon' stores are more important to us than ever.

The age of blue carbon

Coastal blue carbon refers to coastal marine ecosystems that remove and store more carbon dioxide from the atmosphere (sequester) than they emit. These systems are predominantly plant-based, with mangroves, salt marshes and seagrass meadows acting as the super-storers.

Although the term 'blue carbon' was coined in the late 2000s, scientists have been studying the carbon storage potential of marine ecosystems for much longer. One of the earliest studies dates back to 1914, when Danish botanist Peter Boysen-Jensen calculated that seagrass along Denmark's coastline was a major natural carbon store for the country.

Today, the ever-increasing need to capture and store carbon dioxide is propelling blue carbon research. Governments worldwide are slowly beginning to include coastal blue carbon ecosystems in their climate mitigation plans, while carbon offset markets are increasingly supporting organisations that manage, protect and restore them.

Marine plant-based ecosystems capture carbon in a similar way to their terrestrial counterparts. They photosynthesise, taking in sunlight, water and carbon dioxide to create the energy they need to live and reproduce. The carbon becomes incorporated into the plants' bodies – their leaves, stems, roots – and sediment around them. When the plants die or lose their leaves (or other parts of their bodies), that detritus ends up in the sediment. "There's a lot more carbon below ground than above ground," Dr Dorothy Peteet, senior research scientist at NASA/Goddard Institute for Space Studies, and adjunct professor at Columbia University, explains. If left untouched, she adds, carbon trapped in sediment can stay there for hundreds, if not thousands, of years.

The salt marshes of Brooklyn Bridge Park in New York support wildlife and protect the park from big waves

Parrotfish swimming among seagrass in Zanzibar, Tanzania

Dr Peteet is a paleoecologist who's been studying salt marshes and other wetlands around the US for more than 20 years. "I became enthralled by salt marshes because they're at the intersection of course of land and water, and they're so important for biodiversity and carbon storage," says she says. To understand the long-term storage potential of salt marshes, Dr Peteet says, you have to dig deep.

Like in other parts of the world, the salt marshes in and around New York are old. "Most of the marshes in the Hudson Estuary are about 7,000 years old," says Dr Peteet. Over millennia, salt marshes have been quietly storing carbon in their muddy sediments, with the oldest layers sitting at the bottom. To discover how carbon storage changes over time, Dr Peteet has to take core samples as far down as she can.

"It's all done by hand. I had a football player help me one year,

These systems are predominantly plant-based, with mangroves, salt marshes and seagrass meadows acting as the super-storers

MARIDAV/SHUTTERSTOCK, BEN JONES/OCEAN IMAGE BANK

and we got down to 11m; then a basketball player helped me get down to 13.7m," Dr Peteet recalls. This labour-intensive process has revealed historical declines in carbon storage rates, like during times of drought and fire in the Medieval Warm Period (c. 950–1250). Such historical information is crucial to understanding how much carbon can be stored as our climate changes.

Counting on carbon

Calculating the carbon storage of any given system is a complex task. Alongside variations over time, storage capacity can vary over space as well. One study from Dr Aurora Ricart, of Bigelow Laboratory for Ocean Sciences, demonstrated that seagrass storage capacity varies even within a single estuary. Dr Ricart attributed the variability to differences in the rates of fine sediment and detritus deposition in different parts of the estuary. More broadly, other factors such as seagrass species, the size and complexity of seagrass meadows, and pollution can influence how much carbon can be stored.

Such variation isn't unique to seagrasses. "Mangrove forests are one of the most productive forests in the world, and able to store high levels of carbon. In some areas, we see 200 tonnes per hectare being stored. In others, it's over 1,000 tonnes," Dr David Williamson of the Institut de Recherche pour le Développement explains. He says that unlocking the carbon potential of mangroves and other blue carbon ecosystems isn't just important from a scientific perspective – it's vital for their protection.

Researchers estimate that between 2000 and 2016, around 3,400km^2 of mangroves were lost across the globe, primarily due to farming and aquaculture development. Thanks to the carbon market, Dr Williamson says, that is beginning to change.

"Carbon crediting really started to take off about 15 years ago, but the price of a tonne of carbon was very low," he explains. Even when harnessing the power of volunteers like Hobson, restoration work is not cheap. What's more, compared to converting mangroves to other land uses, conservation isn't necessarily an attractive option – or even an option at all for communities living in poverty.

Today, the carbon market looks quite different. Some countries are even calling for a minimum price on carbon to encourage investment in low-carbon technologies and mitigation options, like conserving and restoring blue carbon ecosystems. "When you have $70 or more for one tonne of carbon, you start to think differently," Dr Williamson says.

The social aspect

Poverty can be a real issue for long-term conservation, which is why, Dr Williamson notes, some carbon credit schemes take a social-ecological approach. Alongside restoration and protection work, funds are also invested in the local community. "This could be renovating the school, contributing to a dispensary, improving medical care for women in labour," Dr Williamson says. Indeed, some of the most successful carbon credit-backed projects, such as Mikoko Pamoja ('mangroves together'), or government-funded projects like Lamu Mikoko ('Lamu mangroves') have worked to relieve poverty and create sustainable livelihoods while building local capacity to restore and protect vital ecosystems for the long term.

As crucial as restoring and maintaining natural carbon solutions is for climate mitigation, there is a caveat. Planting more seagrass, mangroves or salt marshes will not store all the carbon we need to avert the worst impact of the climate crisis. Our oil consumption and our greenhouse gas emissions are increasing. If we are truly serious about addressing the climate crisis, we must reverse this trend, rapidly and drastically. ■

FIND OUT MORE

To find out more about decarbonisation of the marine industry and the energy transition, join the Marine Fuels Special Interest Group through IMarEST.org

COMMENT

It's high time for a Blue Deal

SUSTAINABILITY

Ocean economies need to be at the heart of 'build back better' schemes

By Diana Barrowclough
Senior economist at the United Nations Conference on Trade and Development (UNCTAD)

The need for sustainability and resilience has long been acknowledged for the land economy, but it is needed just as much – maybe more – for the oceans. At the UN Ocean Conference in Lisbon in April, the United Nations Conference on Trade and Development floated the concept of a Blue Deal to enable conservation and sustainable use of ocean resources.

What is meant by a Blue Deal could vary in different countries, but the general idea is that any post-Covid-19 rebuilding, or 'building forward better', needs to have oceans sustainability as a priority. One reason is that the emergency measures introduced by governments around the globe had profound impacts on coastal and ocean economies.

The Blue Deal concept brings together different ways in which ocean-based goods and services can lead to a more sustainable recovery from Covid-19. One way to think about it includes what UNCTAD described as an Ocean Pillars approach, which adds to the traditional sustainable environmental, social and economic criteria, additional and oceans-particular considerations such as compliance with the law of the sea, trade, transport and fisheries agreements, as well as sound governance and scientific and technological policies.

Another contribution comes from the Sustainable Ocean Economy principles for responsible business practices – particularly in terms of oceans' health, productivity, governance and engagement, and data gathering and transparency – allowing private-sector engagement in Sustainable Development Goal 14 implementation. It further includes 'Blue' BioTrade products that have the advantage of being of natural origin, legally harvested and sourced, traceable, biodegradable, recyclable and with a lower carbon footprint. These products can be closer to markets and can directly contribute to expanding local employment and to the economic recovery, particularly in developing countries. In this regard, the pandemic can be an opportunity to 'build back better' and develop more rooted value chains on blue circular and socially inclusive performance.

Fisherman repairing fishing nets

Finding the finance

One way UNCTAD is trying to support this is in its work identifying relevant codes under the Harmonised System (international nomenclature for the classification of products) for ocean-based goods as currently being catalogued under the UNCTAD's 2020 ocean-based sector classification. This helps facilitate their potential inclusion in multilateral or regional environmental goods negotiations, so as to help create incentives for the marine sector to grow.

Technological and managerial innovations are also needed to help support marine value chains, reduce the risk of infections, and ensure continuity in the provision of goods and services in the ocean economy.

To help support all of this, finance will, of course, be essential – in particular public sources for ocean-oriented finance. Until now, the bulk of capital deployment towards a sustainable ocean economy came

A fish farming unit containing sea bass and sea bream in growing cages

Fishing boat returning to shore

GEET THEERAWAT/AERIAL-MOTION/CPG-PHOTO VIA SHUTTERSTOCK

from governmental commitments as official development assistance (ODA). As a first step, all donor countries should live up to the pledge they have committed and increase ODA to 0.7% of GDP level. A second step is to significantly increase the share devoted to the ocean economy, which at present is less than 2% of the total – far too low to conserve the resources on which a multi-trillion-dollar industry rests, let alone to conserve the planet.

It could even be time to consider a special 'blue bank', or at least a 'blue desk' within a development bank. Some development banks in ocean-driven economies incorporate certain marine activities as part of their business. However, they are not yet treated as a particular category. Similarly, some of the big new southern-led banks such as the Asian Infrastructure Initiative or the New Development Bank have an infrastructure focus and favour renewable and green investments that can impact on the oceans economy. But none have yet identified a specific blue ambition – even though their member owners are often deeply embedded in and impacted by the oceans economy.

Having focused and dedicated blue public banks could potentially help improve the interface between public and private finance, if it can direct private finance towards productive investment and not leave the public role as simply the bearer of risk. Improving regulation of the financial sector will be important – blue or green finance needs more clarity and consistency on environmental, social and governance criteria, monitoring and regulation.

Plan of action

All of these suggestions can be seen as a call for a Blue New Deal, a sister to the Green New Deal already gaining support and traction around the world. As always, the first argument will be that there is no money to pay for the investments implied, but this is not the case. Flags of convenience are estimated to suck billions of tax revenues out of the countries where shipowners are headquartered, and which could be directed to the oceans economy. Similarly, fossil fuel or harmful fish subsidies could be redirected to finance a new Blue Deal, based not only on a blue bank, but on other policy and financial instruments that encourage stock and ecosystem management, improve traceability and compliance with sanitary measures for blue products, enhance safety and social protection of crews and coastal workers, enable sustainable coastal and marine ecotourism, and support alternative livelihoods and economic activities of small-scale fishers and coastal populations.

Additionally, phasing out fossil fuel and harmful fish subsidies will directly contribute to climate change mitigation by reducing fuel consumption and greenhouse gas emissions, and improve the sustainability of stocks worldwide.

These recommendations need to be implemented quickly, as the world's progress towards achieving the UN SDGs has been delayed so much that some goals may not even be achievable now. ■

The Blue Deal concept brings together different ways in which ocean-based goods and services can lead to a more sustainable recovery from Covid-19

Diana Barrowclough is a senior economist at UNCTAD, unctad.org

Quick-thinking AIS submarine fix

A fault-finding process leads to successful, if unusual, electrical engineering remedy

BY DANIEL MEGSON

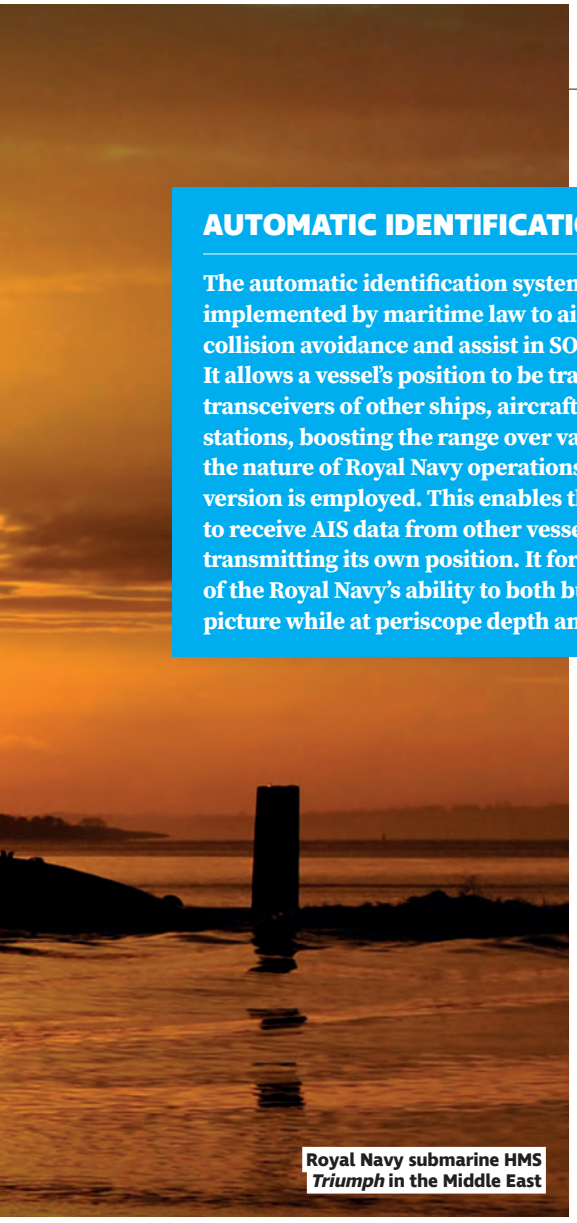
During my recent deployment on a Trafalgar Class submarine as a radio engineering artificer, the automatic identification system (AIS) on-board became defective, necessitating an urgent repair to restore command's operational capabilities.

The auxiliary equipment on-board was temporarily incapable of displaying the shipping contacts in the vicinity. Despite a failure to display the AIS contacts, the auxiliary equipment passed all functional testing and operated correctly in all modes.

To assist me with my work on-board, I have access to a variety of electronic books of reference. These contain relevant details from the manufacturer on capabilities plus guidance on how the equipment operates and functions. While examining the system diagram, I used these to note the voltages and frequencies that I would expect to see during my preliminary tests. I began my fault-finding process with 'specification-based' testing, sometimes known as 'black-box' testing. This technique uses a flowchart based on the design specifications of how a system should respond in different situations. Depending on the outcomes from my preliminary investigation, I would be able to further refine the cause of the defect.


Royal Navy petty officer Daniel Megson

I began by examining the input power supply to the AIS power supply unit and the transmitter/receiver. According to the system schematic, all voltages were correct. While testing the voltages, I found that the receiver illumination light was not on, suggesting that there was no reception path. From this I was able to determine that AIS did not have a reception path, leading me to conclude that either the aerial or antenna was



Royal Navy submarine HMS *Triumph* in the Middle East

AUTOMATIC IDENTIFICATION SYSTEM

The automatic identification system (AIS) was implemented by maritime law to aid in both collision avoidance and assist in SOLAS situations. It allows a vessel's position to be transmitted to the transceivers of other ships, aircraft and coastal stations, boosting the range over vast areas. Given the nature of Royal Navy operations, a restricted version is employed. This enables the Royal Navy to receive AIS data from other vessels without transmitting its own position. It forms a crucial part of the Royal Navy's ability to both build the tactical picture while at periscope depth and remain safe.

defective. The AIS on-board is able to utilise two VHF aerials attached to two separate masts. Bespoke on-board equipment then connects to AIS to enable the selection or change between these antennas.

Process of elimination

I then tested the functionality of the antenna-switching equipment itself. Upon mast selection, I observed that the switching slice PEC displayed the correct voltage, confirming proper operation. Because AIS requires VHF reception, I attempted to utilise the on-board VHF radio on both masts to demonstrate VHF reception and operation down both antennas to further eliminate possible options, as I continued to refine my fault finding. Reception was shown down on only one of the two masts. I returned to the book of reference to determine if AIS would function on the last operational antenna. The book of reference said it functioned on both antennas on some Royal Navy platforms, but not others.

Using the information acquired in my fault-finding procedure, I communicated with the AIS design authority via email for further information. Its response provided more extensive wiring and system diagrams, with an emphasis on the cabling from the equipment to the two antennas via multiple junction boxes. Using the elimination strategy of the 'half-split' method, I was able to locate the problem. In this instance, the test results reflected whether the issue occurred prior to or subsequent to the test point. This eliminated half of the system as a potential cause of concern.

I repeated the process at the system's problematic halfway point in order to identify the precise issue. I selected the relevant junction box situated in the centre and verified the cabling to ensure correct voltages and continuity. Referring back to the wiring schematic, I proceeded to the final testing point I could gain access to, which was the final junction box in the circuit, with the knowledge that the system was functioning correctly at the halfway point. This junction box was difficult to access, which resulted in the creation of a revised risk assessment given the uncommon nature of defect to meet the health and safety requirements. This was crucial given the risk of working under raised and pinned masts, and the potential risk of crushing. The junction box was situated 9ft high within a confined compartment not normally accessed.

The captain trusted and supported my revised plan. I returned aloft to the junction box and connected the new cable to the other working antenna using a different junction box

The final test point

I proceeded aloft with a multimeter and opened up the junction box connecting to the relevant test point, a cable pinned into a tag strip IAW with wiring diagram. This was the last possible test point unless the mast that housed the antenna itself was defective. This was later confirmed upon the submarine's return alongside. However, owing to the submarine's continuing operations, a return alongside was not an option at this point.

The final test point failed a continuity check, indicating a faulty cable up to the mast, forcing the process to a halt. I presented an option to reroute a known working VHF connection cable to the other functioning mast after matching the two antenna mast wiring diagrams.

This concept was sent in detail to two separate design authorities for further confirmation. Both design authorities subsequently advised me not to proceed with my idea and the best option was to return to port. The captain, however, trusted and supported my revised plan. I returned aloft to the junction box and connected the new cable to the other working antenna using a different junction box.

On completion, a Royal Navy operator functionally tested the AIS and the system now displayed AIS contacts. We were then able to return to full operational capability and remain on operations. ■

Royal Navy petty officer Daniel Megson was awarded the IMarEST Royal Navy Operational Award for his fix to the AIS.

Stealth – the new dimension

Tricks to 'hide' naval ships have become more sophisticated

BY JOHN BARNES

Today, designers of modern warships have a new weapon in their armoury: stealth. This is defined as "moving with extreme care and quietness, especially so as to avoid detection", and now, as applied to warships, concerns minimising their radar signature and also wake, acoustic and heat signature reduction. In the past, stealth was applied in other ways.

Up until the end of the 19th century, warships were usually presented in an immaculate condition with typically black hulls, white upperworks and buff funnels and masts – a highly visible projection of sea power. Slowly, though, it was realised that this made them an easy target for enemy fire, and it was necessary to devise a way of concealing them.

The answer was paint, specifically, many shades of grey, so that they would merge into the background of sea and air. Henceforth, this would become the standard, basic colour for warships right up until today – the UK Royal Navy is often called the grey funnel line, in reference to Alfred Holt's Blue Funnel merchant ship company.

During World War I, when it was clear that if you could not hide, at least try to confuse the enemies' gunners, techniques adopted – many to defeat submarine attack – included the painting on of false bow waves to suggest the vessel was sailing faster than it was, and so-called dazzle painting to confuse the shape and movement of the targeted vessel. The most extreme of these techniques was the so-called 24 class of minesweeping sloops, which were designed to appear to be going in either direction. They had identical bow and stern profiles, a similar bridge structure, both fore and aft, and a mast that might be positioned in front of or behind the funnel. Further confusion was caused by some of the 22 units built (two were cancelled) being dazzle painted.

World War II saw more use of paint with a variety of camouflage schemes being developed by many navies for vessels operating in different areas, but the arrival of radar overcame these, as it would reveal a vessel whatever the attempts to hide it. A new approach was needed, and this would not emerge until the 1960s.

Aviation sector sets the standard

In 1964, ironically as it would turn out, a Soviet mathematician, Pyotr Ufimtsev, published a paper entitled *Method of Edge Waves in the Physical Theory of Diffraction*, in the journal of the Moscow Institute for Radio Engineering in which he showed that the strength of the radar return from an object is related to its edge configuration, not its size.

The logical conclusion was that even a large aircraft could reduce its radar signature by exploiting this principle, but the resulting design would be aerodynamically unstable. It was only in the 1970s that computers would become powerful enough to safely fly such

WIKIMEDIA

HMS *Sir Bevis* was a 24 class minesweeping sloop for the Royal Navy and is covered in dazzle painting camouflage

a plane and, as a result, Lockheed Corp was able to develop the F-117 Nighthawk, which first flew in 1981. Its radar image was much reduced, and a number served with the US Air Force until 2008.

If this technology could work for a plane, could it not be adapted to a ship? Not surprisingly, it was Lockheed that led the way. In 1984, it built the experimental *Sea Shadow* to determine how a low radar profile might be achieved. It featured a small waterplane area twin hull (SWATH) form and was constructed at Lockheed's Redwood City, California, facility. The 50m-long vessel displaced 572t and was used for a variety of trials, but was only revealed to the public in 1993. It operated until 2006 and was scrapped six years later.

During World War I, when it was clear that if you could not hide, at least try to confuse the enemies' gunners, techniques adopted... included the painting on of false bow waves

Changing shape

For a stealth ship to have a minimal radar response, it must deal with radar beams coming from near or slightly above the horizon produced by patrol aircraft, other ships or sea-skimming anti-ship missiles with active radar seekers. Therefore, the shape of the ship must avoid vertical surfaces, which would reflect these strongly back to the emitter.

A stealth shape can be achieved by constructing the hull and superstructure with a series of slightly protruding and recessed surfaces, while 'round' shapes


Sea Shadow


Zumwalt destroyer


Visby corvette

STEALTH DESIGN COMPARISON

Vessel	*Sea Shadow*	Zumwalt destroyer	Visby corvette
Length	50m	190m	72.7m
Beam	21m	24.6m	10.4m
Draft	4.6m	8.4m	2.4m
Displacement	572t	15,907t	640t
Machinery	Diesel electric	2 x gas turbines	4 x gas turbines + 2 x diesels
Output	-	70.8MW	18.6MW
Speed	14.2kn	30kn	35kn

such as funnels and gun turrets are eliminated or covered up. Also, cavities that present a horizontal face are to be avoided, since they act like a trap and are very visible to radar. To get around these limitations, many ships use features such as panels that cover reflective surfaces or use alternate designs of hardware. Also, every effort must be made to have the smallest gaps on the ship as possible. Hull shapes include tumblehome hull designs, which slope inwards from the waterline, and SWATH designs that allow for better stability when using a tumblehome hull.

The shape of the hull can also have a great effect on the reduction of noise from a ship, particularly from the vessel's machinery. Methods include muffled exhaust systems, modified propeller shapes and pump-jets. Electrical and acoustic noise can also be reduced by adopting a main propulsion system that is either fully electric or a hybrid solution with a main diesel engine and an electric motor.

For a stealth ship to have a minimal radar response, it must deal with radar beams coming from near or slightly above the horizon produced by patrol aircraft

Similarly, it is important to reduce the infrared emissions that would be used by heat-seeking missiles.

Modern stealth ships

Today, there are many examples of vessels incorporating stealth technology to a greater or lesser extent. An extreme case is the Zumwalt-class destroyer, which is the US Navy's version of a modern stealth ship. Despite being 40% larger than an Arleigh Burke-class destroyer, the radar signature is said to be similar to a fishing boat's, while sound levels are comparable with the Los Angeles class submarines. The tumblehome hull reduces radar return and the composite material deckhouse also has a low radar return. The infrared signature has also been significantly reduced. The US Navy claims that, overall, the destroyer's angular build makes it "50 times harder to spot on radar than an ordinary destroyer".

The class was designed as multi-mission stealth ships with a focus on land attack as naval gunfire support, but with secondary roles of surface warfare and anti-aircraft warfare. Originally, 32 examples were planned, however, cost escalation has resulted in only three being built at a unit cost of a staggering $4.24bn ($7.5bn including R&D costs), far exceeding the cost of a nuclear-powered Virginia-class submarine at $2.68bn.

The Swedish Navy's six Visby class corvettes are designed to elude visual detection, radar detection, acoustic detection and infrared detection. The hull material is a sandwich construction comprising a PVC core with a carbon-fibre and vinyl laminate. Avoidance of right angles in the design results in a smaller radar signature, reducing the ship's detection range. ■

WIKIMEDIA

Building the future

Digital manufacturing and other smart technologies promise to transform the maritime sector, but new expertise and skilled personnel are needed first, found a survey by the IMarEST and Protolabs

BY JOSEPH FLAIG

Digital manufacturing and other smart technologies promise to transform the maritime sector – but new expertise and skilled personnel are needed first, according to an exclusive survey by the IMarEST and Protolabs.

There is a wealth of opportunity on the horizon. Automation and digitalisation promise to transform the maritime industry, boosting efficiency and ensuring it continues to play its central role in global freight, transport, energy and countless other sectors long into the future.

Getting there will be far from easy, however, and one major issue threatens to prevent progress: a lack of expertise and skilled personnel. Alongside decarbonisation, the skills gap was identified as the main challenge facing the industry by two-thirds (65%) of respondents in a new survey by the IMarEST and rapid manufacturing specialist Protolabs.

Looking at key innovations, the value they add to the industry and the potential barriers to adoption, the survey of 255 IMarEST members included marine professionals from all levels: naval architects and senior engineers to lieutenant-commanders and consultants, and many more between.

Alongside decarbonisation, the skills gap was identified as the main challenge facing the industry by two-thirds (65%) of respondents

Despite the diversity of job roles, the skills issue was the major concern for most respondents. A lack of expertise was also identified as the greatest challenge facing maritime's adoption of digital manufacturing techniques, picked by more than half (53.8%) of all those who took part.

"Skilled manpower is still the key manufacturing 'technology'," said one respondent – but with limited availability, it seems to be holding back the industry.

"Without proper training at all levels, there will be no future in the UK," another said. "There are opportunities for companies who train and develop their staff – something currently lacking."

Conservative mindsets among decision-makers, mentioned by several respondents as a barrier to the adoption of digital manufacturing techniques, could

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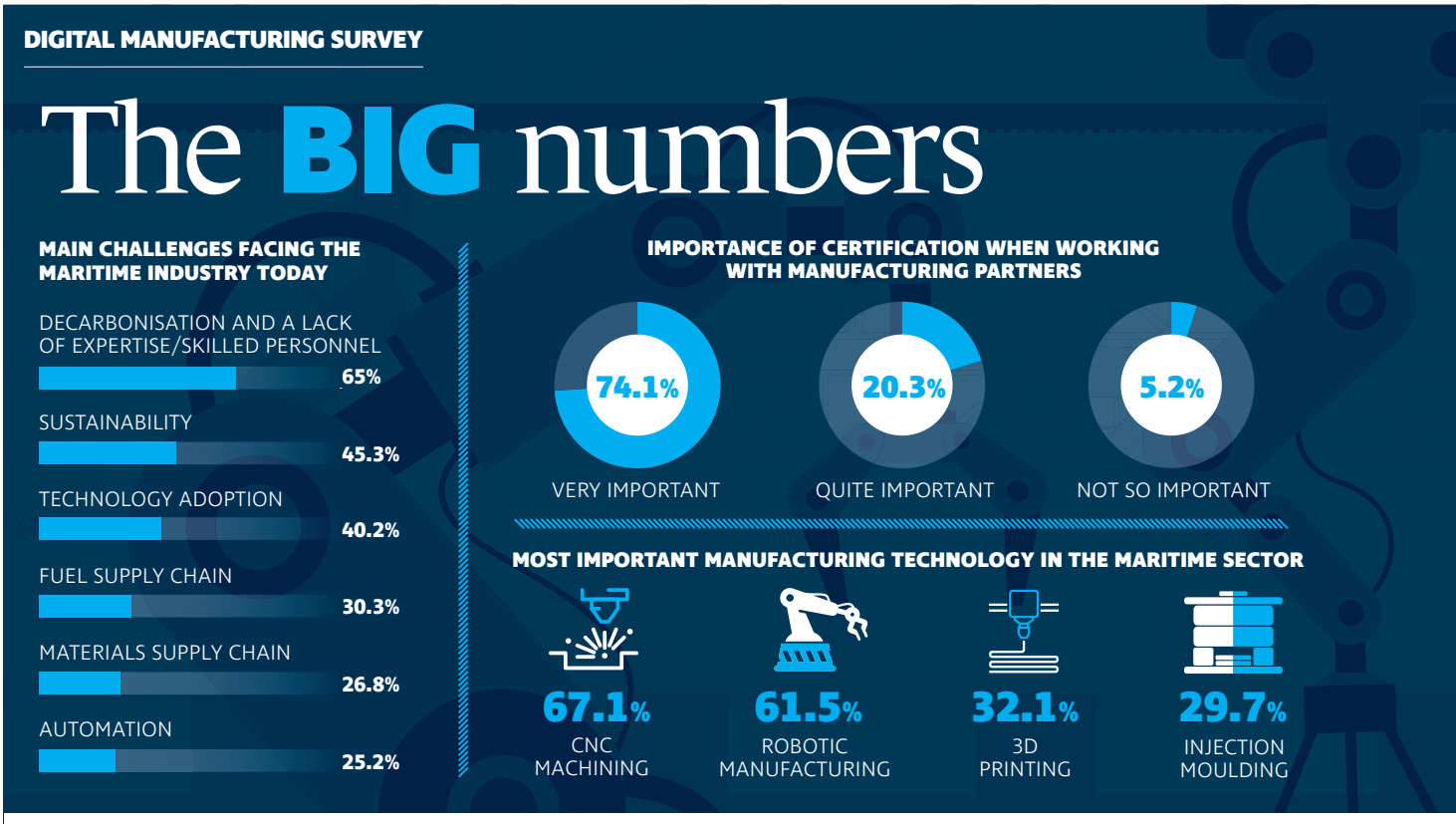
DIGITAL MANUFACTURING SURVEY

The BIG numbers



explain some of the reticence to develop workers' capabilities and enable them to spearhead digitalisation in their organisations.

After the lack of expertise, equipment cost was the second-biggest challenge (picked by 44.6%) and the third was lack of training (39.8%). Lack of awareness (38.3%), time to adopt (37.1%) and not meeting technical or performance specifications (33.1%) were other major challenges. Availability of digital manufacturing techniques was seen as the least significant issue, picked by less than a quarter (24.3%) of respondents.

Slow adoption

With such significant hurdles in the way, the modernisation of manufacturing technologies and techniques is often painfully slow. A lack of automation persists in many businesses, with two-fifths (40.7%) of respondents saying that none of their manufacturing services are automated. Only 7.7% said more than half is automated.

"There is a lack of adoption of new technology, especially in the shipping sector. Conditions on-board ship or offshore installation have not really changed for years, and rely upon shoreside support," one respondent said.

CNC machining is the most important manufacturing technology in the maritime sector, the survey found, selected by two-thirds (67.1%) of those who took part. Robotic manufacturing was a close second at 61.5%, while 3D printing and injection moulding were seen as less important, selected by 32.1% and 29.7% respectively.

When asked about the key manufacturing technologies currently being used in the sector, welding was mentioned by several respondents, along with other conventional methods such as casting, rolling and forging.

"There is a lack of adoption of new technology, especially in the shipping sector. Conditions on-board ship or offshore installation have not really changed for years, and rely upon shoreside support"

A large proportion of respondents (44.1%) said that none of their manufacturing was done in-house, while another quarter (24.9%) said less than 25% was done in-house. A very small number (7.4%) said more than 75% was done in-house.

Challenges and opportunities

As with automation and digital manufacturing, decarbonisation is both a challenge and an opportunity for maritime organisations. Done right, it can help protect marine environments, prevent harmful emissions into the atmosphere, and ultimately create a more sustainable and efficient industry. The industry is huge, however – the International Chamber of Shipping put the total value of the annual world shipping trade alone at more than $14 trillion in 2019, making widespread change slow and expensive. Many alternative fuels or electrification techniques are still relatively unproven or difficult to rapidly expand, compounding the issue.

As such, decarbonisation was the joint biggest challenge facing the industry, selected by two-thirds of respondents (65%), alongside

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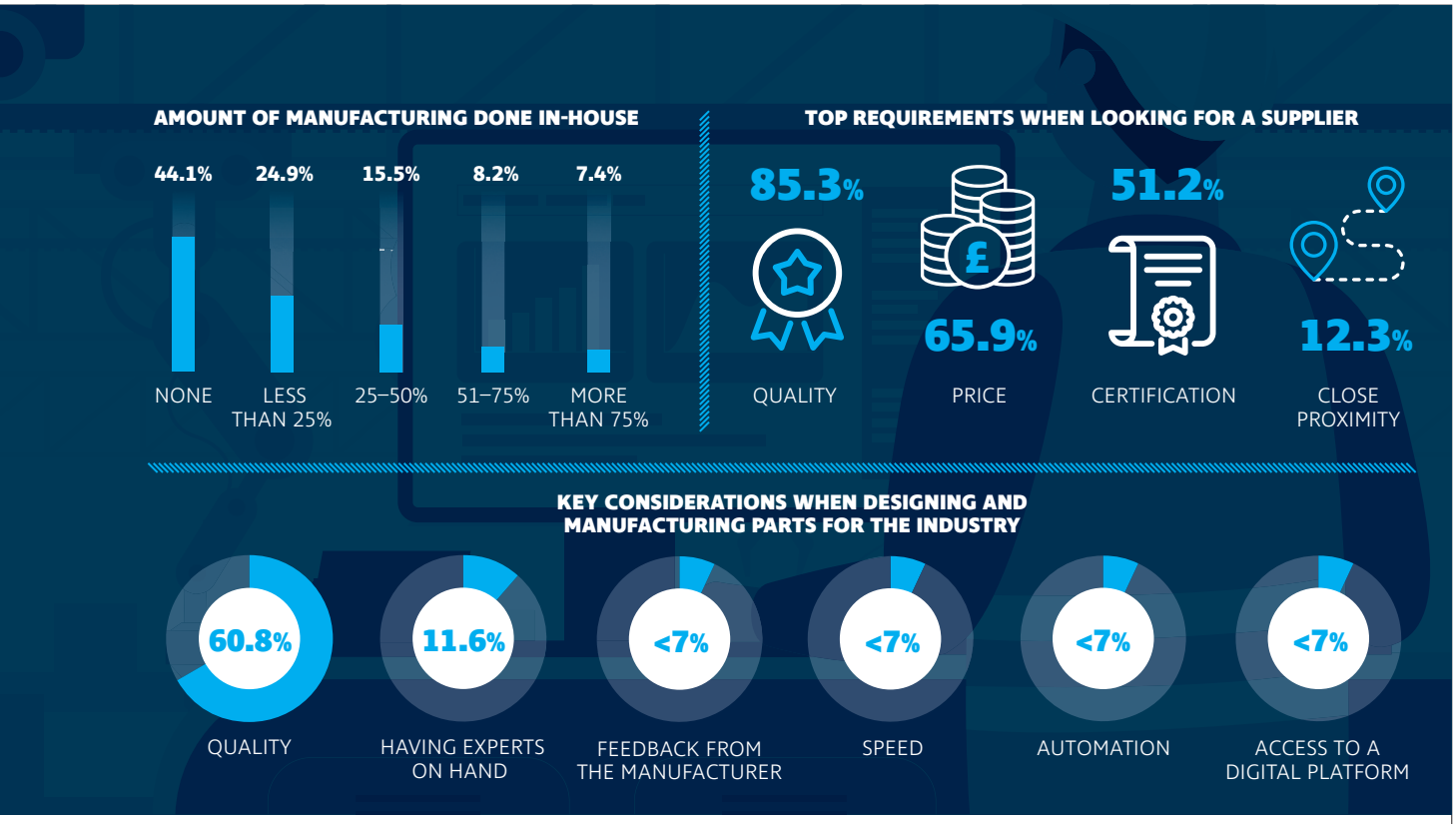


the lack of expertise and skilled personnel. Sustainability followed (45.3%), then technology adoption (40.2%). The fuel supply chain was selected by 30.3%, while 26.8% said the main challenge was the materials supply chain.

Thankfully, respondents saw a lot to look forward to in the maritime industry. While far from straightforward, decarbonisation was seen as a major future opportunity. Technology such as alternative fuels, low-carbon techniques such as wind-assisted propulsion, air lubrication to reduce hull resistance, electric propulsion, solar power and even discrete nuclear power plants on-board merchant marine vessels were seen as potential solutions in the race to reduce emissions. New renewable technologies, such as tidal energy or floating wind farms, will also rely on maritime techniques and expertise.

Robotic and additive manufacturing could be transformative for ships at sea, cutting the price for replacement parts and helping ship staff minimise downtime. "3D printing technology will play a big role," said one person. "There will be a lot of opportunities in the near future when it comes to the manufacturing of marine components."

Autonomy will also boost efficiency for worldwide freight, with autonomous craft and drones offering streamlined logistics. Uncrewed transport could follow 'low-manned' solutions, helping keep seafarers out of potentially dangerous situations, while remote reading of health and monitoring systems – enabled by sensor networks and other technologies – will enable monitoring and reconfiguration of systems from a distance.

Clearly, there is a lot to look forward to on the horizon – but organisations need to take the initiative and train their workers on cutting-edge technology to ensure the industry gets there. ■

AUTOMATION & DIGITALISATION: THE PROTOLABS VIEW

Tasos Pantelis is European project engineer at Protolabs.

Addressing the findings of the survey, Pantelis said: "The maritime industry is not the first to be cautious with its adoption of automation and digitalisation. More industries are reaching out to utilise the skills and expertise from digital manufacturers like ourselves. The key about collaborating with Protolabs is the mitigation of risk, access to the latest technology, drawing on expertise from our engineers when looking for advice on materials, and processes to best suit every project, while fitting to tight deadlines."


Rob McCallum and Tim Macdonald on the Anzac dive to Challenger Deep

Journey to the bottom of the sea

The search for scanning technology that pushes the boundaries of what is currently possible

BY TIM MACDONALD

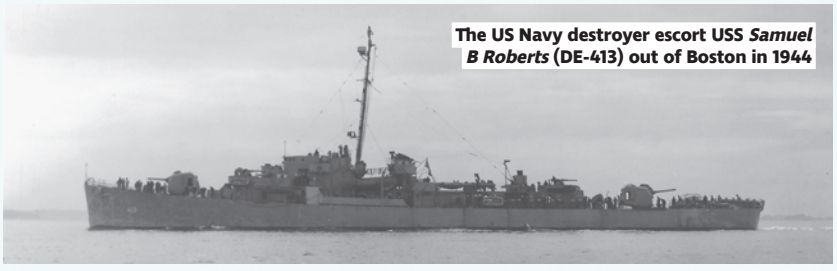
Caladan Oceanic's founding vision was to explore the deepest parts of the world's oceans. The Five Deeps Expedition from 2018 to 2019 travelled 47,000nm (87,004km) and completed 39 manned submersible dives, which successfully included the first manned descent to the bottom of each of the world's five oceans.

The subsequent and ongoing Ring of Fire Expeditions from 2020 to 2022 have travelled more than 150,000nm and completed 115 manned submersible dives to date, totalling over 1 million vertical metres travelled. These have comprised of an array of archaeological dives including ones that successfully located and surveyed the deepest-known shipwrecks, USS *Johnston* and the USS *Samuel B Roberts* in the Philippine Trench.

Other world firsts across these expeditions included the deepest manned dive, to a new record 10,925m at the Mariana Trench's Challenger Deep, as well as the first submersible and pilots to repeatedly dive to the bottom of the ocean.

Deep-sea exploration

These expeditions have provided unprecedented opportunities to sample and video previously undocumented subsea geological and archaeological features and all associated fauna. All dive sites are mapped, videoed, imaged and sampled across a range of depths, temperatures, salinity gradients and latitudes. These expeditions have also provided many unique opportunities to visualise and characterise some of the Earth's


The US Navy destroyer escort USS *Samuel B Roberts* (DE-413) out of Boston in 1944


Dr Deo Florence Onda and Victor Vescovo diving the Philippine Trench


Sub team Hector and Tim on Mariana Trench's Challenger and Sirena Deep dives

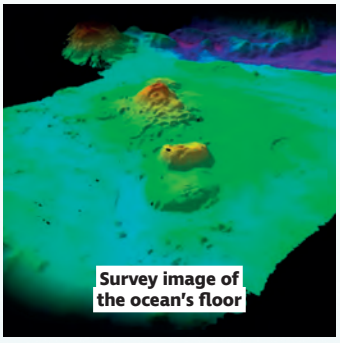
US NAVY VIA WIKIPEDIA, CALADANOCEANIC.COM

The *DSSV Pressure Drop* returning from the Mariana Trench

tectonic marvels, as many voyages have, for example, included diving tectonic plate boundaries.

Our 68m research and exploration ship *DSSV Pressure Drop* carries a full ocean depth (FOD) submersible, multibeam sonar, a trio of advanced FOD-capable seafloor landers and space for 45 crew, scientists and mission specialists.

Locating subsea features, whether subduction, fracture, trench or rift zones, underwater volcanoes or indeed the deepest points within the deepest parts of the world's oceans, would not be possible without *DSSV Pressure Drop*'s two Kongsberg EM 124 multibeam echosounders (MBES). MBES are designed to produce highly precise data to full ocean depth (11,000m) and are mounted to the ship's hull on a gondola fixed ˜20m from the ship's bow.


Survey image of the ocean's floor

The dual swath, 16-sector system has a nominal frequency of 12kHz and operates at a frequency of 10.5–13.5kHz. Positioning on-board was determined by a Kongsberg Seapath 380+; sound velocity is collected by a fixed-mount Reson SVP70 at the transducer head and both are integrated real time into the Kongsberg SIS 5 data-acquisition software.

Scientific studies

Across these expeditions and subsequent scientific voyages, over 1 million sq km of seabed has been hydrographically surveyed with the ship's EM 124. While the MBES have been instrumental in determining the true depths of all surveyed dive sites, they have resolution limits due to the extreme operating depths. The MBES are highly accurate to estimate depth (z-axis), but resolution on the horizontal plane (x-y plane) at FOD is 75m x 75m. This is extremely efficient when characterising geographic regions, finding large geological features and planning submersible dives and lander deployments. But it does not allow for object detection or small geological feature characterisation at these extreme depths.

Local depth and temperature data are also collected from four conductivity, temperature and depth probes (Seabird SBE-49 15,000 psi Paine Pressure Sensor), as they record vertical profiles of salinity, temperature and depth on descent and ascent. One of these probes is attached to the *DSV Limiting Factor* and the other three are mounted on each of the supporting lander systems. These landers are three stationary autonomous subsea vehicles that are deployed from the *DSSV Pressure Drop*. Additionally, five depth sensors are utilised (RBR Virtuoso) – two on the submersible vessel and one on each support lander. This information is then used to calibrate the submersible dive depths as well as calculate full-ocean, sound-velocity profiles.

Submersible success

As alluded to, the crown jewel of Caladan's arsenal is the Triton 36,000/2 submersible called *DSV Limiting Factor* (*LF*). It is the world's first two-person, FOD or 10,925m-rated, titanium-hulled submersible, which is commercially certified for an unlimited depth and amount of dives.

To date, the *LF* has successfully completed more than 100 manned submersible dives (1,000,000m+ vertically traversed) and provides a continued platform for science, film-making and exploration that has already substantially contributed to our understanding of the world's oceans. The *LF* is capable of completing horizontal video transects of up to 2,000m and 1,500m vertical transects while capturing high-definition video footage, which enables the characterising of all surveyed geological and biological information for scientific publication. The *LF* simultaneously captures water-quality data with its on-board sensors.

To date, the LF has successfully completed more than 100 manned submersible dives (1,000,000m+ vertically traversed) and provides a continued platform for science, film-making and exploration

Seafloor scanning

While the world-class combination of the shipboard multibeam, scientific landers and manned submersible provide unprecedented access to the ultra-deep part of the ocean, we are left with a capability gap to map the seafloor in high resolution. The ship's MBES map large areas with 12km SWATH (180km^2/hr at 8kn) at FOD with a horizontal resolution of 75m x 75m; the *LF* conducts 2km x 15m wide video transects (~0.3km^2) per dive. We need to overcome this apparent coverage gap to detect objects on the seafloor in ultra-deep water or to provide high-resolution scans of the seafloor in larger areas than the submersible's forward-looking sonar or video cameras can provide.

Enter the development of a first-in-class FOD side-scan sonar, implemented by Caladan Ocean with its partners Hadal Subsea Engineering and Deep Ocean Search (DOS). Identifying a supplier willing to attempt to adapt their technology for FOD capability is not easy. DOS identified that Jetasonic Technologies, which supplies side-scan sonar transducers to the commercial market, was willing to test its transducers to 1100bar to rate them for use at FOD. Its Model 630 – already tested to 9,000msw equivalent – was identified as the best candidate in ultra-deep waters.

As the *LF* is DNV-certified, any instruments integrated onto the *LF* require DNV approval. This is to ensure there is no risk to human life while operating subsea, and includes review of and testing for pressure vessels, electrical integration and mechanical integration. As the transducers had no implodable volume, DNV did not mandate a pressure test, but reviewed and approved the mechanical and electrical integration.

It was decided that the transducers should be pressure tested to 1125bar (11,000msw) to ensure there would be no electromechanical failure that would prevent their functionality on the submersible at FOD. Caladan's partner Triton Submarines in Barcelona, Spain, was engaged to test the transducer in the same test chamber that conducted 90% of the testing for the original design and build of Caladan's subsea assets.

***DSSV Pressure Drop*'s full ocean depth submersible**

There is no shortage of hurdles to overcome with the integration of a side-scan sonar onto the world's deepest-diving submersible

Post-pressure test, the transducers were bench tested by DOS for any defects and passed on all fronts. So, we now have transducers that can withstand the extreme pressure at FOD, but will they return useful data?

Overcoming obstacles

Eighteen months into the project, we have identified the hardware, developed the integration plan on the vehicle and pressure-tested the transducers with a DNV certification for use on a manned vehicle. At the time of writing in early July, we head off for sea trials in the coming weeks followed shortly by an attempt on locating World War II shipwrecks in the Philippine Trench, the third-deepest trench on the planet.

There is no shortage of hurdles to overcome with the integration of a side-scan sonar onto the world's deepest-diving submersible. These include: expensive specialist components that cannot be modified, complying with DNV's manned submersible code; continued Covid-19 restrictions complicating supply lines and logistics; operational schedule changes; maintaining a clean analogue data signal through the multiple layers of the submersible's electrical safety features; and data processing.

By far the biggest hurdle will be developing a navigation solution to allow some georeferencing of the water fall produced by the side-scan sonar. Diving at FOD (10,925m) is operating on the edge of what is physically possible for current subsea communications along with hardware and software restrictions that are prohibitively expensive to overcome and limit the navigational accuracy that most survey grade sonars work to.

Prior to integrating the side-scan sonar, the operational requirement of the subsea navigation was to locate a submersible to ensure safe operation while surfacing the submersible around surface vessels, and provide a latitude and longitude position (+/-100m) and depth for the data collected. I will unpack the navigational problems in my next technical note for *Marine Professional* as we move into the operational phase of the equipment development. ■

Tim Macdonald is a submersible pilot and operations/engineering manager at Caladan Oceanic/*DSSV Pressure Drop*. Contact him on tim@hadalsubsea.com. Caladan Oceanic partners include Triton Submarines, EYOS Expeditions, Deep Ocean Search and Hadal Subsea Engineering.

Membership drive reaps early rewards

Lalantha Fernando notes that site visits and financial support are helping to attract new members

BY CARLY FIELDS

What are the guiding objectives for your branch?
We always thrive to enhance our professional behaviour and integrity when serving the community with our services. We strive to impress members with our social and professional projects. We look to help retired members in various ways. And we provide support through scholarships for Sri Lanka's less fortunate marine engineering students and in-planning special English language courses for students to improve their English language skills.

What's the one standout branch event of 2022?
This year we conducted a field visit to one of Sri Lanka's 50MW thermal power plants, which was well received. We hosted 50 marine engineering cadets from various marine engineering institutions in Sri Lanka.

We ran another such event in June, visiting Colombo Dockyard, which is one of the largest in the region. Again, we expected around 50 engineering students to engage in this field visit. We also ran a lecture on 'Emergency and Safety Situations on Board Ships', which was attended by more than 70 marine engineering students and other professionals.

Nahil Wijesuriya (in uniform, centre) sponsored a recent scholarship awarding ceremony conducted for less fortunate marine engineering students

What plans do you have for further development of the branch?
The branch is continuing its membership drive, aiming to bring in 25 to 30 new members. We are delighted that we have already enrolled more than 15 new members this year and look forward to enrolling more before the year end.

We are also closely monitoring the number of engineers graduating from the local maritime authority (the Ministry of Shipping), as there is on average more than 300 engineers graduating each year from various training institutions and universities. The branch is in the process of developing a programme to introduce more quality marine engineers both nationally and internationally.


Branch members with some of the marine engineering students

What are the three main topics that keep your branch awake at night?
- Demand for marine engineers in the industry
- Improvement of the quality of engineers
- Increasing the number of new members for the institute.

What are the big regional opportunities on the horizon for your branch and members?
We are excited by growing opportunities to secure employment on-board ships and also in shore-based roles. There are more than 500 marine engineers from the region that join foreign-going vessels each year.

What one thing would you change about your region in relation to the marine environment?
We would like to support the continuing education of our members on how to maintain clean environments through close monitoring and implementation of regulations imposed by shipping authorities and other regional bodies. ■

Lalantha Fernando IEng IMarEng MIMarEST is chairman of IMarEST's Sri Lanka Branch and senior consultant at Ceyline Engineering Services (Pvt) Ltd.

“The challenges within the industry are multifaceted and complex”

Dr Sajid Hussain explains why globalisation, cross-cultural interactions and technological change are keeping maritime educators on their toes

BY CARLY FIELDS

How did you first get involved in the marine industry?
It was 1972; I was 12. Bangladesh achieved liberation in 1971. I was a minor freedom fighter. I saw news on the newly established Bangladesh Shipping Corporation (BSC) with a picture of the first ocean-going ship, the *MV Banglar Doot* (*Ambassador of Bangladesh*). I heard the term ‘marine engineer’ for the first time from my father and heard about the Bangladesh Marine Academy (BMA) from a journalist who just visited the Academy. During my school days in Rajshahi Cadet College (Regimental), I became fascinated with the senior cadets applying for the BMA. I read and re-read the prospectus of the BMA, eagerly awaiting my turn to apply. My time came in 1978 after I had completed my HSC (A Levels). I was accepted and successfully completed four years of cadet training at the BMA, under City & Guilds in London from 1978 till 1982, which included a third year at sea. I was also appointed chief cadet captain in my senior year at the BMA. After graduation, I commenced my sea career as a cadet engineer in BSC, leading to my award of CoC Class-I MEO from the UK Department for Transport. I then served as chief engineer up until 1993.


Dr Sajid Hussain

How did your career evolve from marine engineering to training and development?
While in the BMA, I was inspired by the then commandant, Captain EJ Coolen – a British national who died on 4 August 2016 – and the chief engineer, Ken RG Rotter – a British national attached to IMarEST. Their expertise and enthusiasm led me down the route of marine education. I decided to acquire substantial skill and experience at sea, which I would then bring to my alma mater. During my seafaring career, I kept my link with the BMA through the cadets and I kept my study books, notes and the materials of my CoC exams for possible use in my future would-be teaching role. At the conclusion of my seagoing career, I joined the BMA as an engineer instructor in 1993, and was promoted to the position of commandant of the BMA in 2009.

You were the first marine engineer to be appointed commandant of the Bangladesh Marine Academy. How symbolic is that and what does that recognition mean for marine engineers?
The 24 commandants before me were all from the navigation stream. While that was merely coincidence, it had become an urban legend that only a master mariner could be the commandant. This meant

Meeting the IMO secretary-general, Kitack Lim

With Bangladesh Prime Minister Sheikh Hasina at a cadets graduation ceremony

"My achievement of reaching the commandant position… has been an unprecedented inspiration for marine engineers, and my longevity in the role has supported recognition in marine engineers' capability to command as well"

that engineering cadets would get demoralised, too. However, the truth is that no marine engineer before me had served long enough to reach the position. My service since 1993, and my achievement of reaching the commandant position in 2009, has been an unprecedented inspiration for marine engineers, and my longevity in the role has supported recognition in marine engineers' capability to command as well.

What does your role on the World Maritime University Board of Governors involve?

The World Maritime University (WMU) Board of Governors (BoG) comprises 30 members headed by the IMO secretary-general. The BoG formulates principles and policies that govern the WMU and approves the work programme. The board meets every year at the annual general meeting. We, the governors, use our maritime expertise and background to further develop the university so that it best serves the long-term needs of maritime administrations. Sustainable funding is one of the current main challenges. We are also actively bringing fellowship funding from our own and developing countries.

From the training-related projects that you are currently engaged with, which excites you the most?

Currently, we have a number of ongoing projects. I am most excited about the establishment of a Simulation Centre and Bangabandhu Techno Marina Complex (Research Centre). Then there is a recent initiative to earn recognition from the UK Maritime and Coastguard Agency. Finally, there are the academic collaboration projects with Solent University, Southampton (UK), the Estonian Maritime Academy (Estonia) and the Maritime Academy of Asia & Pacific (Philippines).

DR SAJID HUSSAIN

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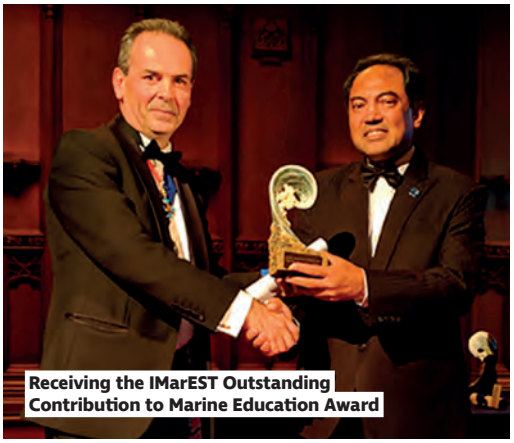
WMU Board of Governors at its 35th session


Receiving the IMarEST Outstanding Contribution to Marine Education Award

"Besides delivering lectures in the Academy, I promote the ocean of opportunity to the young generations through visual and printed media, seminars and visiting students in their colleges"

What challenges and opportunities do you see on the horizon for marine-related training and professional development?
The challenges within the industry are multifaceted and complex due to globalisation, cross-cultural interactions and technological change. Maritime educators need to keep pace with the dynamic advancements ensuring a balance with STCW standards. Transitioning from fossil fuel and automation towards autonomous ships are unprecedented challenges when it comes to upgrading education and skills development. That said, the new generations are 'future-ready' well before they embark on a seafaring career. Thus, these challenges are actually opportunities to step into the future.

I understand that you are an IMO Maritime Ambassador. How do you promote the industry through that role?
I am one of 40 IMO Goodwill Maritime Ambassadors. Ambassadors are spokespersons or advocates for maritime and seafaring professions. Besides delivering lectures in the Academy, I promote the ocean of opportunity to the young generations through visual and printed media, seminars and visiting students in their colleges, highlighting the unlimited prospects of seafaring in providing an exciting and dynamic career in a truly international arena.

What is involved in your role as a trustee of IMarEST and what are your priorities for your three-year term?
The Board of Trustees (BoT) is the IMarEST's governing body and has responsibility for policy, budget, strategy, business plans, investment, expenses and regulations, approves various committee reports, oversees risk management, and monitors related Science Council and Engineering Council issues. My priority is on membership growth.

What would you say to other Fellows interested in getting more involved in the IMarEST as a trustee?
Being on the BoT means holding the helm of the IMarEST. On the one hand, this requires time and effort, but on the other, it delivers professional importance. Therefore, I encourage dynamic and intelligent Fellows to volunteer to join the BoT.

Finally, what are you most excited about in the future, and what is the biggest challenge facing the marine industry?
I'm most excited about the advancement of science and technology – from automated to autonomous, from fossil to gas fuels and from carbon-intensive to pollution-free ship operation. I am also excited by the prospects of a new cohort of 'smart seafarers' that will be shore-based, but more knowledgeable and more skilled than ever before. ■

ABOUT DR HUSSAIN

Dr Sajid Hussain CEng CMarEng FIMarEST is commandant of the Bangladesh Marine Academy. He is an IMO Goodwill Maritime Ambassador, a trustee of the IMarEST, a chartered engineer through the UK Engineering Council, a chartered marine engineer through the IMarEST, a governor at the World Maritime University in Sweden, a council member at the IMarEST and a maritime expert of the IMO and GlobalMET in Australia. He has authored 23 books, 30 research papers and more than 250 features, achieved the IMarEST President's Commendation in 2012, the IMarEST award for his paper 'Vision of e-Learning & its application into MET' in 2007 and the IMarEST award for 'Outstanding Contribution to Marine Education 2019'. Sajid also achieved IMarEST Recognised Speaker status in 2020.

DR SAJID HUSSAIN

Making a marine mammals career count

Job matrix gives new insight into different options for marine mammals-related employment

BY NIRU DORRIAN & JULIA JACOBY

Marine mammals are essential for maintaining a balanced ecosystem and are often referred to as sentinels of ocean health. This means they can act as effective indicators of current or potential negative impacts on individual and population-level animal health. Studying these species allows us to improve the management of impacts that can ultimately affect both human and animal health.

Marine mammals are also considered charismatic megafauna, which helps raise and stimulate public support for their conservation and that of the oceans in general, and inspires many to pursue a career working in this field.

Inspired by this, the IMarEST's Marine Mammals Special Interest Group (SIG) has created a Marine Mammals career matrix to provide a guide to the types of roles across sectors and the skills required. It is ideal for students considering their future careers, whether as a protected species observer in industries such as oil, gas, renewables, marine or coastal construction sectors, a researcher in academia, an expedition scientist in ecotourism or a veterinarian, among many others.

These career roles share many essential skills such as good communication, teamwork, problem-solving, project management, data analysis and following safety regulations. The marine mammals world is highly competitive, and it is essential to gain specialist and technical skills that are not stand-alone careers, but may be part of an expansive professional career.

The matrix features career case studies of inspirational people working across a variety of professions in the marine sector

Additionally, the matrix provides employers with valuable insight into the difference between the many specialist roles to ensure they understand and recruit individuals with the right skills for their projects.

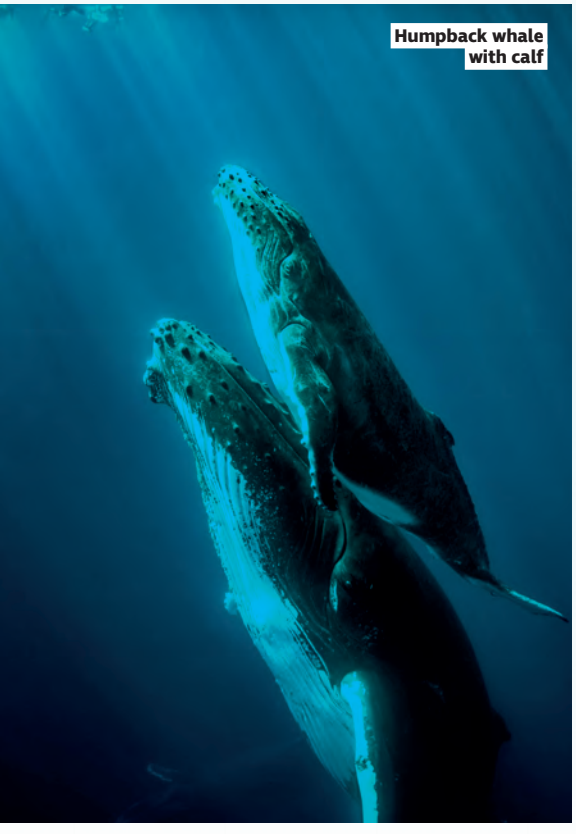
Inspiring stories

The matrix also features career case studies of inspirational people working across a variety of professions in the marine sector. These professionals were invited to talk about their career experience on the platform to help students decide their own career path.

Featured in the case studies, Pedro S Baranda, founder and director of MMR4 – Marine Mammal Research, Rescue, Rehabilitation and Release, said: "I go where I am needed, any part of the world, in order to train any kind of team that would like to learn or improve their marine mammal rescue and rehabilitation protocols

WIRESTOCK CREATORS/SEB C'EST BIEN VIA SHUTTERSTOCK

FIELD	ROLE TYPES	EXAMPLE ACTIVITIES	KEY SKILLS AND EXPERIENCE
Industry (E.g. Oil & Gas, Renewables, Marine & Coastal Construction etc.)	Passive Acoustic Monitoring Operator (PAM)	• Acoustically survey for marine mammals using specialist software and hardware • Understand and follow regional and/or international legislation and Environmental regulations • Be aware of onboard operations to ensure availability • Provide post-processing and analysis as per project protocols • Troubleshoot software and hardware issues	• Basic understanding of marine acoustics, post-processing and analysis • Familiarisation with marine mammal acoustic signatures • Previous experience conducting marine mammal surveys • Experience on vessels or at sea • Additional experience in the deployment and operations of specialist equipment • A good attitude to conducting concentrated monitoring effort, often for long days and several consecutive weeks • Data collection, analysis and report writing
	Noise Monitoring Technician/ Assistant	• Provide technical assistance to the site-based team • Equipment and system maintenance • Automatic/ manual data recording and analysis • On-site monitoring of conditions, including noise and vibration • Calibration of monitoring equipment	• Understanding of marine acoustics • Familiarisation with marine mammal acoustic signatures • Ability to troubleshoot hardware and software issues • Technical and engineering background • Appreciation and understanding of site operations • Experience on vessels or at sea and willingness to work in a variety of environmental conditions
Academia	Professor/ Lecturer	• Teach lectures and workshops • Journal articles/conference presentations • Lead field research • Supervise students & research staff • Grant-writing & funding networking	• Strong academic grounding; doctoral-level qualification in relevant Scientific or engineering disciplines is usually required • Creativity and intuition in communication to a wide range of audiences
	Research Scientist	• Conference presentations • Fieldwork and data analysis • Journal article writing • Bids and funding applications • Supervise research assistants • Provide conservation awareness	• Strong academic grounding; doctoral-level qualification in relevant Scientific or engineering disciplines is usually required • Good research skills including planning, intuitive problem solving and data analysis • Understanding of optical remote sensing e.g. to use and process satellite imagery, validate satellite activities • Experience with project finances to demonstrate the ability to work to budget and in particular write and secure grants • Potential to present effectively in written and verbal means to a wide range of audiences • Good IT skills and some knowledge of coding languages
Stranding & Animal Care	Wildlife/ Aquatic Veterinarian	• Research and treatment in office and fieldwork • Sedating mammals for procedures • Performing exams and surgeries • Provide intensive care for young animals • Communicating with rehabilitation facilities, technicians, officials and members of the public • Teach lectures and workshops	• Willingness to travel and work day and night • Creativity and intuition in communication • Tending to animals in the water while handling medical equipment • Dealing with frightened, irritable and/or heavy animals • Technical proficiency; ability to use medical machines and databases • Critical thinking; making though decisions about sick animals without emotion
	Pathologist	• Prepare and perform necropsies on cadavers • Handling, euthanasia and subsequent tissue preservation • Manage cadaver receiving and disposal activities • Maintain and utilise laboratory equipment • Conduct routine safety inspections for workspace	• Physical stamina (lifting of heavy cadavers) • Willingness to work odd-hours • Care required for safe use of dangerous equipment



Humpback whale with calf

"This is a very challenging and demanding job when you may have to deal with incidents such as rescuing and caring for an orphaned baby seal"

and techniques, from big whales to baby seals. This is a very challenging and demanding job when you may have to deal with incidents such as rescuing and caring for an orphaned baby seal that has no chances of life whatsoever without your intervention, and you must be on hand at all times of day."

Els Vermeulen, research manager at the Mammal Research Institute Whale Unit, Department of Zoology and Entomology at the University of Pretoria in South Africa, said that she is driven by a "deep-rooted passion for marine mammals as well as research and management. Working towards a better understanding of these amazing creatures and using that knowledge to contribute to a better conservation management in a heavily anthropogenically impacted world is what keeps me going."

Lorenzo Scala, a bioacoustician and project manager, shares his thoughts on the challenges and rewards of bringing together his passions of technology, the marine environment, conservation and animal welfare, adding that "experiencing a changing landscape from the movement of fossil fuel to renewable energy opens up a whole host of opportunities for marine scientists". ■

FIND OUT MORE

Niru Dorrian CSci CMarSci FIMarEST is chair of IMarEST's Marine Mammals SIG. For more information on the SIG or to join, email niru@whalefish.org

COMMENT

Today's naval ships, designed for tomorrow

CARBON NEUTRALITY

Future-proofing vessels to achieve net zero ambitions

By Felicity Landon

The naval vessels being built today will likely be around in 2050. So, what decisions are being made to facilitate meaningful steps on the path to net zero? Earlier this year, delegates from across military and civilian aspects of warship design, construction and operation gathered in Portsmouth to discuss operational and support measures, energy-saving technologies and energy sources in support of 'Roadmap Net 0'.

"As a warship designer, there are a number of questions we look to the wider community to support, including governments, equipment manufacturers, customers," said Richard Trumper, chief technologist, BAE Systems Naval Ships. "It really comes down to some of these big questions: how much progress do we really want to make at any point in time in the net zero arena; where do we want to be on that curve; and is it an affordable, sustainable progress?"

Warships have important national functions – getting it wrong can cause all sorts of problems, he reminded the audience. However, as a designer of niche vessels, "we have to follow, not lead, the future fuel choices", he said. "We need clarity on bunker availability."

Naval operations require unique features, said Christian von Oldershausen, naval segment director at DNV, not least that they should be able to operate from one to 760 days at sea without returning to their home base. "Being out there, with the need to be refuelled and replenished with spare parts, ties into the maintenance concept; autonomy plays a large role in that thinking.

"Replenishment at sea and the supply chain is going to be the crucial factor if you are operating out there for two years – where do you get your fuel and where will it be? That will have an impact on the design of naval vessels." For example, a ship using batteries would need 10 times more volume to accommodate that power, "and that will have an impact on design", he said.

Fuel flexibility

There has not been a lot of guidance from NATO on net zero, said von Oldershausen; the armed forces need to put pressure on NATO over this, as one country 'going out on a limb' on fuel choices would not work.

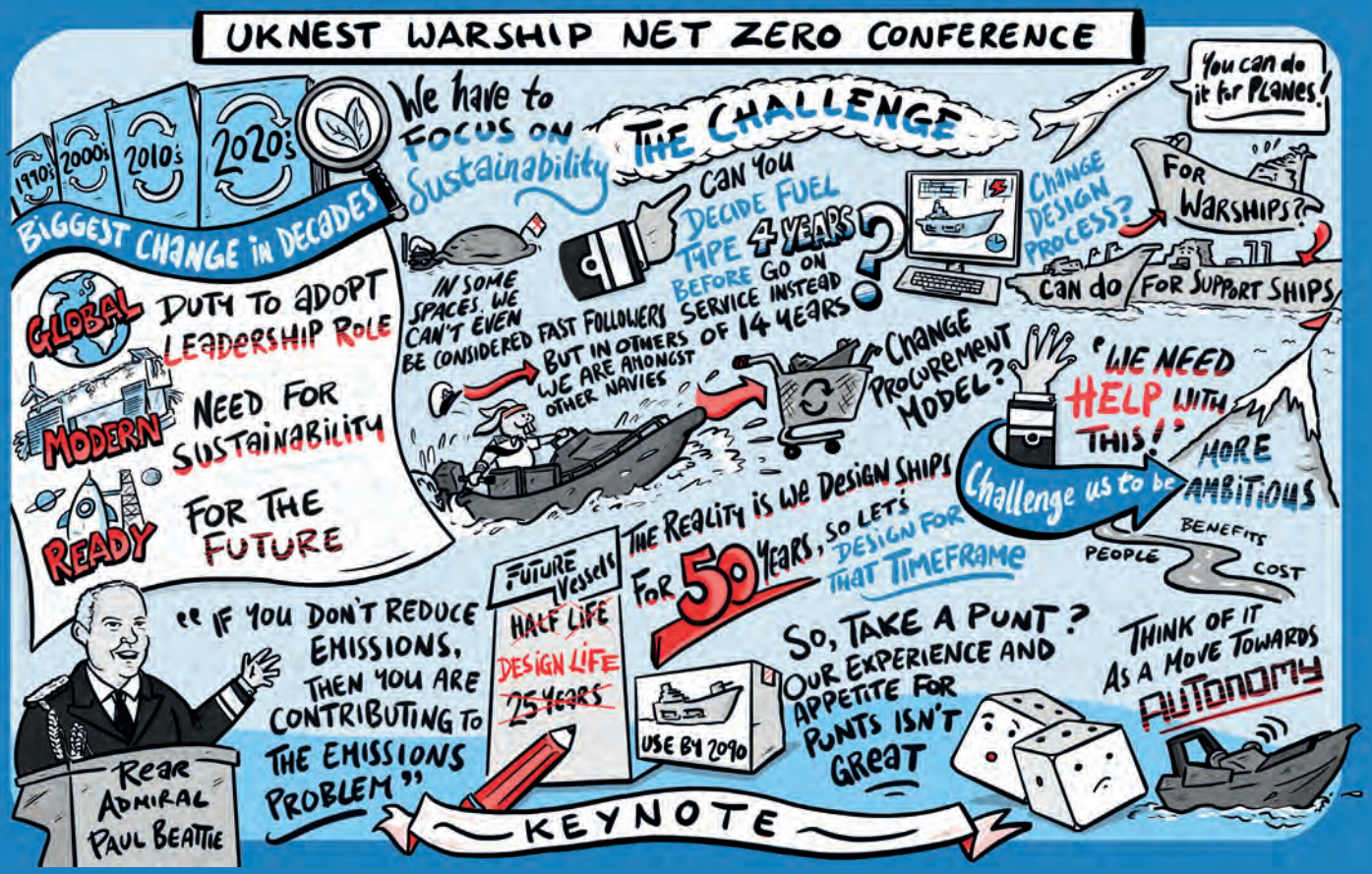
"Replenishment at sea and the supply chain is going to be the crucial factor if you are operating out there for two years"

Trumper added: "It is a question of how far we want to go in terms of fuel flexibility. The Navy wants to replenish at sea to sustain endurance. Therefore, it is not just about the warships, it is the logistics tool, and are you willing to put different tanks for fuels on an RFA vessel?"

Paul James of Lloyd's Register emphasised that if a navy still wants the same capability as today, "then everyone needs to use similar or interchangeable fuels – and also with the commercial sector, to give you access to fuels outside your supply chain".

There is an opportunity for the military sector to provide some leadership, said Rolls-Royce director Richard Barton. "Commercial shipowners are very worried at the moment; where should they go with all these different options and sitting on their hands over new ship purchases?" he asked. "There is an opportunity for military to offer some leadership in these new technologies."

Achieving net zero ships by 2040 is possible, he said, "but at the end of the day, there is going to be a huge number of ships just going into service that will still be around in the 2040s operating diesel or gas turbines".



Searching for savings

John Buckingham, chief mechanical engineer at BMT, explained potential energy-saving technologies, with gains and challenges, for the Type 23 Frigate, including contra-rotating propellers and wind-based propulsion; absorption chiller plant (ACP); Organic Rankine Cycle (ORC) systems; electrical energy storage systems (ESS), variable speed generators and DC bus; and photovoltaic panels and a solar-reflective paint.

Contra-rotating propellers and wind-based propulsion could deliver 10% savings, he said, "which is significant depending on the area you are working in". A study into the use of ACP estimated a 5% fuel saving in temperate conditions, but this is contingent on climatic conditions, and tropical savings may be higher.

There is an increased consideration of the use of ORC systems on commercial ships as they offer 5%–10% in the power generation derived from exhaust gas and jacket water heat from DG sets and the main engines, but there would be challenges in delivering fuel such as hydrogen or ammonia at sea.

The Royal Navy is often seen as a 'reference navy' around the world and has a duty to adopt a leadership role

The combination of ESS, variable speed generators and a DC bus could lead to 6.4% fuel savings.

Overall, the Royal Navy needs to be bolder with its decisions. As one delegate said: "The biggest challenge for [the shipbuilding] industry is a customer that changes their mind so often that industry hasn't got the confidence to invest alongside them."

The Royal Navy is often seen as a 'reference navy' around the world and has a duty to adopt a leadership role even when it is difficult, said Admiral Paul Beattie, director naval staff, in his keynote speech.

"The Royal Navy will have to be resilient to the effects of climate change and needs the highest standards in the world. The people who join our service today and who are in our service today, whether military or civilian, absolutely and rightly expect us to address climate change and manage carefully our effect on the globe."

If the Royal Navy does not keep up with allies and the maritime industry, "it will affect our reputation and our ability to recruit the best people", he warned. ■

FIND OUT MORE

The IMarEST's International Naval Engineering Conference and Exhibition 2022 (INEC) takes place on 8–10 November at the AULA Conference Centre, TU Delft, Netherlands. INEC provides those who design, build, operate and maintain ships and submarines, including students and researchers, with a platform to share ideas, create networks, promote good practice and demonstrate excellence in this global and diverse domain. For more information or to register, go to imarest.org/events/category/categories/imarest-event/international-naval-engineering-conference-and-exhibition-2022

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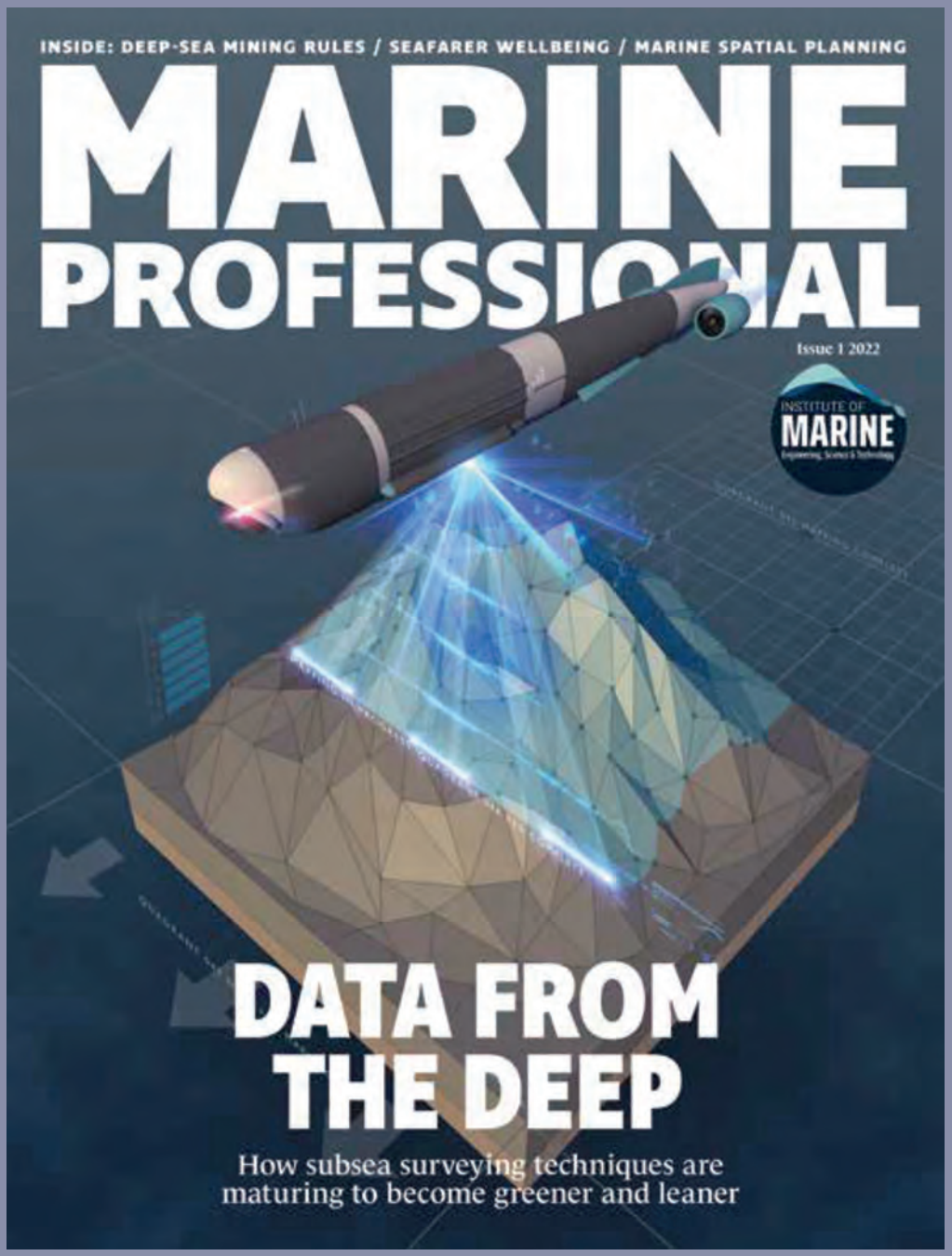

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The latest initiatives and member benefits from the IMarEST

What's new on IMarEST TV?

Decarbonisation is a common theme covered by the latest IMarEST Branch-hosted webinars and lectures.

The South East England & London Home Counties Branch welcomed speaker Dr Peng Wu, senior mechanical engineer at AqualisBraemar LOC, for a presentation on 'Decarbonising coastal shipping using fuel cells and batteries', based on his research on hybrid fuel cell/battery propulsion system design and intelligent operation.

Then, the Aberdeen Maritime Branch hosted Tristan Matthews, marine division manager at Alfa Laval, for his webinar on 'Sustainable shipping and decarbonisation', where he concluded that fuel choice for shipping is entering a new paradigm shift over the coming years and consequently, the 'ship of the future' will require a very different range of equipment and mindset.

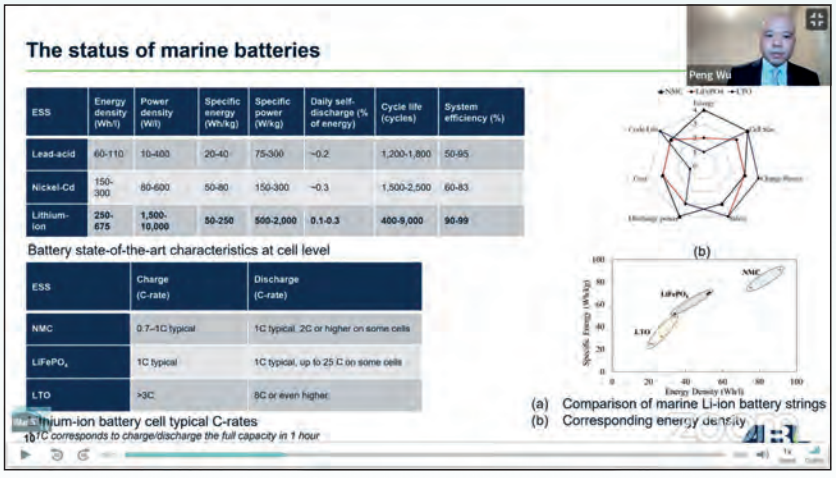
Speaker John Grant from Wärtsilä also presented to the Branch, covering the three interlinking themes of decarbonisation, future fuels and ongoing engine developments.

The Naval Engineering SIG looked at the topic of 'Electrification of the seas – from waveforms to warp drive'. With more than 30 years of experience electrifying the mining, renewables, marine and naval space, GE Power Conversion's Nick Smith shared his personal experiences on the challenges and successes of electrification in industry, but particularly in marine and naval applications.

New technologies

Meanwhile, Dave Barnard from Flexlife presented a webinar on 'Subsea ROVs in the offshore oil and gas industry' for the North East Coast Joint Branch, giving an overview of subsea remotely operated vehicles in the offshore oil and gas industry. Dr Linda Sørensen, head of HSEQ and human factors at Frontline Management AS, explored the issues faced by seafarers in operating ships while at sea during the Covid-19 pandemic. She discussed how such issues may affect the design of future ships and potential modifications to existing tonnage.

At the East of England Branch, a lecture on 'New ship specification and tender' saw Commodore Robert Dorey MA FIMarEST, director of operations at Trinity House, tell of the approach by Trinity House to address challenges at the specification, design and tender stages of ship procurement. CeraPhi Energy's Richard Jenkins presented an 'Introduction to geothermal energy' to the Branch that looked at the various technologies that can be deployed to provide heat and power from geothermal sources.



Dr Peng Wu presented on 'Decarbonising coastal shipping using fuel cells and batteries'

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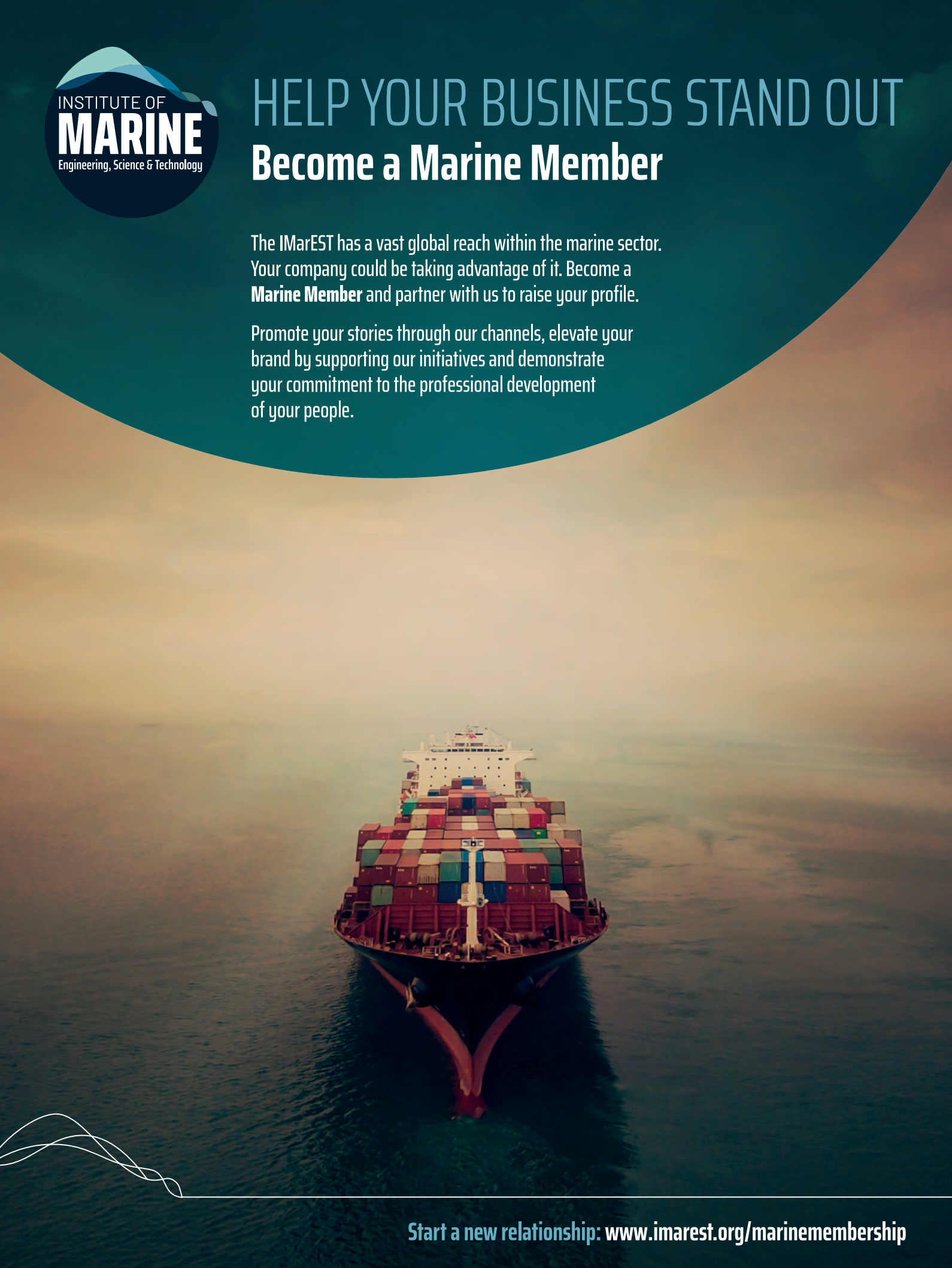

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News in brief

Refreshed Library for members

The IMarEST is pleased to announce the launch of a brand-new online Library, available now to all members. Replacing the previous platform, the new and improved Library features more than 10,000 records and items, dating back to the Institute of Marine Engineer's inception in the 1880s. Specific items can be found by searching for titles, authors or other search terms, but it is also now possible to browse entire collections, meaning all entries into a journal or magazine can be found. Bringing together records from across multiple digital platforms, the Library is a growing repository for research across the marine sector. In addition, two collections have been made publicly accessible with the support of BMT: the *Journal of Naval Engineering* archive and *Papers on Engineering Subjects*.

Aside from regular updates from the developer that will keep the Library easy to use, one feature that will be particularly of interest to members is the option to submit original published work. Members are invited to provide details of their published work for feature in the Library, ensuring that it continues to represent the entire IMarEST community. Users can also opt in to email alerts when material of interest to them is uploaded, as well as the option to share items of interest in private groups.

More information on the Library, as well as how-to-use video tutorials, have been sent via email to all members and you can visit now at **imarest.org/library**

Revised Human Element Checklist enters force

A revision of the IMO Human Element Checklist submitted to the IMO by the Human Element Industry Group (HEIG) – of which the IMarEST is a member – has been approved by the Marine Safety Committee and Marine Environment Protection Committee.

Martin Shaw, President Elect and past chair of the IMarEST Human Element SIG and HEIG representative, says: "The correct use of this checklist will ensure that the Human Element and other operational issues are considered at the earliest stage of developing new 'outputs' by IMO to ensure any changes that affect the operations of ships have been risk assessed and mitigations put in place. In addition to the effect on safety, it should also reduce implementation and operation costs."

The HEIG raised its concerns in 2018 about the effectiveness of the original checklist, which was introduced in 2006. The group felt that while initially effective, changes in IMO process and organisation had reduced its effectiveness, and analysis by the group confirmed that the checklist was not being properly completed.

The IMO unanimously approved and welcomed the proposal for a revision by HEIG members. Having been delayed for two years due to the Covid-19 pandemic, the revisions were recently reviewed and accepted. Shaw adds: "Both original and revised versions cover issues that go beyond a strict interpretation of the human element. This was maintained in the revision to ensure important issues were not missed and to avoid the creation of a second document. The new document could be better described as a 'Management of Change' process."

IMarEST accreditation

Demand continues to grow for marine engineering courses to be accredited by the IMarEST, with around 100 academic courses from higher education institutions, in addition to a number of globally accredited industry schemes.

The IMarEST is seeing an increase in demand for the Institute's independent assessment of activities that contribute to continuing professional development, such as training courses or events offered by companies from across the marine sector.

2022 European International Submarine Races

The IMarEST's European International Submarine Races, hosted by QinetiQ, saw teams of students from the Universities of Southampton and Warwick in the UK, and from the US, Canada, Germany and Taiwan competing against each other.

This year's winner was Rhine-Waal University of Applied Sciences, Germany, and the runner-up was the University of Michigan, US. The École de Technologie Supérieure from Montreal, Canada, won the BMT Award for Innovation; Rhine-Waal also took home the UKNEST Agility Award.

DIARY DATES

8–10 NOVEMBER
International Naval Engineering Conference and Exhibition 2022, Delft, Netherlands

8–10 NOVEMBER
International Ship Control Systems Symposium 2022, Delft, Netherlands

"As engineers, we have an ethical responsibility towards society"

Engineer and oceanographer **Vic Grosjean** on why he launched the Ocean Innovators series to support an ocean sustainable development goal

BY CARLY FIELDS

Q: What does your current role involve?
I wear many hats. I am a mechatronics engineer, a university lecturer and the CEO of OceanX Group in Australia. My roles involve developing and integrating innovative technologies to monitor and protect the environment. My career focus is to build cooperation between organisations to preserve the future of our oceans, promote peace and support the environment. I work a lot with developing communities. With a large portfolio of coastal projects acquired over 16 years of ocean-related work, I specialise in integrating nature-based solutions, social innovation and smart engineering technologies applied to environmental monitoring.

Q: What is it about your role that excites you most?
I thrive to support developing coastal communities most at risk of climate change and pollution. I truly believe that, as engineers, we have an ethical responsibility towards society. The favourite part of my job is giving back to the community through awareness and education. This is why I launched the Ocean Innovators video series to promote innovative solutions helping to protect our oceans.

Q: What's the most important lesson you've learned in your career?
I have learnt that sometimes the solutions of today can become the problems of tomorrow. Society has a tendency to promote engineering solutions over social and nature-based solutions. On average, engineering solutions are 90% more expensive than traditional well-implemented nature-based solutions in developing countries. One key to better integrate engineering solutions is to support local initiatives, engage with local communities and traditional owners.

Q: What opportunities are opening up for the marine sector now?
Humanity has recently entered a new era. Climate change and global instabilities are completely reshaping our world, our trades and our levels of security. I am truly convinced that the marine sector has a critical role to play in this new world order. To foster sustainable development, we must support small island nations and invest in coastal communities.

Q: What would you like to change in the current marine landscape?
We absolutely need more investment in the current marine landscape. Did you know that UN Sustainable Development Goal number 14, 'Life Below Water', is currently one of the least-funded sustainable development goals? Obviously, if we fail to achieve a goal linked to the biosphere, it will immediately compromise the other goals.

Q: What are the main challenges and opportunities facing the marine sector right now?
Industry 4.0 is what we call the Fourth Industrial Revolution. Many opportunities lie in ever-increasing interconnectivity and smart automation in the marine sector. Our biggest challenges are encouraging diversity and inclusion, and better cooperation with developing countries.

Q: Where do you see your career going over the next 10 years?
Supporting multilateral organisations to launch academic programmes, which will bring together ocean engineering and the knowledge of traditional owners.

"Climate change and global instabilities are completely reshaping our world"

Vic Grosjean is CEO of OceanX Group and executive producer of the Ocean Innovators video series, which features key solutions to help save oceans.

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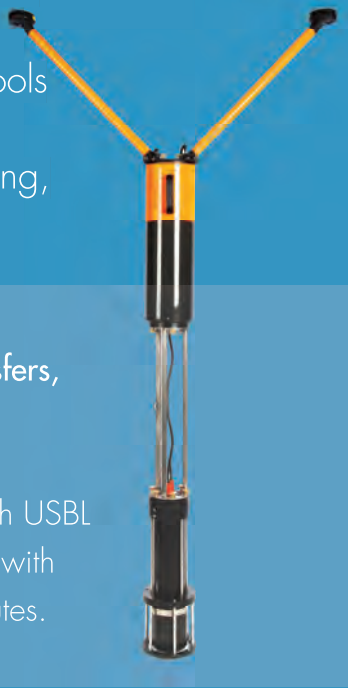

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