MARITIME REPORTER AND ENGINEERING NEWS

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June 2024

Digitalization & Leveraging

Digital Twins

Since 1939 | Number 6 | Volume 86

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U.S. Harbor Craft

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NO.6 / VOL. 86 / JUNE 2024

26

Departments

Photo on the cover: Fairbanks Morse Defense | Image this page: General Dynamics Mission Systems

The American Society of Naval Engineers
Upcoming Symposia

Multi-Agency Craft Conference
MACC
July 16-18, 2024
Renaissance Hotel, Portsmouth, VA

FMMS
Fleet Maintenance & Modernization Symposium

SEPTEMBER 16-19, 2024
VIRGINIA BEACH CONVENTION CENTER, VIRGINIA BEACH, VA

www.navalengineers.org/Symposia

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The transition happening in maritime is undeniable, as emission reduction/ decarbonization, digitalization, automation and the plight of the seafaring community globally grab headlines. But the big question revolves around the pace of change. Looking at what is currently on the IMOs regulation docket in regards to the big one – decarbonization – yes, there is a timeline in place, but there is ample wiggle room to determine how and when those targets are met.I 'm writing this from Athens, Greece, on the sidelines of Posidonia 2024, an exhibition which sits at the seat of global shipping. One particular conference featured multiple presentations on the latest technologies to enable the emission reduction quest – from carbon capture to fuel transition and the incorporation of new 'green' fuels to leveraging the latest in digital capabilities. When the presentations concluded and questions came from the audience, one notable Greek shipowner delivered a statement disguised as a question and essentially boils down to: 'everyone keeps talking about the technology, nobody talks about the cost: how much is all of this going to cost?' In shipping as in all aspects of business and life, the bottom line is the cost.

As this is our "Digitalization" edition, I'm really happy to present my recent conversation with **Trey Taylor**, Director of Digital Innovation, Fairbanks Morse Defense (FMD), who discussed FMD's position and offering on digital twin technology with insight on what it can help save, what it can help shipowners to do, and yes, lo and behold, what it costs. His story starts on page 24.

On the subject of Digital Twins, this, too, was the topic of our new ***"Maritime Matters: The MarineLink Podcast"***, a podcast which featured **Patrick Ryan**, SVP & CTO, ABS; **Juan Prieto**, Regional Manager Americas, Cadmatic; and **Pete Sinclair**, Director of Technical Services, Fincantieri Bay Shipbuilding. Having been in this seat for 30+ years, I am always loathe to call any conversation, story or topic a 'favorite', and I won't do it here either, though I will say this 40-minute podcast conversation was one of my 'Top 2' conversations of the year!

Why? All three executives were free in sharing not simply the ivory tower, corporatized speak on digital twins, rather in my humble opinion they were offering up real, grass roots, granular detail on how digital twin technology can be used in the U.S. shipbuilding environment. Best of all, in many instances they simply left me out of the conversation and interacted directly with each other, resulting in some good and useful points emerging. But please, don't believe me, have a listen or a watch yourself by **scanning the QR code above**, and feel free to share your thoughts on the content. Also, if you have a topic you feel would be good fodder for a future podcast, reach out to me via email.

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AI to Maritime Trainers: "Watch Your Back" [*Part 2]*

By Murray Goldberg, CEO, Marine Learning Systems

Last month's Training Tips for Ships discussed the role of Artificial Intelligence (AI) in the future of maritime training. My thoughts on this were triggered by the recent headline in the Financial Times: "Andreessen Horowitz raises $7.2bn and sets sights on AI start-ups". Andreessen Horowitz is one of Silicon Valley's most prominent venture capital firms and they are seeing fit to deeply invest in the burgeoning AI revolution. Typically, this means change is upon us on a timescale that is now very meaningful to us. As I said in last month's article, AI is no longer a "tomorrow" thing. It is a "today" thing.

The question at hand for the purposes of Training Tips for Ships is whether AI will replace us as maritime trainers. Last month we made the argument that it could. This month, we look at the more comforting (to some) counter arguments - those supporting the idea that AI could never fully replace us humans in our role as maritime trainers. The strongest arguments against AI fully replacing us tend to focus on the human element or the soft skills that trainers bring to the training experience. Can an AI replicate these? It depends on your opinion of what the future brings - so let's look at some examples of these arguments.

Our first argument focuses on the role that the emotional connection between trainer and trainee plays in the learning experience. Many argue that AI would struggle to form these genuine connections and therefore would be unable to understand the deeper nuances of human emotions. Human empathy, intuition, and the ability to build trust would be compromised and it is reasonable to think that their lack could affect the training experience.

Another argument focuses on AI's simple lack of a physical body, and the experience derived from using that body in a maritime setting. AI might be able to simulate or model physical skills, but the learnings gained from actually performing these tasks in real-world conditions is (for now) unique to humans. Maritime trainers' firsthand experiences allow them to convey subtle, real-world insights that an AI might struggle to understand and convey. On the other side of this, any aspects of maritime training that require the demonstration of physical skills could obviously pose a problem for an AI. How can it get around this basic issue?

A third argument comes in the form of an AI's ability to mentor a trainee and act as a role model. The role of a mentor goes beyond knowledge transfer; it involves inspiring, motivating, and guiding individuals in their careers. The mentor-mentee relationship is deeply personal and relational, requiring trust, respect, and confidence. This is something that an AI, no matter how advanced, might find hard to authentically replicate.

This brings us to the fundamental questions of trust and credibility. To truly act as an effective trainer and mentor, the

trainer must earn the trust of the trainee. Trainees trust trainers who share their experiences, who can demonstrate expertise, and who have "been there and done that". Trust is a fundamental element in quality training relationships. Human trainers earn credibility through their careers and personal connections, while AI, regardless of sophistication, might have a hard time establishing the same level of trust.

We expect that AIs, at least in certain areas, will greatly surpass human abilities. They already have. However, all the above examples rely on the assumption that there will be limits on how authentically an AI can reproduce human thoughts and emotions. But remember - the endgame of AI research is not to mimic the thoughts of humans, but rather to generate an intelligence that actually has those thoughts, emotions and (eventually) experiences. If AI research gets there (and in my opinion it certainly will), then the only remaining argument against AI replacing human trainers is whether the humans being trained are biased against AIs and therefore inherently skeptical of them as trainers. But if AIs actually become excellent trainers, then even this impediment will likely be short lived.

And, of course, this article ignores the potentially bigger question of whether we will need to train humans at all in our future AI-populated maritime environment.

No one can tell us with certainty what the future holds for AI and its effects on us and the maritime world. It is simply too unknown and complex to reliably predict. Therefore, we will have to wait and see. But with absolute certainty we can say that change is coming, that it will not take long, and that it will not be boring.

Thank you for reading and until next time, train well and sail safely.

The Author

Goldberg

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SL-7

Using an SL-7 to Preserve our Container Ship History?

By Rik van Hemmen

I have raised the subject of SL-7's as museum ships before in a cursory fashion, but lunch with John Riddle, a retired Sea-Lander, convinced us that it deserves a bit more consideration.

Based on prior columns it should be clear I am extremely cagey about museum ships. Ships are significant historic object, but due to their size they are often impossible to maintain as historical objects. Moreover, we maritime types tend to become sentimental about historic vessels and then discover that the rest of the world really does not care that much about our maritime history and museum ships tend to struggle to survive due to a lack of the larger population's attention.

Meanwhile, maritime continues to make history and, within the lifetime of our older sailors in arms, we turned the world upside down with the introduction of containerization.

The United States and, to a significant extent Malcolm McLean, but also many other Americans, can fairly lay claim to being the originators of the concept. Somehow this is worthy of memorialization, but, to date, no effort in this regard has been made.

Worse, the first containers ships have all long gone to the scrap yard, and the question arises as to how we would preserve the history of the container ship.

In this regard I would like to make a modest (well maybe an ambitious, but efficient) proposal.

The SL-7's are nearing the end of their lives and maybe not soon, but certainly inevitably, will end up being

scrapped. Why don't we take one of those ships and designate it today as a museum ship?

Then, when the bell tolls for the SL-7's, we know what we need to do.

We get to take one of them, and I propose the Ex-Malcolm McLean, the present Capella, and turn it into the container history museum. I think it is historically and physically an excellent vessel to turn into a museum vessel.

One would initially think it would not do the job, because it is no longer a container vessel, but a container vessel would make a horrible museum ship. And quite frankly we don't need a container vessel to make a proper containerization museum. Anybody can see a container vessel anywhere in the world at any time. What we need is a space to exhibit the bits and pieces that make up containerization and since this stuff is big, we will need a lot of volume and with the Capella that volume exist within the hull of a truly historic vessel.

Let's first discuss the vessel's history. In the late sixties, Malcolm Mclean's concept was advancing at full speed and the rest of the world had to take notice and follow suit. All over the world, shipowners were scrapping breakbulk cargo ships and building container ships, but Sea-Land was already thinking in terms of the next step and decided to build 8 huge and superfast container ships to dominate the Atlantic trade. These ships were built in Holland and Germany for service under the US flag.

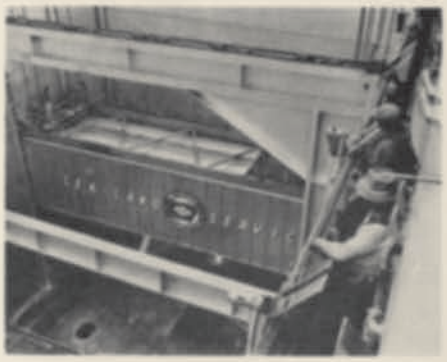
They were a complete tour de force, and while they had teething problems and were quickly hit with the increased cost of fuel due to the oil crisis, they were the world's maritime technical highlight of the early 1970's and discussed, admired and feared all over the world.

Many claim they failed because they were fuel hogs. That was actually not true, because at reduced speed they were very efficient and seaworthy vessels and easily competed against other container ships.

But there was another issue. Sea-Land had selected 35 foot containers as their standard. To prevent Sea-Land from gaining world dominance, the rest of the world ganged up on Sea-Land and selected a standard size (40 feet) that could not fit within the cellular

Pan-Atlantic says:

Lift-On, Lift-Off



. . . . For Faster Cargo Service

ON THE COVER — Specially-designed gantry cranes lift a loaded trailer body from its detachable chassis to swing it aboard the SS Gateway City. Two such cranes are mounted on the vessel's superstructure and move along tracks on the ship's sides for loading fore and aft.

"The greatest advance made by the United States Merchant Marine in our time," said Representative **Herbert C. Bonner** (D., N.C.), Chairman of the House Merchant Marine Committee.

"An answer to the Navy's prayer for speedier transportation," said Vice-Admiral **John M. Will,** Commander of the Military Sea Transportation Service.

These respected maritime leaders were commenting on the Pan-Atlantic Steamship Corporation's "Operation Lift." Their remarks were made on a pier at Port Newark, N. J., where they watched longshoremen load the trailership Gateway City at the record rate of 2½4 tons an hour for each hatch worked. Before her $3,500,000 conversion from a conventional C-2 freighter, the top rate for loading the Gateway City was 40 tons an hour for a larger number of longshoremen.

Malcom P. McLean, President of McLean Industries, Inc., parent company of Pan-Atlantic, said that his company expects to increase the loading rate as the dock workers become familiar with the ship's loading equipment.

That equipment consists of two gantry cranes that move forward and aft on the vessel's main deck, and hatches and hatch openings redesigned to receive loaded truck vans.

When in port the cranes pick up a van from a trailer truck after it has been detached from the chassis by pushing two levers. The van is hoisted aboard and deposited in the ship's hold or on deck. The entire process of picking up a loaded van, depositing it in the hold and returning for the next van takes four-and-a-half minutes. Each loaded van carries about 22 tons.

When at sea the crane arms are folded like a bird's wings until the ship reaches the next port. At the next port, the loading process is reversed.

This new type of ship, which requires no shore installation except a road giving access to the pier, is being hailed by shipping officials as a way of revitalizing coastwise and intercoastal shipping.

By cutting down loading and unloading costs and time, the Gateway City and similar ships will be in a position to compete with over-the-road trucking and rail transport, saving from five to 25 per cent for the shipper, according to Mr. **McLean.**

The 15-knot Gateway City left Port Newark at 1 P.M., Friday October 4, carrying 226 trailers loaded with 4,500 tons of cargo including aspirin, beer and bubble gum. It landed its first trailer at Miami at 7 A.M. on Monday and by 8:30 A.M., the trailer had been delivered to its consignee.

The Gateway City regularly will move cargo both ways over a route embracing the ports of New York, Miami, Tampa and Houston. Following her into this trade is Pan-Atlantic's SS Azalea City, which, like the Gateway City, has been converted to a trailership by Mobile Ship Repair, Inc., Chickasaw, Ala. Four more Pan-Atlantic trailerships currently are being converted at Mobile. It is expected that all six of the converted vessels will be in service by January 1958. All are conversions of the C-2-type dry-cargo ship, which is 468 feet seven inches long over-all. Each conversion maintains the same cargo cubic footage as the conventional C-2.

Pan-Atlantic has been using T-2 tankers with deck equipment to initiate this service, but the combination of tanker and cargo ship proved awkward on this route. The new trailerships will eventually supplant them.

OPERATION LIFT. (Top) Gateway City's cargo is carried in aluminum vans 35 feet long, 8 feet 6½ inches high and 8 feet wide. (Center) Loaded van is lowered into hold. The holds have been specially machined to keep the trailer bodies in place during the sea voyage. (Bottom) The loaded trailership departs on a voyage which is a sea link between truck routes.

Maritime Reporter & Engineering News, November 1, 1957 edition

structure of these beautiful ships. In an elegant turn of game theory, a 35 footer could, with some adjustment, fit in a 40 foot slot, but not the other way around. Worse, it was simply impossible to reconfigure the SL-7's for 40 foot containers. With ever increasing acceptance of 40 footers, the SL-7's suddenly became less attractive.

Remarkably, in this environment Sea-Land ran the SL-7's until the early 1980's. Sea-Land ended up focusing on optimizing these vessels for running refrigerated cargo containers for which Sea-Land managed to maintain dominance using 35 foot containers.

In the early 1980's Sea-Land sold these vessels to the US Government who desperately needed Sea-Lift capacity. Turning these large and fast vessels into high speed RO/RO's was a no brainer. In many ways the converted SL-7's were even more historic, since in a number of recent wars they moved more arms and materials than any other class of vessels.

They have been reasonably well maintained by the US government over the years, and now they are the only true historical surviving vessels from the early days of containerization.

While maintaining large ships is very expensive, the generally flush decked arrangement of these vessels results in a much lower coating maintenance bill than an actual container ship or, say, a passenger ship, and there is plenty of space on deck to fit solar for interior lighting, heating and cooling.

Almost incredibly, in their present RO/RO guise, I cannot think of a better facility for displaying the hardware associated with intermodal cargo movement.

On some of the decks we can display different types of containers, hustlers, spreaders, chassis and even railroad cars. On other decks there can be traditional museum displays on the history of containerization and transportation in general. But why just stop at containerization? Why not provide displays on global economies and the effect of containers on the world at large (good and bad), and how about a display on container homes even right inside the vessel?

These is even sufficient space on these decks to set up a scale container logistics system, where kids can control model cranes, ships in pools, and trains to move cargo intermodally. We are talking about a train set to end all train sets, and indoors at that.

These ships are remarkable event spaces that exceed the capabilities of aircraft carriers which have hangar decks, but for the rest are very tightly packed and therefore make awkward displays. The SL-7 RO/RO were actually designed for massive open internal volume.

Wheelchair access? Are you kidding? It is built in, and with the ramps deployed, no gangways are needed.

The possibilities boggle the mind.

So where should we berth a vessel like this? I am open to suggestions, but let's not forget that the Port of New York, and really New Jersey, is the birthplace of Sea-Land. Anywhere near Port Elizabeth would do it, and be deserving of New Jersey's status as a logistics hub. But money talks; any other state or port that is interested?

For every column I write **Maritime Reporter & Engineering News** has agreed to make a small contribution to an organization of my choice. For this column I select the **National Maritime Historical Society, www.seahistory.org** . Maybe they can provide this concept a little push.

The Author

van Hemmen

Rik van Hemmen is the President of Martin & Ottaway, a marine consulting firm that specializes in the resolution of technical, operational and financial issues.

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US Harbor Craft: Measuring Opportunity for Zero Emissions

By Eric Haun

There are more than 4,000 harbor craft vessels in the U.S. deemed highly suited for zero-emissions operations, according to a recent report produced by CALSTART in partnership with Intelatus Global Partners.

The report, "Sizing the U.S. and California Harbor Craft Market", looked at the U.S. commercial harbor craft and inland and nearshore vessels above 600 kilowatts (kW) or 805 brake horsepower. Approximately 10,000 vessels were counted in total, including crew and supply boats, ferries and excursion vessels, fishing vessels, pilot boats, towboats, tugboats, workboats and other vessel types.

Of those vessels, 4,405 were identified as most suitable for hydrogen or electric zero-emission operations, including ferries, pilot boats, towboats and tugboats. More than half of these (58%) are towboats, and some 56% are 25 years of age or older.

In Service CAT 1 Harbor Craft by Age Group

Age Group	Ferry	Pilot	Towboat	Tugboat	Total
0-5	56	2	199	7	**264**
6-10	85		331	67	**483**
11-15	46	1	317	113	**477**
16-20	78		205	138	**421**
20-25	98	2	118	80	**298**
≥25	500	1	1,385	576	**2,462**
Total	**863**	**6**	**2,555**	**981**	**4,405**

Source: Intelatus Global Partners

"The 2,462 older vessels represent the lower hanging fruit in terms of suitability for replacement or repowering with zero-emission solutions, whether hydrogen, fully electric or other zero-emission technology," said Philip Lewis, director of research at Intelatus Global Partners.

Vessel owners seeking to slash emissions from their operations can choose from a bouquet of energy carrier and converter options, though a great number of factors must be considered—often on a case-by-case basis to meet the given needs of a specific vessel and its operational profile.

"In the short-sea and inland segment, the most suitable zero-emission options include renewable based hydrogen, hydrogen-based fuels and renewable electricity stored in battery energy storage systems," Lewis said. "All the options have advantages and disadvantages, chief among which is the cost and availability of zero-emission fuel, the certification that a fuel is truly zero-emission and the availability of infrastructure and equipment to produce, distribute and convert zero-emission fuels. As the energy transition continues to gather pace, these challenges will, in theory, be addressed."

Increasingly, global, regional, national and local agencies are promoting various measures aimed at reducing harmful emissions from the maritime sector. As a result of this regulatory environment, as well as growing commercial pressures to prioritize environmental, social and governance (ESG) objectives, the adoption of zero-emission vessels is accelerating, though technical and financial challenges remain.

"In the U.S., the focus of standards is tilted toward the reduction of NOx and particulate matter PM," Lewis noted. "California is in a unique position that it can set its own emission standards, which are currently higher than those mandated by the federal Environmental Protection Agency (EPA). Where feasible, California encourages the use of

CALSTART is leading the HyZET project to develop a tugboat that runs fully on hydrogen fuel.

zero-emission options."

The CALSTART-Intelatus study, funded in part by the Clean Off-Road Equipment Incentive Project (CORE), profiled the U.S. harbor craft fleet, but also dialed in specifically on California, finding 676 registered vessels in the state that meet the report's criteria. Of the 360 (53%) vessels determined to be in service, slightly more than two thirds are classed highly suitable for a transition to zero emissions operations.

In Service Cat 1 California Harbor Craft

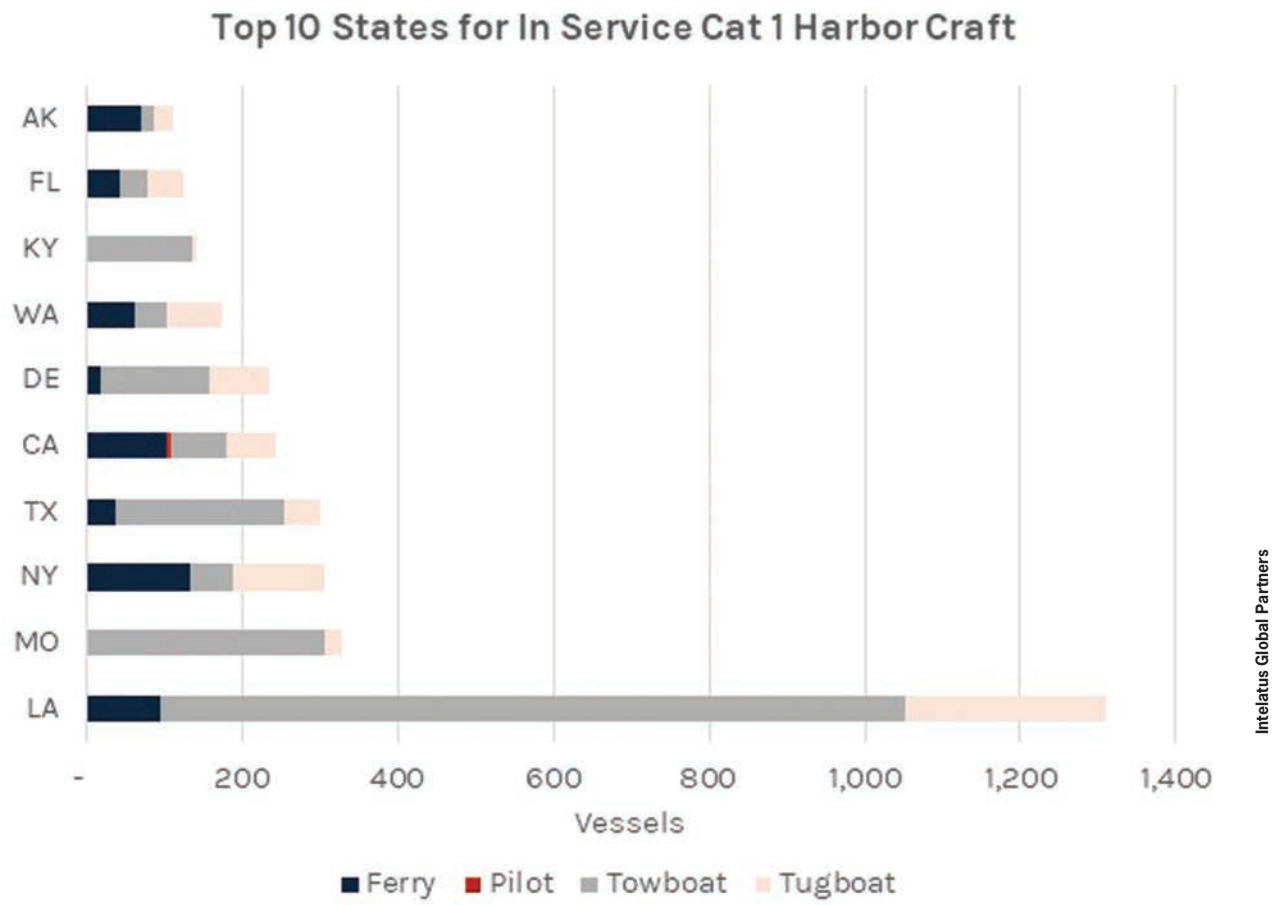
Age Group	Ferry	Pilot	Towboat	Tugboat	Total
0-5	3	2	5	1	**11**
6-10	10		3	5	**18**
11-15	5	1	9	4	**19**
16-20	7		5	11	**23**
20-25	13	2	3	9	**27**
≥25	66		45	35	**146**
Total	**104**	**5**	**70**	**65**	**244**

Source: Intelatus Global Partners

CALSTART is currently leading a team of industry experts, including Crowley, ABB, DNV, Chart Industries, Ballard Fuel Cell Systems and the Port of Los Angeles, in a project called HyZET, which aims to develop a fully hydrogen-powered tugboat.

Lewis said that in California tugboats are considered the closest segment technically for the adoption of the HyZET technology, compared to, say, the towboat segment, which in California includes a number of oceangoing ATBs that may prove less ready for the HyZET concept compared to, for example, towboats operating on the Mississippi River.

"The ferry and excursion vessels and pilot boats, especially those operating on the routine ferry routes, are generally well suited for zero-emission technologies, such as hydrogen and electricity," Lewis added. "That said, some of the excursion vessels that venture further offshore may be less suited for short - and medium-term transition to hydrogen or fully electric technology."



The vast majority (73%) of the U.S. harbor craft fleet is located within 10 states: Alaska, California, Delaware, Florida, Louisiana, Massachusetts, Missouri, New York, Texas and Washington.

AI and the Evolving Cyber Threat

By Scott Blough & Taylor Romero, *Mandiant, Part of Google Cloud*

The maritime transportation system is undergoing a digital revolution. Automation and artificial intelligence (AI) are transforming how ships operate and cargo moves. However, this increased reliance on technology creates a double-edged sword: while AI offers powerful tools for cybersecurity, it also presents new vulnerabilities. This article explores the growing threat of adversarial AI (AAI) in maritime cyber security and how the industry can navigate these challenging waters.

AI: Guardian of the Seas

AI is becoming a vital tool in the fight against cybercrime. Here's how it bolsters maritime cyber defenses:

- **Enhanced Threat Detection:** AI algorithms can analyze vast amounts of data in real-time, identifying subtle anomalies that might indicate a cyberattack in its early stages.
- **Proactive Vulnerability Management:** AI-powered tools can continuously scan shipboard systems and software for weaknesses, allowing for patching before attackers exploit them.
- **Advanced Intrusion Prevention:** AI-powered Intrusion Detection and Prevention Systems (IDPS) can learn to recognize the signatures of known cyber threats and even detect zero-day attacks that exploit previously unknown vulnerabilities.

The Dark Tide: Adversarial AI

However, as AI becomes more sophisticated, so do cybercriminals. Adversarial AI (AAI) poses a significant threat to maritime cyber security:

- **Bypassing AI Defenses:** Malicious actors can craft data specifically designed to deceive AI threat detection systems. For instance, they could manipulate AIS data to make a ship appear legitimate while masking its true intentions.
- **Data Poisoning:** By manipulating the training data used for AI cybersecurity models, attackers could compromise the models themselves, leading them to overlook real threats or misclassify legitimate activity as malicious.
- **Exploiting AI Weaknesses:** AAI can identify vulnerabilities in AI-powered security systems, allowing attackers to bypass defenses or gain unauthorized access to critical systems.

Navigating the Grey Zone

The evolving cyber landscape also presents challenges beyond traditional attacks. Grey zone operations blur the lines between legitimate and malicious activity, making them particularly difficult to detect:

- **False Flag Attacks:** Disguising attacks to appear as if they originate from another nation or entity creates confusion and hampers attribution.
- **Information Warfare:** Manipulating maritime data, such as falsifying AIS signals, can disrupt navigation or mislead competitors, causing economic damage.
- **Supply Chain Infiltration:** Targeting vulnerable suppliers upstream can grant attackers access to critical maritime systems further down the line.

Charting a Course to Secure Seas

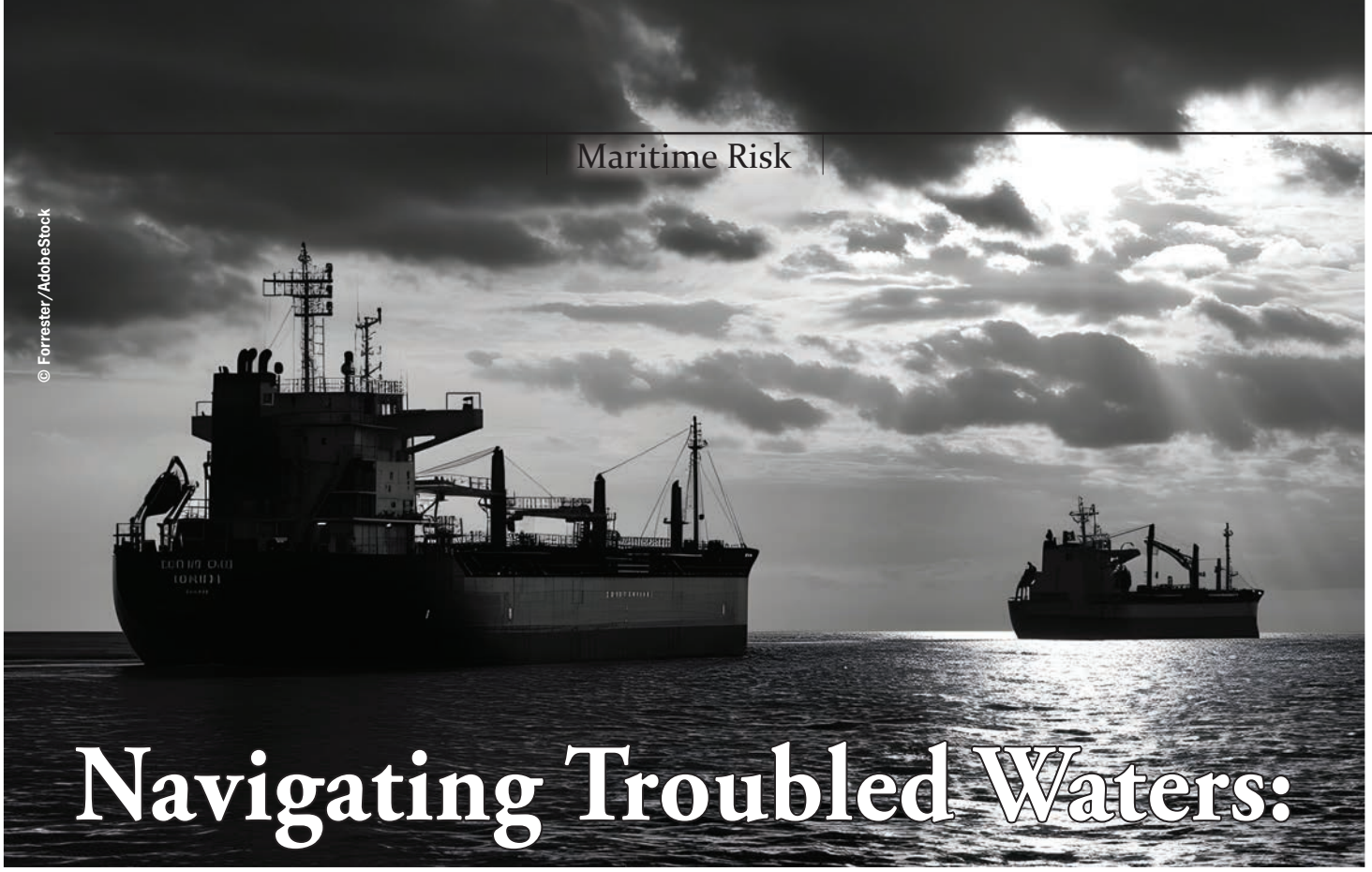
To combat these threats, the maritime industry needs a multi-pronged approach:

- **Adversarial Training:** Simulating AAI attacks on AI cybersecurity models to expose vulnerabilities before attackers do.
- **Explainable AI:** When AI models flag threats, it's crucial to understand their reasoning. Explainable AI techniques can help analysts determine the legitimacy of a threat.
- **Human-AI Collaboration:** AI should augment, not replace, human security expertise. Analysts need to work alongside AI to investigate and respond to potential threats.
- **Industry-Wide Cooperation:** Sharing threat intelligence and best practices between shipping companies, port authorities, and security agencies is crucial to stay ahead of evolving threats.

Conclusion

The maritime transportation system is entering a new era of AI-powered efficiency. However, this progress necessitates a heightened awareness of the risks posed by adversarial AI. By proactively addressing these challenges through collaborative efforts and strategic investments in cybersecurity, the industry can navigate these adversarial seas and ensure the safe and secure flow of global trade.

This is an excerpt from a panel to be presented at Maritime Risk Symposium 2024, scheduled for June 11-13, 2024 at Naval Postgraduate School (NPS) in Monterey, CA. Register here: https://www.maritimerisksymposium.org/



Navigating Troubled Waters:

Current Trends in Marine Risk

By Captain Rahul Khanna, *Global Head of Marine Risk Consulting, Allianz Commercial*

Recent incidents in the wake of the conflict in Gaza have demonstrated the increasing vulnerability of global shipping to proxy wars and disputes. Between November 19, 2023, and the beginning of April 2024, there were more than 50 attacks against merchant shipping in the Red Sea by Houthi militants in response to the conflict. We have also seen the first total loss of a vessel, the first fatal attack, as well as signs that the crisis may have spread following the seizure of a container ship by Iranian forces in the Strait of Hormuz, the world's most important chokepoint for oil shipping.

While we have seen sporadic attacks in the past, the conflict in Gaza has opened the flood gates. Even if a political solution is reached, we may see attacks continue as there is clearly now an opportunity for those wishing to disrupt shipping in the Red Sea and beyond. Ultimately, shipping has become a ripe target for those wishing to wage a proxy war. It opens avenues for terrorists or militia groups to get recognition and hit global markets.

Attacks Put Crew Welfare in the Spotlight

One of the biggest concerns resulting from the attacks is the safety and wellbeing of seafarers. Hundreds of crew have been affected in the Red Sea alone, the latest crisis to impact shipping routes in recent years following the Covid-19 pandemic and Ukraine war, both of which left many seafarers stressed and fatigued having spent months at sea.

Seafarers are on the front line, putting their lives at risk daily. The maritime industry is already grappling with a workforce and skills shortage and there is a great concern that the crises of recent years will impact our ability to attract talent at a time when it must meet growing demands from decarbonization and an increasing reliance on technology.

Drones & Cyber:
Shipping Faces Worrying Threat from New Tech

The war in Ukraine and the Red Sea attacks have also revealed the increasing threat to commercial shipping posed by drones, which are relatively cheap and easy to make, and difficult to defend against without a large naval presence.

Houthi militants have used a wide range of weapons and attack methods against shipping in the Red Sea and the neighboring Gulf of Aden, such as anti-ship missiles and large aerial drones, including so-called 'loitering munitions' that circle an area before targeting the vessel.

Looking to the future, more technologically driven attacks

against shipping and ports are a distinct possibility. Reports of vessels experiencing GPS interference and jamming, which can result in lost or inaccurate signals affecting navigation are increasing, particularly in hotspots such as the Strait of Hormuz, the Mediterranean and the Black Sea. Vessels' Automatic Identification Systems (AIS) can also be spoofed and are open to cyber-attack.

Rerouting Brings Challenges

Attacks against shipping in the Red Sea and Middle East waters, closely following on from the ongoing disruption caused by drought in the Panama Canal, have amounted to a double strike for shipping, causing more issues for global supply chains and adding to the distance vessels must sail.

The Red Sea attacks have severely impacted Suez Canal transits, while a lack of rain and the El Nino phenomenon contributed to the second driest year in the Panama Canal's history, also affecting transits. Both routes are critical for the transport of manufactured goods and energy between Asia, Europe, and the US East Coast.

At the start of 2024 transits in the Suez and Panama canals were down by more than 42% and 49% respectively, compared to their peaks. Whichever route vessels take, they face lengthy diversions and increased costs. For example, avoiding the Suez Canal adds at least 3,000 nautical miles and 10 days sailing time to each trip, rerouting via the Cape of Good Hope.

Businesses that source goods and components from factories in China and South-East Asia have faced delays and higher costs from longer transit times. Some reported rises of 300% for container hire, and logistical delays, adding up to three to four weeks to delivery times, creating cashflow difficulties, and component shortages on production lines.

Such experiences have thrown the shipping industry and the issue of supply chain resilience into the public consciousness. Supply chains have been disrupted by a series of events in recent years, from extreme weather and climate incidents, container ship fires and groundings, through to the pandemic and conflicts in Ukraine and the Middle East, not forgetting the recent Baltimore bridge collapse.

In today's interconnected environment it is even more important to have a 'Plan B' and alternative options. An unexpected event can have a domino effect globally. Shippers around the world should consider diversification of their supply chains and in some cases nearshoring and onshoring might be an option.

Other areas impacted include container capacity, older vessels being kept in service as longer journeys means an increasing demand for ships, inflation – according to Allianz Trade analysis, a prolonged period of disruption in the Red Sea could cause it to increase by +0.5% – as well as the environment. The disruption in the Red Sea, combined with factors linked to the Panama Canal and the Black Sea in the wake of the Ukraine war, could erode the environmental gains achieved through 'slow steaming', as rerouted vessels increase speeds to cover longer distances.

Somalia Piracy Threat Re-emerges

The past year has seen maritime piracy rise. There were 120 reported incidents against ships in 2023, up on 2022. A big concern is the re-emergence of piracy off the Horn of Africa amid the wider security concerns in the neighboring Red Sea.

In December 2023, the bulk carrier Ruen was hijacked, the first reported successful hijacking by Somali pirates since 2017. Between 2005 and 2011, they seized 149 ships and over 3,700 crew for ransoms totaling more than an estimated $300m. A further three vessels were attacked in January 2024, while in March 2023, the bulk carrier Abdullah was hijacked, reportedly only being released after paying a ransom, sparking fears this could encourage further attacks.

Ukraine War & the 'Shadow Fleet'

A gradual tightening of international sanctions on Russian oil and gas exports over the past three years since its invasion of Ukraine has resulted in the emergence of a sizable 'shadow fleet' of tankers, mostly older vessels that operate outside international regulation and often without proper insurance. This situation presents serious environmental and safety risks in key chokepoints where oil is shipped.

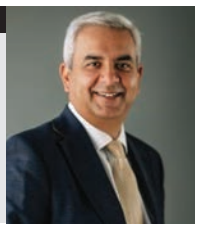
Russia is not the only country to operate a shadow fleet. Iran and Venezuela have used such tankers to circumvent sanctions and maintain oil exports. Estimates put the size of the dark fleet at between 600 to 1,400 vessels, roughly a fifth of the overall global crude oil tanker fleet.

Much of the shadow fleet is likely poorly maintained and may not have undergone appropriate inspections. Shadow tankers also participate in the dangerous practice of ship-to-ship transfers in the open ocean, as well as turning off Automatic Identification System (AIS) transponders to obscure their identity. Vessels have been involved in at least 50 incidents to date, including fires, engine failures, collisions, loss of steerage, and oil spills. The cost of dealing with these incidents often falls on governments or other vessels' insurers if one is involved in an incident.

The Author

Khanna

Captain Rahul Khanna, a marine professional with 27 years of experience is Global Head of Marine Risk Consulting at global insurer Allianz Commercial.



LEADERSHIP PROFILE:

TOR SVANES

AND NAVTOR'S QUEST TO TRANSFORM SHIPPING

*Compliance, performance, profitability, sustainability; take the biggest 'pain points' for almost any shipping company and watch NAVTOR's digital ecosystem work wonders. Here **Tor Svanes**, Founder and CEO, explains how NAVTOR has grown to lead the smart shipping world, why the recent merger with Voyager Worldwide was so critical, and how he hopes to help steer the industry towards brighter, simpler, and more intelligent horizons.*

"The morning of the announcement I got a text from the boss of one of our biggest competitors, basically saying **'blimey, I didn't see that coming!'** *"*

And to be fair, he wasn't alone.

When Voyager Worldwide, a group with over 200 employees and a history stretching back over two centuries, became a NAVTOR company in December last year it took maritime by surprise. It was a deal that made NAVTOR - founded in 2011 with, pre-merger, around 180 employees - a leader in e-Navigation, smart shipping, and the maritime technology domain, catapulting the Norwegian company into a different league.

"Just a few years ago if you had a company like ours with products and services on 4, 5 or 6,000 vessels it'd be huge," Tor Svanes, Founder

and CEO of NAVTOR, said. "But this takes us to over 18,000. That's more than 30% of all the ships relevant to our services in the world fleet. The opportunity that scale unlocks, for both ourselves and our customers, is immense, and that was the motivation here.

"So, this doesn't mark the culmination of our efforts, or the end of our voyage. We see this as just the beginning."

Unlocking Opportunity

It's clear that after well over 40 years in the maritime technology field (he started with Robertson, then owned by Kongsberg, in 1980) Svanes ambitions have anything but diminished. He has helped position NAVTOR firmly facing the future, with a clear vision of 'leading the way in smart shipping innovation'. The Voyager deal, he says, is central to that aim.

"We're delighted with the way NAVTOR has grown, launching industry firsts such as Pay As You Sail ENCs and NavStation, the first maritime digital chart table, along the way," Svanes said. "As we'd built a secure digital ecosystem to unite the e-Navigation portfolio onboard, while connecting vessels to onshore teams, it made perfect sense to take the next step, moving into smart shipping with performance monitoring, management and optimization, and then digital logbooks.

"By integrating everything onto the NAVTOR platform we found we could really unlock the power of data: automating processes, enhancing safety, improving efficiency and delivering both commercial and environmental benefits to shipping companies worldwide.

"But then, as you progress, barriers emerge… and you need to find ways to address them."

In NAVTOR's case those barriers appear to have been the extra 'muscle' needed to achieve the team's ambitions.

Bulking Up

To really lead, helping to enable a more efficient, sustainable and profitable industry, the company found itself hungering for an influx of both customers and resources, in particular human resources.

"Talented developers are hard to come by, and, in a niche defined by digital solutions, absolutely essential for progress," Svanes said. "With Voyager Worldwide we saw a pool of very talented people; 30 developers in their Aberdeen office alone, that could accelerate our innovation. In addition, the customer base obviously adds the volume we were looking for, while the network of offices boosts our global footprint, getting us as close to the customers, on the scale needed to deliver first class service. For example, the deal pushed NAVTOR numbers in Singapore from seven to 75 people. In that respect, our business has been transformed."

Svanes now wants to do the same for the businesses of NAVTOR customers. And integration is the key.

Stronger Together

From the cornerstone of e-Navigation NAVTOR has built up a range of products and services that co-exist in the aforementioned digital ecosystem. Here they share, and feed one another with, a constant flow of data, with each individual solution working to unlock value that is then fed back into the joined-up system.

It creates almost a 'society' of mutually supportive solutions, each one working away for the greater good of all. Or for 'all' read the shipping company, which can simplify compliance, reduce energy consumption, cut administration duties, optimize and prove performance, enhance safety, control costs, and so much more, according to NAVTOR. And this is achieved not just for single vessels, but for entire fleets and (now) united on- and offshore teams.

To list the benefits of each individual offering would take too long – from the ease of automated Passage Planning on NavStation, through to the CII simplifying Emissions Calculator on fleet management tool NavFleet – but Svanes points out NAVTOR's Digital Logbooks as a case study in transformation.

Book to the Future

For anyone from outside the industry, he notes, it'd be "a complete shock" to discover the analogue nature of vessel logbooks in a digital age.

"These are very important data sources, covering a range of critical issues, but they exist in isolation as out-dated, offline publications, often with scribbled entries from under pressure officers that can be difficult to decipher," said Svanes. "As such, they're time-consuming and impractical, a major source of human error, offer no real standardization, little chance for verification or validation, and have to be shared via photocopying, scanning and faxing.

"It's hard to believe they still play such a major role in daily operations for an advanced worldwide fleet."

NAVTOR's approach is to fire the format into the future with digital logbooks that are connected via the ecosystem, gathering all the data – much of which has been auto populated from the team's integrated solutions – so shipping companies have a new, and powerful, big data resource to delve into.

"It simplifies tasks for the crew," Svanes notes, "while opening immense possibilities for real-time data monitoring, efficiency, and continually enhanced sustainability for shipping companies."

Although he admits there's no mandated regulations for digital logbooks yet he believes it's "only a matter of time."

"And, with all the benefits, why would you wait for a mandate?," Svanes asks.

Stepping on the GASS

A return to that issue of scale takes the conversation back to how NAVTOR can really 'lead the way' for smarter shipping

Image courtesy NAVTOR

throughout the whole industry.

And here, again, Svanes' ambitions burn brighter than ever.

NAVTOR has recently set sail with a three-year project christened GASS (Green AI for Sustainable Shipping), working as lead partner with Grieg Star, Maritime CleanTech, Scandinavian Reach Technologies, Simula Research Laboratory, SinOceanic Shipping, and Sustainable Energy/SIVA, with support from the Norwegian Research Council, Innovation Norway, and SIVA.

In short, this aims to enable "data driven decarbonization" by creating AI empowered digital twins of vessels based on precise operational and environmental data. These will then be used to demonstrate a benchmark of real-time optimal fuel consumption. If the actual vessel – and that's any vessel, anywhere, sailing in any conditions – falls short of that standard the data can be instantly analysed to find out why, leading to corrective, on the spot decision making.

"The eventual aim is to create a module that can then be integrated into our portfolio that will allow for dynamic voyage optimisation," Svanes states. "That means both crews and onshore teams can address issues and deviations from plans as they actually happen. Our models show that can make a major impact on vessel energy consumption."

Exactly how major?

"Well, energy savings, and therefore reduced emissions, of around 20%."

Global Gains

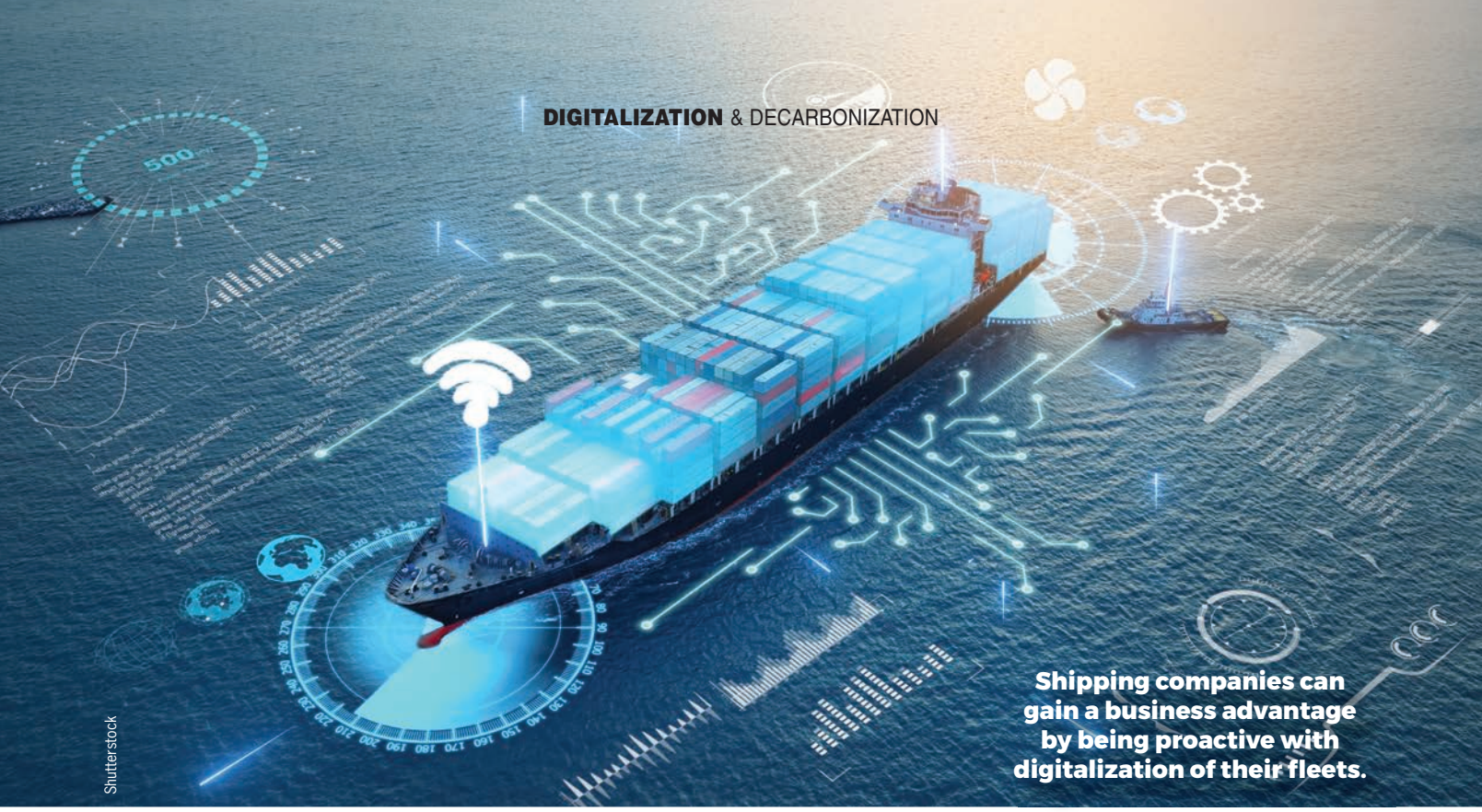
In an industry of declining margins, and ever greater environmental concerns, it's a huge number; and that's just the beginning. Because that's 20% per vessel, but, if the machine learning module is integrated across NAVTOR's entire customer fleet, you can multiply that effect by over 18,000.

And this, it seems, is where the benefit of the merger really hits home.

If the over 30% of vessels in the world fleet have their emissions slashed by 20% that means a cut of over 5% in the overall emissions of the entire shipping industry. That is colossal.

"We can do this," Svanes says with complete confidence, "and this is just one project.

"It embodies what NAVTOR does, it embodies what smart shipping can achieve, and embodies how, through the integration of solutions and utilisation of data, we can help the industry sail towards a more sustainable future."



Shutterstock

Shipping companies can gain a business advantage by being proactive with digitalization of their fleets.

MASTERING A ZERO-CARBON WORLD

*Managing risk to embrace enabling technologies can build resilience amid volatility, says **OrbitMI**.*

Embracing enabling technologies necessary to navigate greener seas can be a market differentiator for maritime leaders as adopting data-driven business processes can build resilience amid increasing volatility - but this also means managing innovation risk, according to OrbitMI CEO Ali Riaz.

Shipping faces an increasingly complex and rapidly changing environment, with market volatility driven by evolving environmental and other regulation, as well as operational factors such as higher costs, fluctuations in cargo demand and crew shortages, and macro issues like economic and geopolitical turbulence at the global level.

Amid this perfect storm, having rapid access to reliable data to inform operational decision-making will be vital to tackle the forces of change and this will demand an effective strategy for digital transformation to deliver competitive advantage, Riaz believes.

"Compliance with existing and emerging regulations can either be seen as a burden or a business opportunity. By taking advantage of change and implementing enabling technologies at an early stage, it is possible to turn an apparent liability into an asset through process automation to boost efficiency," says the head of New York-based software-as-a-service company OrbitMI, which has forged a partnership with class society Bu-

reau Veritas (BV) to support digital transformation in maritime.

"The zero-carbon world is here to stay. Rather than fight that reality, industry players need to learn how to master it," Riaz says. "An important element of a transformation strategy is management of the economic, technological and operational risk factors with innovation. This entails balancing the initial digital investment against potential savings in areas such as fuel consumption, ensuring the digital solution is fit for purpose and assessing the impact of implementation on ship operations.

"Consequently, sound technology adoption requires a thorough decision-making procedure underpinned by knowledge of the process to be automated, an understanding of end-user needs, the compatibility and capability of the solution, and proper vendor evaluation as best practice."

Riaz states that shipping can learn lessons from other industries such as financial, software and life sciences where risk-savvy players that acted early in response to regulation to sharpen efficiency and better manage information flows have emerged as the commercial winners.

"What these industries have in common is that in order to undergo transformation they had to grapple with the issue of transparency in terms of data-sharing and protection. Like shipping, they also faced pressure from governments, regulators, financial institutions and the public," he says.

Data Analytics

Research firm McKinsey & Company has highlighted how application of data and analytics can be leveraged in shipping to gain competitive advantage and unlock value, stating that digital technologies can "help companies navigate these choppy waters" ahead of the next downcycle by enabling prompt decision-making, operational and cost efficiencies, and improved performance. "Smart companies are using their cash to invest now in transformation, making them resilient for the next cycle. Much of this transformation requires an upgrade in digital capabilities. Done right, this can enable the emergence of modern, data-driven companies with excellent intelligence to support their commercial and cost decisions," the firm states. According to McKinsey, data and analytics are a key enabler for a transformation framework comprising the three main value-creation pillars for shipping companies - strategy, commercial excellence and vessel-cost optimization.

In terms of strategy, shipping companies can draw on data and analytics to improve decision-making around fleet composition, such as by combining forecasts for cargo demand and vessel capacity to predict supply-demand imbalances for specific vessel segments.

Optimized Decision-Making

On the commercial side, revenue can be boosted through data-informed decisions around fleet deployment, pool partnering and time chartering in and out, making it possible to optimize fleet positioning based on the evolution of cargo flows. Furthermore, local meteorological data on weather, wind, currents and waves can be combined with real-time views of port traffic, congestion and terminal activities to optimize routes, fuel consumption and port turnaround time, as well as manage delays and just-in-time arrivals.

Operational cost savings can be realized by using digital tools that can collect and analyze data to identify trends, optimize crewing spend and overall procurement of spares, stores and provisions, while also streamlining repair, maintenance, port, drydocking and bunkering costs.

McKinsey cites an example of how a shipping operator was able to optimize fuel consumption through a digital interface between the vessel and shore office that provided visibility on fuel and emissions data, and transparency on voyage decisions. This gave clarity on key levers such as speed, slip, trim and fuel type, and allowed AIS and weather data to be leveraged for route mapping and fuel usage, resulting in a 1% decrease in fuel spending while also promoting healthy competition among captains to improve voyage performance.

The firm estimates that companies pursuing digital transformation have seen significant EBITDA gains of 15-20% on a run-rate basis, while also "future-proofing their businesses, solidifying their decarbonization plans and building in resiliency, resulting in higher shareholder value".

'Fast to deploy and future-proof'

However, as Riaz points out: "It is important to understand that transformation and transparency cannot happen at scale unless technology is fast to deploy, easy to use and designed to be future-proof." And he believes effective technology adoption requires a cultural shift away from siloed data systems, which slow down business processes and hinder efficient decision-making, to data-sharing between different systems and company departments. This can generate what OrbitMI calls intelligent connected workflows, which are used in its Orbit vessel performance platform to create more value from data across pre-fixture, voyage and post-fixture processes.

"Point solutions may deliver some benefits for specific tasks but standalone software operating within a data silo is, ultimately, counterproductive to the data-driven culture we need to achieve real transformation," Riaz says.

"The focus should be on adopting technologies with collaboration, integration and data-sharing at their core, so that they are both integrable with existing IT infrastructure and scalable for future needs. This can create unified solutions with a single source of truth for better decision-making, rather than having divergent data from segregated systems."

'Getting data flowing'

His view is supported by research firm Thetius' recent study entitled 'Common Interest', published together with

"The zero-carbon world is here to stay. Rather than fight that reality, industry players need to learn how to master it."

– Ali Riaz, CEO, OrbitMI

Image courtesy OrbitMI

BV, that states "sharing data has the potential to yield transformative returns on the investments in time, technology and capital resources".

"To move ahead with the technological evolution of the shipping industry at scale, liberating data and improving its liquidity is of vital importance... Getting data flowing is akin to turning on the fuel taps for digitalization and transformation in shipping," according to the report.

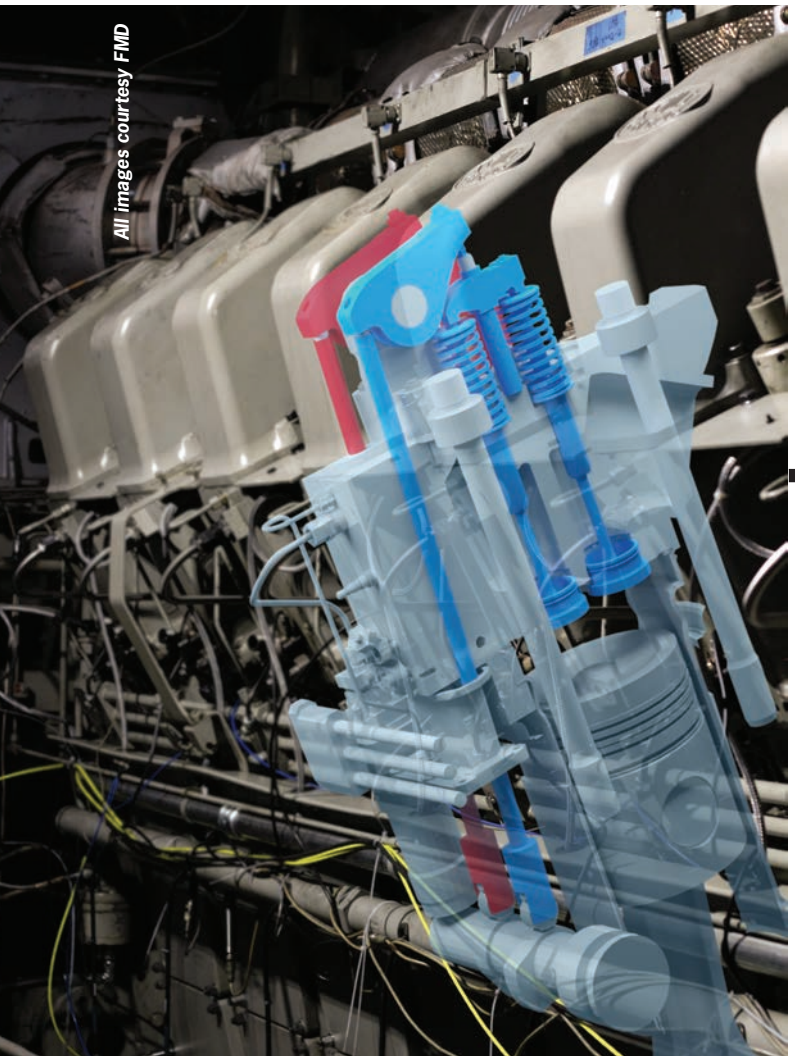
OrbitMI accomplishes this data flow by integrating multiple APIs from various software suppliers into its platform to enhance functionality and value for the end-user. Moreover, its tie-up with BV aligns the latter's vast data resources and deep science with the AI-driven analytical expertise of OrbitMI to accelerate digital transformation in the industry, according to Riaz.

"This partnership demonstrates the importance of data quality and transparency in maritime, which are essential ingredients for technology adoption if the industry is to progress on its transformation journey towards the twin goals of sustainability and profitability," he concludes.

The Author

Marshall

Steve Marshall is a business writer with long experience in maritime and offshore media, having worked for leading industry publications TradeWinds and Upstream, and now with media consultancy Blue-C.



All images courtesy FMD

FMD TAPS THE POWER OF DIGITAL TWINS

The advent of digital twin technology is spreading across maritime as companies seeking to harness the power and promise digitalization. ***Trey Taylor****, Director of Digital Innovation, Fairbanks Morse Defense (FMD), discusses the evolution of its own digital twin technology, highlighting its capabilities as a tool in real-time engineering support and its ability to generate action.*

By Greg Trauthwein

'*Digital Twin'* is a term increasingly common term in maritime, a core tenant of the digitalization discussion. But what exactly does *'digital twin'* mean, and more importantly, how can it be leveraged to enhance ship efficiency?

"We recognize two different approaches to digital twins," said Taylor. "One we call a simulation, or a digital twin that is projecting forward the way a system performs, based on choices you make, digitally. It's a way to simulate outputs and outcomes of different systems' configurations without risking a capital asset. The second type is what we call an operational twin, a one-for-one representation of the active system as it is performing right now. That lets me take an end-user into a capital system, like a power plant, and have them see all of the pressures, temperatures, monitoring, all the power plant working together in real time from anywhere in the world."

From where Taylor sits, digital twins are collaborative tools: one is in design, configuration, and scoping, the other in operations and maintenance. Ultimately, it comes down to getting the entire technical team – from the operational and maintenance team onboard, to land-based engineering support inclusive of OEMs, to solve problems, to relieve maintenance activities, to give systems more 'up' time.

A Call to Action

Digital twins are not just about the data, it's about deploying information to result in actionable items. "We build systems that try to reduce the cognitive burden of the people that are operating the system," said Taylor. "The digital twin will make recommendation. If I'm going to go 20 knots for 16 hours in four-foot seas, I can enter those paradigms and it make a recommendation on the power plant configuration."

A more mundane but equally important use of digital twin tech for FMD is for the general overview and maintenance of Navy ship engines. "We monitor that data in real time and provide a visualization tool to the Navy so they could see what's happening in that engine external to the PLC. We have some AI ML in there that helps recognize when there might be a problem. So that we can, before the system alerts, create an awareness that "hey, something is changing in your system.

"We build systems that try to reduce the cognitive burden of the people that are operating the system."

Trey Taylor, Director of Digital Innovation, Fairbanks Morse Defense (FMD)

Here's where it is. Go take a look. We have access to the data if the Navy wants to provide it, so then our technical team can come right behind the Navy's organic capability and provide our OEM insights into plant health."

Taylor believes that driving action is the core value of digital twin technology. "I believe the outcome of digital twins that everyone's looking for is action. The data is important to drive actions, but that's where the hole in the system is today. It doesn't tell the sailor to go do something. It says, "Here's the big picture." But it doesn't tell them: *"Here's where you're going to go. Here's where you need to fix. Here's where you need to touch."* And that's what the customer wants. They want the ability to easily drive preventative maintenance or responsive action to change of capital assets."

The cost saving has multiple potential tendrils, from heading off problems before they create bigger problems, but also in delivering real condition-based monitoring that could allow the extension of traditional time-based maintenance items.

"If they can assess the equipment and see that the equipment is still healthy and stable, they may be able to push something like a spare part change every 5,000 hours to maybe every 8,000 hours. That has a substantial cost benefit over the life of these vessels, especially for the U.S. Navy."

Finally, the digital twin's ability to maintain and catalog historical data is invaluable for future planning. "The Navy keeps good records, but they're a bit obtuse, [and it can be] hard to get to the meat of what happened and why. With a digital twin, that data's there forever," and can be leveraged to avoid similar problems in the future.

Enabling Engineering Support

In the commercial space, digital twins are limited only by the availability and use of bandwidth which effectively links ship to shore, and as multiple new satellite systems emerge and the cost of bandwidth falls, additional real-time benefits and opportunities emerge.

"The big liners are already running digital twins in real time on their ships. And they're doing it under active management. Meaning, there's someone that's monitoring these ships pretty much 365 days a year. The big companies are recognizing good economic benefits from doing this, keeping the ships active longer, spending less on spares, spending less on repair, and being able to have more hours on these engines at sea."

The U.S. Navy is a different story.

"In the Navy, they're slow bandwidth; they're highly secure networks; they don't want to have signals going 24/7/365 off that vessel because it gives away location data. We build our digital twins for the Navy to be 100% on-premises, meaning they run on the ship. They don't have to touch back to the internet at all to get any of the services working. And then we've built a facility that, if there is a path back to NAVSEA or to Navy cyber ops that they can offload that data on their own. They don't need Fairbanks to pull it."

Ultimately, FMD aims to create platforms that are generic so that other OEs can interface with it: "we're not trying to create silos, we're trying to create platforms as opposed to a "Fairbanks exclusive," said Taylor.

While there is economy in scale in rolling out digital twin technology to multiple engines, vessels and fleets, Taylor doesn't see the tech as a necessity for every single product and system on the ship.

"I think the high-cost, high-value capital equipment that's going to cost you the most to maintain, or is a safety requirement for that ship to sail, are the kind of systems you want [in the digital twin]."

Typically, for me, I can deploy [digital twin on] an engine today for about $60,000. That's with all the hardware, all the setup, the configuration. That's what it takes for me to build one," said Taylor. In manufacturing scale delivers costs savings, and the same can be said for digital twins: as the number of similar engines on a fleet goes up, the time to build and connect them via digital twin goes down. "The economics get better if I have a four-engine ship, or 16 ships with four engines apiece; the economics get stronger every vessel that I deploy on." While FMD has been on the digital twin journey for more than three years, Taylor said that in some respects, you're always at the beginning "because the technology's changing, it gets better. From our perspective, the platform will never be done, [because we will constantly evolve new features, new technologies that become available, faster, cheaper technologies for doing analysis of data, for example. This is a constant evolution."

Photo courtesy General Dynamics Mission Systems

BOATS EVOLVE TO KEEP PACE WITH EMERGING THREATS

NAVY COMBAT CRAFT

By Edward Lundquist

***Ghost**, a high-speed stealth boat that was nearly cancelled, has been resurrected. The low-observable Ghost is a SWATH (small waterplane area twin hull) vessel with a speed of up to 35 knots and a very shallow draft. General Dynamics Mission Systems has teamed with Juliet Marine Systems to make Ghost configurable as a manned, remote control, and unmanned platform and to integrate the modular payload capability for a broad spectrum of missions.*

Combat craft are used by both large and small navies, and every navy, coast guard or maritime service operates some kind of boats.

The U.S. Navy's boats are used for a variety of tasks from personnel and cargo transport to ship repair and maintenance to environmental response.

The combat craft range from pull sized patrol boats down to ridged-hull inflatable boats (RIBs) armed with machine guns. Boats include shipboard RIBs, maritime security boats, dive support boats, workboats, and a number of others that help carry out escort, anti-terrorism / force protection, search and rescue, maritime interdiction and visit, board, search and seizure missions.

The U.S. Navy's boat fleet is operated by different entities. The shipboard boats come under Commander Fleet Forces Command and Commander Pacific Fleet. Workboats and dive platforms used for ship husbandry come under Naval Facilities Engineering Command or Naval Sea Systems Command. Boats used for special operations or maritime security functions are managed by Navy Special Operations Command and Navy Expeditionary Combat Command.

The Navy's boats and combatant craft acquisition and life cycle management (LCM) services are the responsibility of PMS 300 under PEO Ships, which supports major customers such as Naval Expeditionary Combat Command (NECC), U.S. Fleet Forces Command (USFFC), Commander Navy Installations Command (CNIC), Naval Special Warfare (NSW), and other customer enterprises.

The Naval Surface Warfare Center Carderock Division operates its Combat Craft Division at facilities on Joint Base Little Creek/Fort Story and Naval Base Norfolk, and provides in-service engineering support for the Navy's existing fleet of combat craft and boats, as well as design, prototyping and modification of boats to upgrade their capabilities or serve in new roles. CCD is also called upon to advise commands on what boats will best serve the required purpose.

Ships carry their own boats, but other boats and craft must be transported by ship or aircraft.

Designs, materials, propulsion and systems have been evolving rapidly to meet emerging requirements and counter growing threats.

Materials

Fiberglass, aluminum and composite are commonly used for boats and combat craft. New and larger 3-D printers are making it possible to print entire boats.

The University of Maine (UMaine) Advanced Structures and Composites Center in Orono, Maine has a 3D printer that has successfully produced two new large-scale boats in

The NCPV Betelgeuse is an 85-ft. vessel built by Metal Shark.

Photo courtesy Dominican Navy

U.S. Navy photo by Chief Mass Communication Specialist Dustin Kelling/Released

A combatant craft assault boat transits during training April 2. Special Warfare Combat Crewman regularly conduct specialized training to enhance fleet integration and support to joint commanders. Naval Special Warfare is the nation's elite maritime special operations force, uniquely positioned to extend the Fleet's reach and gain and maintain access for the Joint Force in competition and conflict.

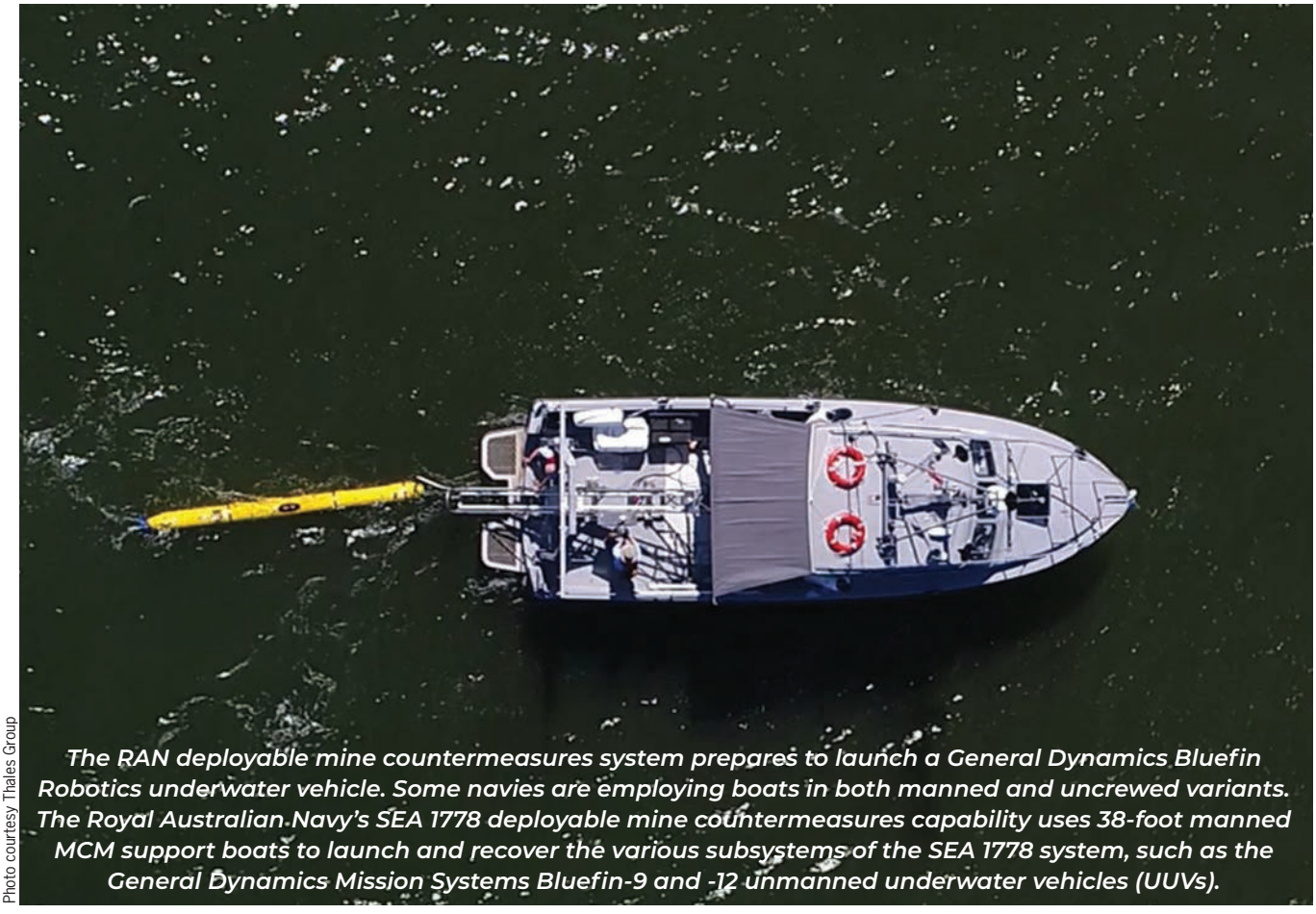


Photo courtesy Thales Group

The RAN deployable mine countermeasures system prepares to launch a General Dynamics Bluefin Robotics underwater vehicle. Some navies are employing boats in both manned and uncrewed variants. The Royal Australian Navy's SEA 1778 deployable mine countermeasures capability uses 38-foot manned MCM support boats to launch and recover the various subsystems of the SEA 1778 system, such as the General Dynamics Mission Systems Bluefin-9 and -12 unmanned underwater vehicles (UUVs).

just a few days.

According to a press release from the university, two prototype boats were developed for the Marine Corps to support logistics of disperse personnel. "The larger one can carry two 20-foot shipping containers, while the other can transport an entire rifle squad with three days' worth of food, water, and other supplies," the release said.

Back in 2019, UMaine used its 3D printer to manufacture 25-foot 3Dirigo boat in just 72 hours. It was the world's largest 3D printed boat as well as the world's largest 3D printed object at that time.

CCD is using basic hulls 3-D printed from high density polyethylene HDPE by Tideman Boats. The boats are easily configured for a variety of purposes. According to the company's website, their boats are non-corrosive, unsinkable and indestructible.

The HDPE boats can be easily converted or configured for different missions to become a serviceable experimental asset for R&D or demonstration purposes.

Propulsion Considerations

Rear Adm. Massimo Annati, a retired Italian naval officer and an expert on small boat design and operations, said propulsion is, of course, a key factor for high-speed craft. "In the case of small craft, with limited draft, traditional propellers cavitate quite soon and 35-40 knots represent a definite limit. High-speed craft exploit surface drivers or water-jets. Both have some pros and cons, though proponents of one or other solution tend to describe it as the very best for all the possible situations."

According to Annati, surface drives (also known as surface-piercing propellers) were designed to operate with just half of the propeller disk underwater. This implies that surface propellers eliminate cavitation by replacing it with ventilation. Water-jets offer a number of advantages up to speed of 45-50 knots. In term of maneuverability the water-jets out-maneuver the surface-propellers at all speeds. In particular water-jets offer much tighter turnings and can perform emergency crash-stop maneuver.

"Even if articulated surface-drives have a better behavior, yet they can't beat the water-jets. Both water jets and articulated surface drives are turnable and trimmable, and don't require a rudder. The surface-propellers are also quite scarce when one has to move astern, while instead water-jets are very responsive. Quite the same for slow motion and holding position in current or tides. Waterjets can do easily the job, while surface-propellers have a lot of troubles and can operate only at a minimum speed of 6 to 7 knots," Annati said.

Waterjets provide some safety in shallow water. "Collision

Photo courtesy of UMaine.

Additive manufacturing can now print entire boats. The University of Maine's 3Dirigo weighs 5,000 pounds and was printed in 72 hours.

with submerged objects or grounding can be a tolerable event because the intake is flush with the bottom of the craft and the drive system has just a limited further draft. This allows a water-jet craft to cross very shallow waterways without great risks. However, running in shallow waters with the presence of sandy bottom (or in presence of small objects like plastic bags, nets, branches of trees, sea weeds, etc.) can easily cause an impeller stoppage, for it operates like a giant vacuum cleaner, sucking is nearly everything it can."

In case of boats equipped with surface-piercing propellers, Annati said collisions or groundings represent a very serious risk of damage. "Also, the presence of swimmers in water nearby the boat, be they combat divers to be deployed-recovered, or stranded people to be saved, represents a critical hazard, because the blades of a surface propellers would behave just like a food-processor."

Weapons

Boats and combat craft have been equipped with small arms to crew remote-controlled guns and even missiles, such as Rafael Spike, Griffin, NLOS and Hellfire Longbow.

Speed and firepower have become valuable attributes for naval boats. But, according to John Kaman, a retired Navy captain and naval engineer with expertise in combat craft, "If you're going to go fast, then you need shock-absorbing seating for the crew and stabilization for your gun."

U.S. Navy photo by Mass Communication Specialist 1st Class Michelle L. Turner/Released

The Navy operated riverine command boats (RCBs) in the Arabian Gulf as a multi-mission platform for maritime security operations, maritime infrastructure protection, and theater security cooperation efforts. The RCB is a variant of the Swedish Combat Boat 90. They were heavily armed for their size and augmented the 140-foot coastal patrol boats (PCs) based in Bahrain. The PCs have now been decommissioned and replaced by U.S. Coast Guard fast response cutters. The RCBs were replaced by the MK VI patrol boats, which have also since been withdrawn.

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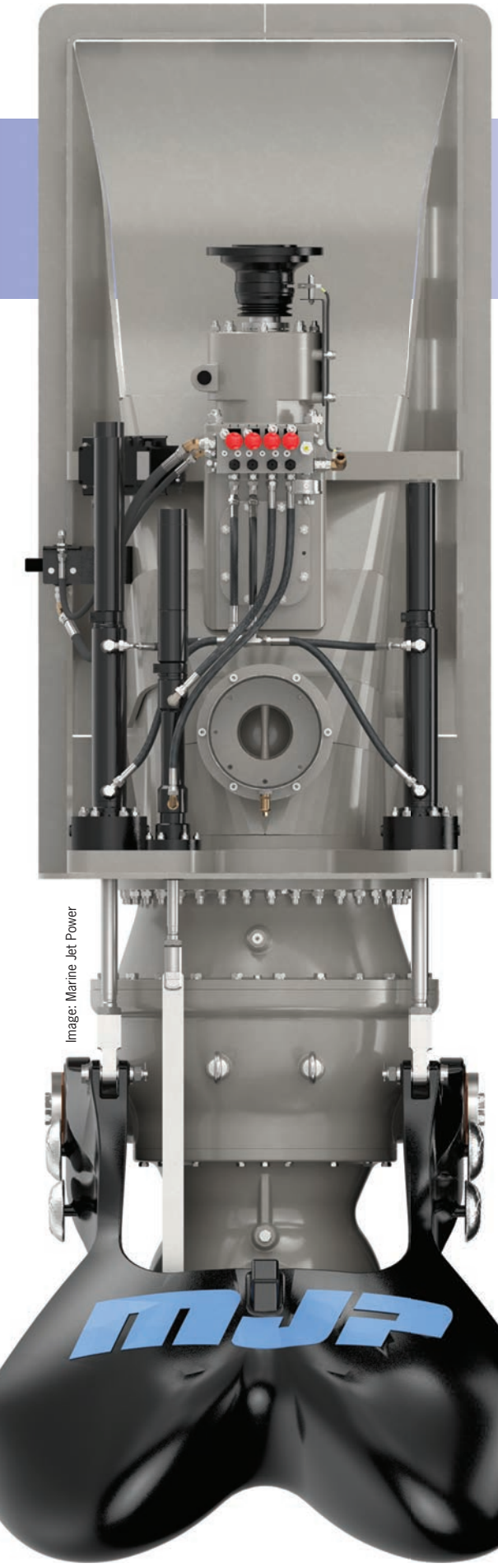


Image: Marine Jet Power

Propulsion systems for working vessels come in many shapes and sizes, and vessel owners looking to build new or refit have no shortage of options to choose from, whether their goals are high power, high efficiency or high speed (or a combination of each). *Maritime Reporter & Engineering News* explores latest advancements in this space, from new tech to new builds.

High Thrust Jets

In June, **Marine Jet Power (MJP) unveiled the latest iteration of its X-Series waterjets: the X-HT (pictured left)**, tailored for vessels that require high thrust at low- to medium-speed applications (up to 35 knots) such as offshore wind crew transfer vessels (CTV), which require precise maneuvering and consistent power.

"CTV operators prioritize high static thrust for safe and efficient crew transfers," said **Robert Magnusson**, MJP Global Sales Director. "This trend has led to a rise in propeller selection in recent years. However, with the introduction of our new MJP X-HT Series, we can now match the performance of the best propeller systems in static thrust, while still delivering the numerous advantages that waterjets offer." Currently available in three sizes, the 280 X-HT, 310 X-HT and 350 X-HT, with maximum power ratings of 611 kW, 800 kW and 1000 kW respectively, the X-HT waterjet has applications in other segments of the workboat sector as well, including passenger ferries, patrol boats and other utility vessels.

The X-HT series' compact design allows larger diameter jets to be installed in narrower hulls, optimizing performance and maximizing thrust without compromising space or requiring extensive modifications to the vessel's structure. Additionally, the lower-input power capability of the X-HT ensures it remains lightweight and cost-effective to operate, unlocking fuel and emissions reductions.

Jonas Tegström, CEO of MJP, said, "The X-HT combines our cutting-edge technology with practical enhancements that meet the evolving needs of our customers, particularly in the wind farm sector, providing superior efficiency and thrust in a compact, economic package."

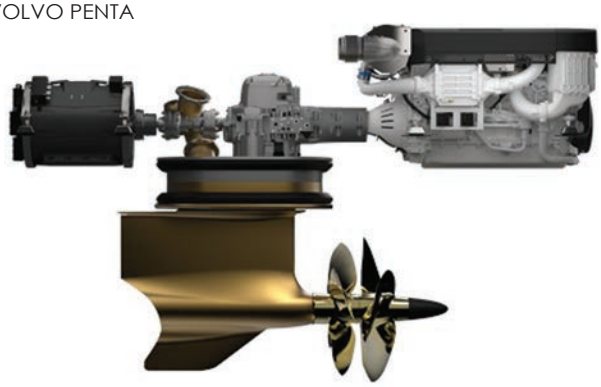
HamiltonJet late last year debuted the compact and lightweight HJ215 waterjet, built for greater efficiency at high speeds, making it a great fit for thrill-seeking tourist crafts, search and rescue vessels and other marine sectors. "This model will appeal to a broader global market, where we know its power and efficiency can deliver real and meaningful returns for our customers," said HamiltonJet CEO, **Ben Reed**.The HJ215 has been designed for close coupling to the engine near the transom, maximizing usable space within the boat, and it will drop into an existing HJ213 hull space with no required modifications. The new factory-made TURBO II impeller option offers superior performance where acceleration and high thrust in aerated water are important. The factory manufactured Trim Nozzle with electric actuation configuration delivers faster acceleration from the start and allows adjustment of the boat trim on the go.

The latest in a new range of hydrodynamically optimized waterjets from **Castoldi, the Turbodrive 400 HCT**, has been 12 years in the making, according to the company's owner, **Giacomo Castoldi**, who said tech advancements have unlocked significant operational benefits. "Thanks to the

CASTOLDI

HAMILTONJET

VOLVO PENTA



SCHOTTEL

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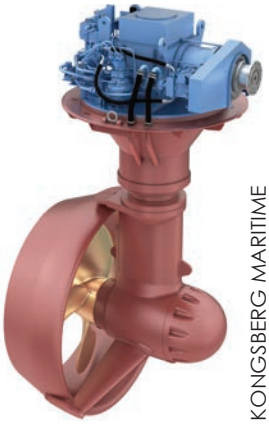


developments in [computational fluid dynamics (CFD)], the new Turbodrive 400 HCT is around 12% more efficient than the outgoing model and is perfectly interchangeable with it," Castoldi said. "Refit customers upgrading from the Turbodrive 400 HC to the Turbodrive 400 HCT will be pleased to learn that the bolt patterns have remained the same, removing the need for costly and time-consuming structural work around the duct and transom."

The Turbodrive 400 HCT features a durable hydraulic gearbox (heavy duty certified) and multi-disc clutch allowing the drive to be engaged and disengaged without stopping the engine. Capable of handling up to 882kW (1,200 mHP) of input power, the Turbodrive 400 HCT also fields a redesigned steering system ensuring greater precision, further reducing speed loss during turns. Additionally, a new reversing bucket geometry and increased hydraulic power enable prompt and efficient crash-stop maneuvers.

Pods & Thrusters

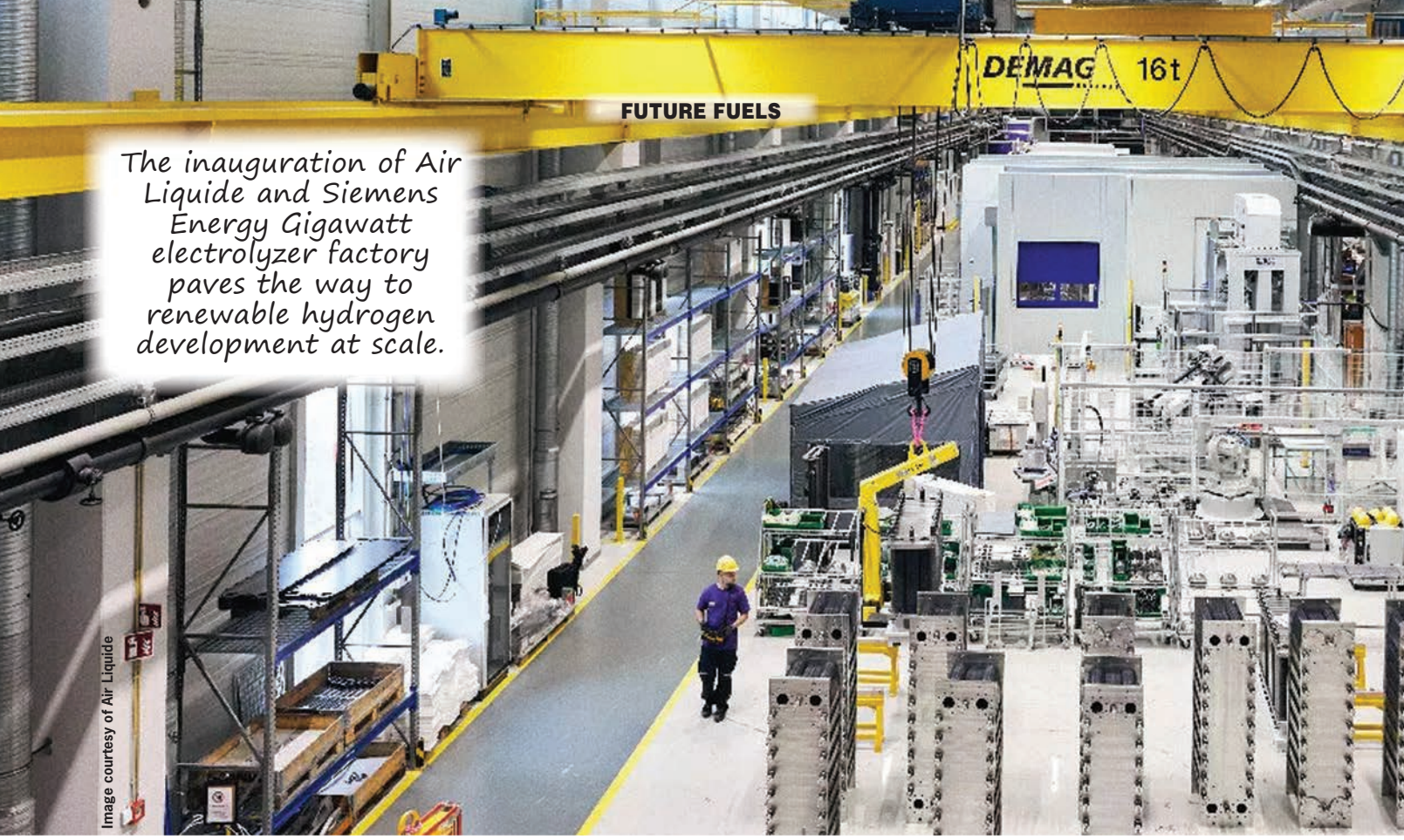
Another recently introduced propulsion solution with strong uptake potential in the CTV sector—as well as other commercial vessels and superyachts—is the **Volvo Penta IPS Professional Platform**, slated for commercial availability from 2025. The new fully integrated helm-to-propeller solution builds on its proven Inboard Performance System (IPS) and Electronic Vessel Control (EVC) technology with enhancements for larger vessels. Installed as a twin, triple or quad, the system enables each vessel to have four to eight power sources – from combustion engines running on renewable fuels such as HVO or renewable diesel to fully electric or hybrid solutions. In addition, a new smart Eco Mode feature automatically starts/stops individual engines based on the power needed for a given situation, optimizing fuel consumption and engine running hours. With the complete system, users can expect up to 30% total fuel savings and emissions, the manufacturer said. "This new Professional Platform will provide new options for energy efficiency and aid in efforts to achieve decarbonization at sea in marine industries," said **Johan Inden**, president of Volvo Penta Marine. "We see this as a major step towards decarbonization in superyachts and commercial vessels between 25-55 meters."

The company is working with CTV operator Northern Offshore Services (N-O-S) to trial the platform, with vessels that will set sail in the second half of 2024.

SCHOTTEL will equip Guangzhou Port Group's latest e-tug with a pair of 360-degree steerable RudderPropellers type SRP 360 in the LE-Drive variant. The new harbor tug, to be built by Lianyungang Hongyun Co., will measure 37.9 x 10.5m and will be mainly used for berthing assistance, escorting and towing in the Port of Guangzhou. Each SRP has an input power of 1,500 kW and a propeller diameter of 2.2m. The embedded L-Drive variant of the SRP reduces the installation height of the thrusters.

Kongsberg Maritime recently won a contract to supply azimuth thrusters to Turkish shipbuilder Med Marine, to power six new sterndrive tugs for the Tunisian port authority OMMP. The 28m new tugs, of Robert Allan RAstar 2800 series design, are designed for a range of towing and harbor operations in Tunisian ports.

Each newbuild will be equipped with a pair of Kongsberg Maritime's US205 FP azimuth thrusters. The thrusters feature 2.8m, fixed pitch propellers which will deliver efficient operation and enhanced maneuverability, providing the tugs with a significant bollard pull of 60 tons.



The inauguration of Air Liquide and Siemens Energy Gigawatt electrolyzer factory paves the way to renewable hydrogen development at scale.

Image courtesy of Air Liquide

GETTING ELECTROLYZERS READY TO MEET GREEN HYDROGEN DEMANDS

Electrolyzer technology is going to have to get cheaper and more scalable if it is going to enable a global green hydrogen economy.

By Wendy Laursen

Somewhere on a benchtop in Brimsdown, London, there is a lab-scale prototype that can extract the platinum and polymers from PEM electrolyzer membranes so they can be recycled into new membranes.

Why? To reduce the cost of electrolyzers and therefore green hydrogen. Electrolysers use electricity to split water into hydrogen and oxygen, and to meet global expectations for 2030 and then 2050, they must produce green hydrogen cheaper than hydrocarbon-based methods. They must also be able to do this at scale.

Electricity makes up most of the production cost of green hydrogen, and researchers around the world are trying to reduce that, but Johnson Matthey's benchtop unit is also representative of the fact that, despite new electrolyzer technologies well past lab-scale testing, there will still be a major role played by more established technologies such as PEM and alkaline electrolyzers.

Current technologies can be roughly categorized into two main groups: those suitable for use with intermittent renew-

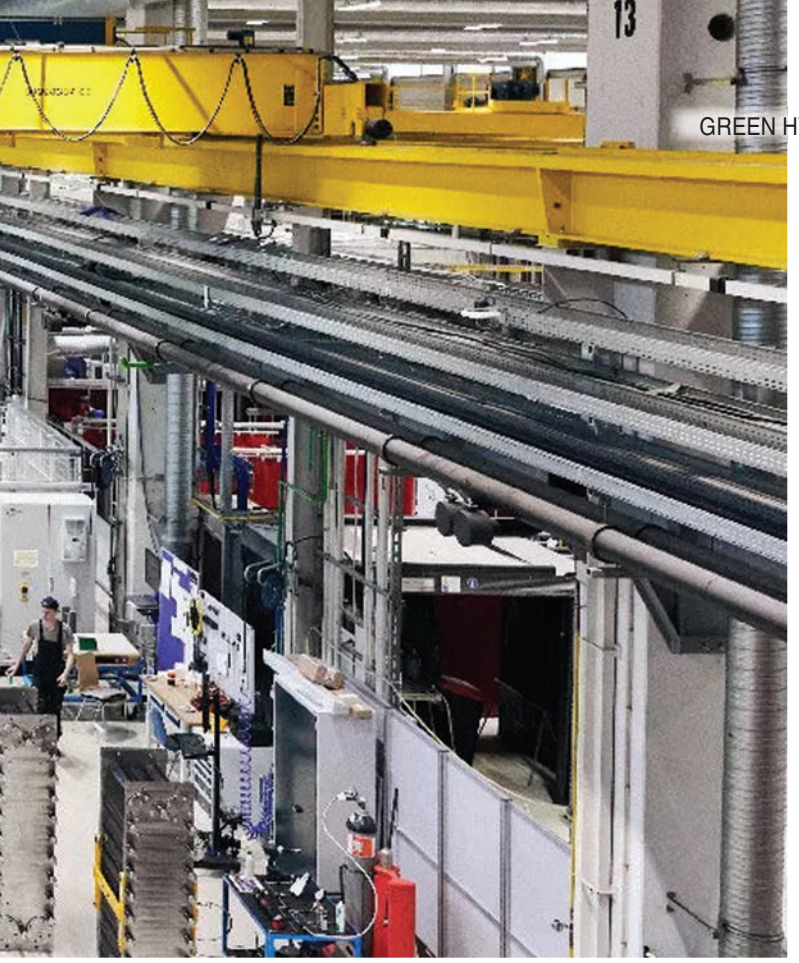


Image courtesy of Accelera

Accelera by Cummins leadership and distinguished guests cut the ribbon at the opening of Accelera's first electrolyzer production site in the U.S.

In April, Fortescue officially opened an electrolyzer manufacturing facility in Australia – one of the first globally to house an automated assembly line.

Image courtesy of Fortescue

able energy like PEM, pressurized alkaline and anion exchange membrane (AEM) and those suited to grid power or being incorporated into industrial plant like atmospheric alkaline and solid oxide electrolysis (SOE).

SOE is a growing technology that can also operate in reverse to act as a fuel cell, and AEM, a development of the PEM concept but with cheaper materials, is an emerging technology. While alkaline electrolyzers use a liquid electrolyte, and PEM electrolyzers use a polymer electrolyte, SOE use a solid-state ceramic electrolyte and requires heat to operate. But new variations on existing themes continue to emerge as the industry tackles cost and scalability challenges, and each have different materials, chemistries and heat and pressure requirements.

Using solar and wind energy, green hydrogen can be produced at peak times by running electrolyzers and then storing the hydrogen for later. "Here, there's an important role to play for green hydrogen which can operate at a different scale to batteries to balance out fluctuations in the supply of, and demand for, renewable energy production," says Synne Myhre Jensen, Public Affairs Advisor at Norwegian hydrogen company Hystar. As part of the company's HyPilot project, collaborator Equinor is planning to demonstrate dynamic hydrogen production tailored to the variable output typically found in offshore wind applications.

Johnson Matthey will supply membrane electrode assemblies for Hystar's patented PEM technology. "Each of our stacks can produce two to three times more hydrogen than a conventional stack, enabling more hydrogen production at peak production times and capitalizing upon lower electricity prices," says Jensen. "During these moments, the exact energy consumption is not important, as the electricity price is low anyway. It is then a matter of how much hydrogen you can produce by fully utilizing the renewable sources available." The technology is also more compact and safer than traditional PEM electrolyzers due to built-in air circulation to prevent combustion, she says.

Another project, the EU-Funded HyScale project, aims to upscale an efficient, durable, sustainable, and cost-effective AEM electrolyzer technology. Project partner CENmat claims to have re-engineered electrolysis from scratch to produce a system that operates with catalysts and electrodes free of critical raw materials and anion exchange membranes free of forever chemicals.

Australia's research organization CSIRO is developing both PEM and SOE technology. Its high-efficiency tubular SOE technology uses a series of sintered ceramic tubes and easily obtainable metals and can efficiently produce hydrogen and syngas (a mixture of hydrogen and carbon monoxide) – something that distinguishes it from existing PEM and alkaline technologies. It is also highly scalable.

"There is a limit to what extent efficiency of electrolyzers can be further improved," says Dr Sarb Giddey, Senior Principal Research Scientist and Group Leader at CSIRO. "The efficiency will stay in the 70-75% range maximum due to

CSIRO researchers Dr. Gurpreet Kaur and Dr. Sarb Giddey with the high temperature furnace for sintering the ceramic tubes.

Image courtesy of CSIRO

the thermodynamic limits and the losses related to balance of plant. The electrolyzer cost, electricity costs, and scale are still the major challenges for the large-scale adoption of hydrogen production via electrolysis for decarbonization of various energy sectors."

While SOE technology holds promise for power-to-X applications, it has a limited lifetime and its dynamic capabilities are currently a barrier to large-scale commercialization, so Denmark's Dynelectro has developed a novel SOE technology that uses a mix of alternating and direct current and can accommodate fluctuating green power and temperature variations. This is expected to increase the lifetime of SOE stacks from two to 10 years.

The scale-up of well-established technology is already underway. Accelera is developing 25MW PEM electrolyzer modules suitable for larger electrolyzer projects (>200MW). The systems will be manufactured in its new US facility and also at another new plant in Spain.

Manufacturing speed is also increasing. Air Liquide and Siemens Energy officially inaugurated their joint venture gigawatt PEM electrolyzer factory in Berlin last year. The factory leverages robotics for series production, as does Fortescue's new PEM factory in Australia.

As a result of all the development underway, DNV predicts that electrolyzer costs will drop 25% by 2030 and 50% by 2050. Another prediction is that electrolyzer capex will drop and the market will consolidate mid-term, especially for large-scale electrolyzers. This could lead to supply chain optimization that could further reduce production costs.

But where? China could disrupt the industry and take the same commanding market share it has in other industries despite the US pumping money into the industry (Nel and its partners received around $90 million from the Department of Energy for seven electrolyzer projects in March).

While much of China's electrolyzer production is currently satisfying the domestic market, that is likely to change. Bright-H Technology recently claimed industry leading energy efficiency for its alkaline technology, and Sungrow Hydrogen says its latest electrolyzer not only breaks the record of hourly hydrogen yield per PEM stack in the Chinese domestic market but also catches up with advanced international technologies in a number of key indicators.

So, the future of electrolyzers may well be found on a test bench in Hefei.

Image courtesy of Hystar

Johnson Matthey will supply membrane electrode assemblies for Hystar's patented PEM technology.

DNV predicts that electrolyzer costs will drop 25% by 2030 and 50% by 2050.

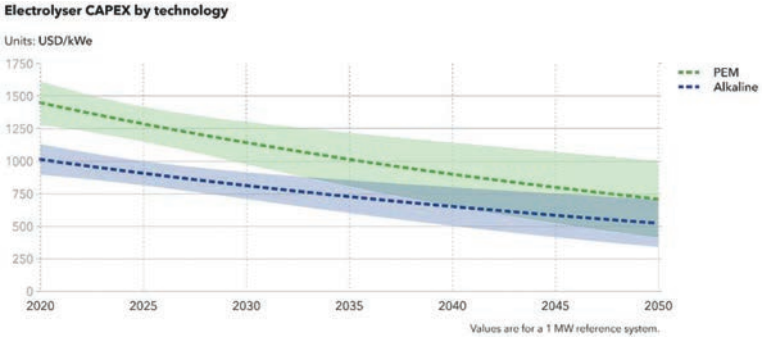


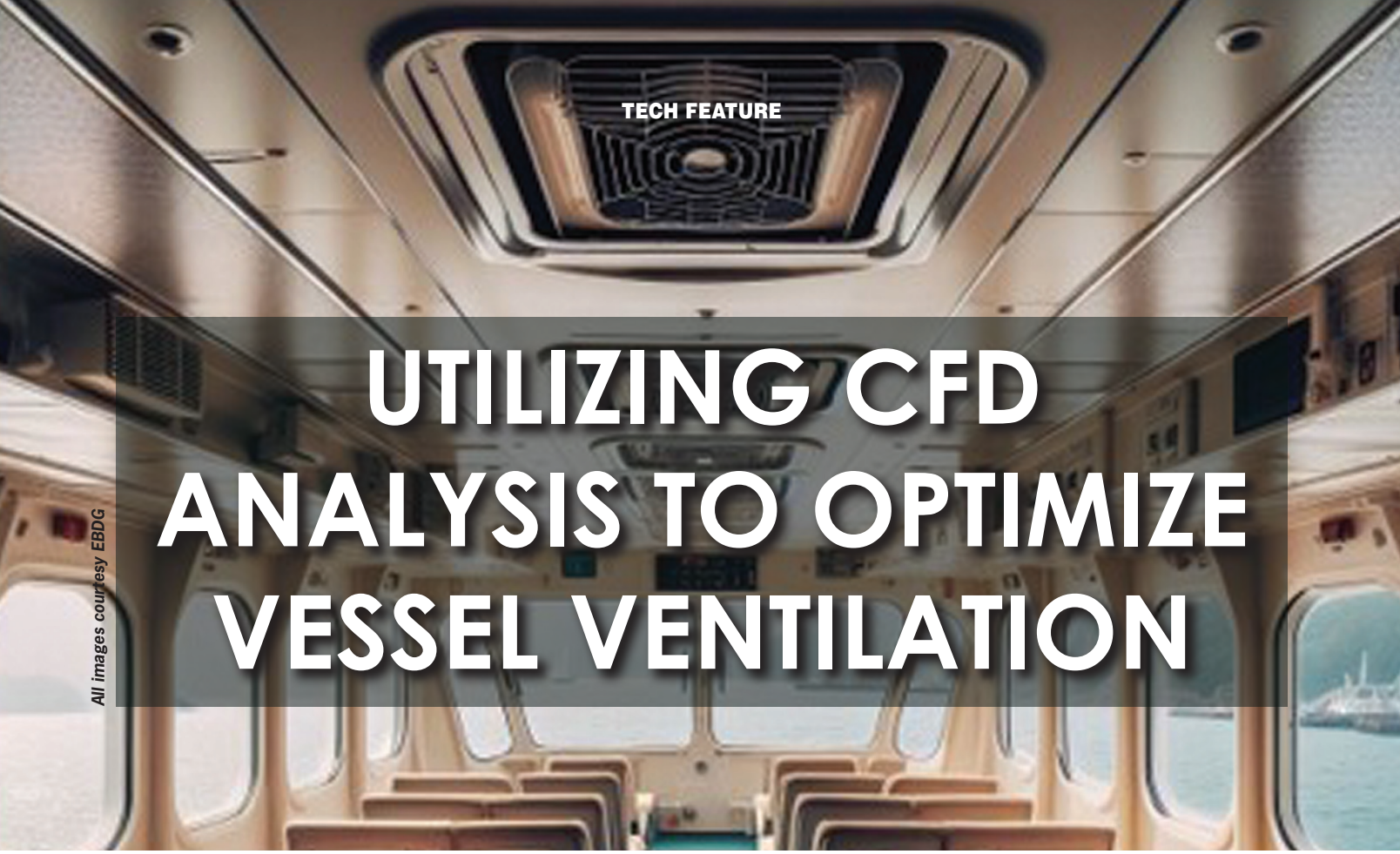
Image courtesy of DNV

Hydrogen Ship Tech –

RIX M2H2 Hydrogen Generator into an Integrated Power System

Aiming to streamline the energy transition, RIX has pioneered a simplified solution for emission-free marine operations. Its M2H2 reformers produce fuel cell ready, 99.97% pure hydrogen on-demand. Now combined into the same package with PEM fuel cells, this new integrated power system design improves not only energy efficiency and density, but also ease of implementation. With a modular, scalable design, systems integrate into existing shipboard infrastructures with minimal retrofit. The integrated solution is a self-contained unit designed to conserve space and energy resulting in optimal efficiency. Tapping into safe, stable methanol as a feedstock fuel source that acts as a hydrogen carrier, the complexities of transporting and storing hydrogen are eliminated, and the M2H2 reformer within the Integrated Power System instead takes advantage of the worldwide availability of portside methanol to meet environmental mandates.

Image courtesy RIX



All images courtesy EBDG

UTILIZING CFD ANALYSIS TO OPTIMIZE VESSEL VENTILATION

By Brian King, PE, Principal Emeritus, and Drew Matz, PE, Naval Architect

When envisioning the future of vessel design, considerations for heating, ventilation, and air conditioning (HVAC) may not always take precedence. Yet, the significance of proper HVAC systems cannot be overstated, particularly when it comes to ensuring optimal passenger experience. Among the critical aspects of HVAC, ventilation and air circulation onboard vessels stand out as pivotal factors in maintaining healthy and clean air environments.

In this paper, we delve into the key role that Computational Fluid Dynamics (CFD) analysis plays in optimizing vessel ventilation systems. By leveraging advanced simulation techniques, vessel designers and engineers can not only enhance passenger comfort but also prioritize their health and well-being. From mitigating airborne contaminants to regulating temperature and humidity levels, the application of CFD offers multifaceted solutions to the complex challenges inherent in HVAC design for maritime environments.

Computational fluid dynamics (CFD) is an analysis technique that uses numerical mathematics and data structures to analyze and solve problems of fluid flow. In a CFD simulation, volume is discretized, or divided up, into many millions of smaller individual volumes. The fluid flow through each of the smaller volumes can then be calculated to determine the flow characteristics throughout the entire volume. Using this technology, ventilation systems and interior compartments can be digitally modeled to observe the airflow and compare the depth and path of discharge. More sophisticated CFD models can also be used to analyze the flow and dispersion of particles throughout a space or to consider the impacts of convection in compartments with large temperature gradients. The digital model allows for rapid testing of many different ventilation configurations. Vent styles, locations, sizes, and flow rates can all be adjusted until an optimal ventilation arrangement is found.

In ship design, the most prevalent use of CFD is to predict hull resistance and determine propulsive power requirements of a hull model. Due to the relative accessibility of hull numerical model creation and modification, CFD has allowed naval architects to optimize hull shapes through use of many iterations, zeroing in the hull shape that provides the least propulsive power required to meet a design speed. Often, but not always, the CFD analysis results are validated using a traditional physical hull model run in a towing tank. Building the physical model, and iterating its shape followed by a towing tank test for each hull shape modification is significantly more costly and time consuming than using the virtual model and numerical iterations of CFD. Other tests that have tradition-

ally been performed in towing tank; wake measurement, seakeeping, maneuvering, shallow water testing and most other types of testing can all be simulated through CFD analysis. The traditional physical model testing in a towing tank still has its place, but for most projects, the cost effectiveness and expediency of a CFD analysis is the approach of choice for a new or modified hull design.

While propulsive power prediction is the most common application of CFD in ship design, the many possible applications of CFD to what happens above the waterline may be just as beneficial. These include superstructure wind resistance, fire propagation prediction, toxic and flammable gas dispersion, and ventilation systems optimization. This article will focus on smart ventilation design and systems optimization through the use of CFD tools.

Smart Ventilation System Design

Before any development of a heating, ventilation and air conditioning (HVAC) design, let alone optimization of the vessel design, the objectives must be clear. The broad design objectives of any HVAC system are:

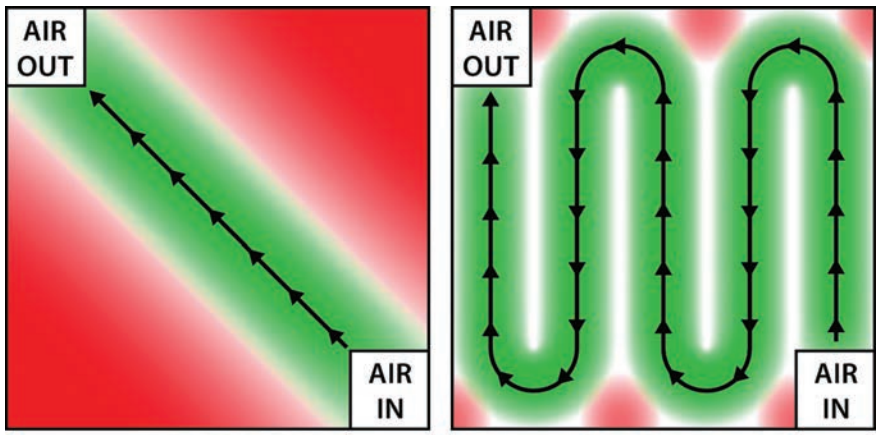
- Be sufficiently sized to meet the heating and cooling requirements of the vessel. This starts with knowing the ambient environment in the regions that the vessel will operate. These are often expressed as interior temperature and humidity requirements when outside air temperatures are at their near worse case in both the heating season and the cooling season. One design objective might be to provide cabin heating sufficient to maintain 72 degrees F when outside air temperature is 20 degrees F in the region of operation. Similar is true for sizing the air conditioning system.
- Distribute the air in a balanced fashion so that all locations within a conditioned space get sufficient air flow and there are no locations over ventilated or under ventilated.
- Be quiet, appropriate to the space it serves. Ventilation noise is annoying at least. Pilothouse and accommodation spaces need to be much quieter than machinery spaces. Often the design criteria is expressed as maximum DBa limits for each space served. To put this into a practical perspective, ventilation noise should be able to be ignored and forgotten by an occupant in the space.
- Be effective and efficient. A poorly designed HVAC system will neither meet its design objectives or be energy efficient in doing so.
- Assure good indoor air quality.
- Meet regulatory requirements for air exchange rates and fire isolation.

Optimized ventilation design can enhance the overall passenger experience while onboard.

Careful attention to each of these objectives during design will result in a ship's ventilation system that is comfortable for the occupants, provides a healthy indoor environment and is energy efficient. Many of the objectives described above can be facilitated and predicted in the design phase through the use of CFD before they become construction problems to be resolved at much greater cost. Similarly, existing vessel problems with ventilation can often be identified and a design solution developed before costly and sometimes ineffective modifications are made.

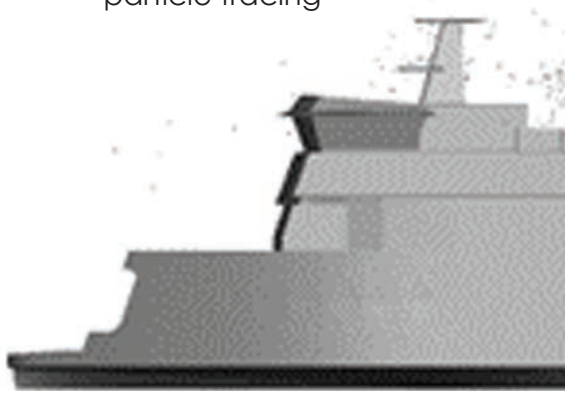
Providing healthy and comfortable indoor air begins with assuring that the outdoor air brought into the ventilation system is as clean as possible. Conventionally designers have used intuition and experience to locate the fresh air intakes. Good design practice includes separating fresh air intakes from air discharges as widely as possible to prevent short circuiting and locating fresh air intakes away from engine and boiler exhausts, sewage and fuel tank vents to prevent particulates, noxious and toxic fumes from being pulled into the ventilation system. Conventional design practice alone does not always work to assure that the air entering the intakes will be clean.

Ships superstructures, being the irregular shapes that they are and moving in all headings relative to wind direction, make locating intake air openings challenging. The challenges become greater with smaller vessels with smaller superstructures, "wide separation" of exhausts and intakes becomes a relative term. A CFD analysis can facilitate the ideal placement of air intake openings when in proximity to exhaust discharges and tank vents. It can even predict under what conditions clean air intake becomes bad air. Sometimes the solution isn't relocating the air intake but slowing down the air velocity across the intake louver, adding a fashion plate to increase separation distance, or reshaping an exhaust discharge to create a greater projection of the exhaust gases away from the vessel. These issues get addressed through the design process



All images courtesy EBDG

Figure 2: Exhaust particle tracing



to optimize the system.

HVAC system optimization is important for shipboard energy efficiency as well as reducing system weight and costs, but also for passenger comfort and safety. Harmful pathogens such as norovirus, respiratory syncytial virus (RSV), Covid-19, pneumonia, tuberculosis, influenza (the flu), and even the common cold continue to be able to spread through the air, ship operators have had to consider what can be done to mitigate shipboard airborne pathogen transmission.

While the struggles of virus containment are well documented on cruise ships and other crowded spaces, the pervasiveness of airborne pathogens has demonstrated that it is just as important for smaller vessels to take steps to reduce the spread of infections as well. Proper mitigation techniques may help prevent crew members from spreading infection to one another or reduce the risk of passenger vessels becoming the site of a so-called "super spreader" event.

In this article, we will be examining one of the opportunities for pathogen containment that should receive consideration from ship operators: the ventilation system. Traditionally, ventilation system design has concentrated on the number of air changes per hour (ACH) in a particular space. While increasing the ACH is known to improve the dilution factor of infectious agents, thereby reducing the possible spread of disease through infectious particles, it does not increase the ventilation system's effectiveness. In other words, not all air changes are equal. We must think beyond a simple exchange rate to the actual dynamics of air movement within a space.

Two opposing factors must be considered when optimizing a ventilation system to reduce the risk of airborne particle transmission: depth of exchange and path of exchange. Here, depth of exchange refers to how much of the space has received fresh air (outside or filtered) after one exchange cycle and path of exchange refers to the distance the air must travel before exiting a space.

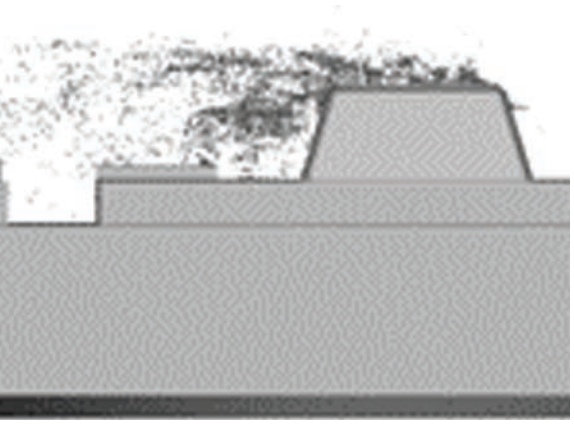
Designing a ventilation system for minimal airborne particle transmission requires a balance of both factors, maximizing the depth of exchange while minimizing the path of exchange. This is best explained by comparing the images in Case 1 and Case 2. These figures represent a simplified two-dimensional space with a ventilation inlet in the lower right corner and a ventilation outlet in the upper left corner. The arrows represent two different hypothetical paths of airflow through the space, with green representing fresh air and red representing air already present in the space.

Case 1 has a poor depth of exchange because, even though the total volume of air exchanged may meet a certain ACH rating, the airflow is such that

the corners of the space receive little to no fresh air after an exchange cycle. Conversely, the airflow in Case 2 results in an excellent depth of exchange as nearly all parts of the space are filled with fresh air after one exchange cycle. Having a high depth of exchange is important for removing airborne contaminants from wherever they originate in a space. Imagine if a sick passenger were seated in the upper right corner of the space. In Case 1, removing the infectious particles from the air would take much longer as there is little to no airflow in that corner. But in Case 2, removal of any infectious particles is ensured due to the high depth of exchange.

Let us now consider the path of exchange. Case 1 represents a good path of exchange, meaning the distance the air must travel before exiting the space is as short as possible. Case 2 has a poor path of exchange because the air must travel a very long distance before exiting the space. To understand why this is important, imagine now that a sick passenger is seated in the lower right corner near the air inlet. In Case 1, infectious airborne particles are efficiently removed from the space, minimizing the potential to pass by other passengers and infect them. In Case 2, infectious particles are carried by the airflow through the entire space, increasing the likelihood that they could infect passengers in other areas along the path to the outlet.

While it may be easy to imagine an improved ventilation arrangement for the idealized space presented above, visualizing the airflow to balance the depth and path of exchange is



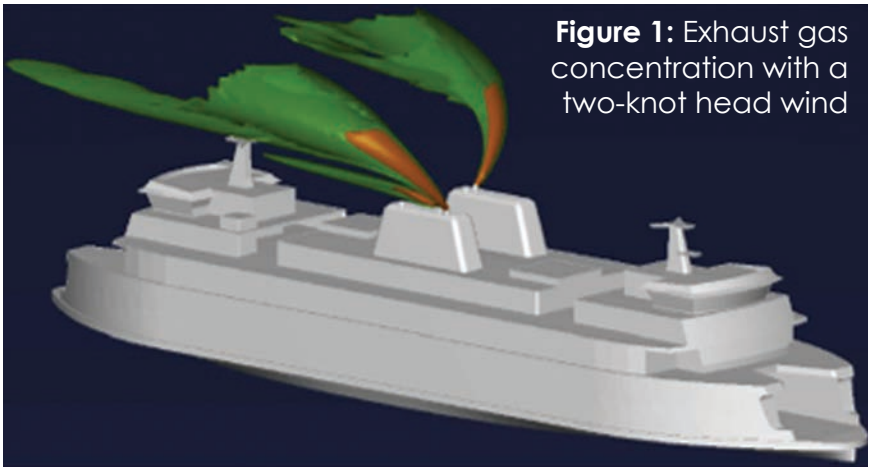


Figure 1: Exhaust gas concentration with a two-knot head wind

much more difficult in actual practice. The airflow is not only affected by the complex three-dimensional space of shipboard compartments, but furnishings, equipment and people within the space can alter the path of the air as well. Fortunately, modern day engineering analysis tools such as CFD are up to the task and can be used for fluid flow visualization and overall system optimization.

The CFD analysis begins with creating a three dimensional (3D) digital model of the hull and superstructure. It needs to be accurate in its

dimensions and shape but can generally be devoid of most details unless they are large items that can disturb airflow. Fluid (air, water, gas, etc.) flow modeled over the hull and superstructure will simulate the vessel underway at various speeds as will modeling the net flow influence from various directions to simulate wind conditions. Engine and boiler exhaust discharge can be added to show exhaust gas projection and dissipation, as shown in Figure 1.

Fresh air intake flows can also be added.

Visual representations of analysis results will show the pressure gradients over the superstructure as

well as flow direction vectors and velocities. It is well known that fluid flows from areas of high pressure to low pressure, but finding and tracking the pressure gradients is made much easier through the CFD visualization tools. It is even possible to particle trace, e.g. a pathogen, and watch its defined entry point through its path along the vessel until it has left the system. Figure 2 shows particle tracing of exhaust gases emanating from exhaust stacks. Inside air would be shown in a similar way.

Areas of concern revealed through flow visualizations can be corrected and rechecked until optimized for all conditions of vessel operation. Once the CFD model is set up, iterating solutions is simple and cost effective. Conventionally this type of analysis was done in a wind tunnel at great cost using a smoke wand and yarn taped to a physical model. Iterating solutions was prohibitively expensive; CFD iterations of model changes and re-analyzing can be a matter of hours versus wind tunnel iterations taking days or weeks to make changes and re-analyze. With CFD, the entire domain (the vessel and its environment) is digitized and point information is available anywhere in the domain. While focusing on one aspect of the ventilation system often reveals a second area that needs attention. That second area has already been analyzed by the computer and the data can be immediately accessed. With a wind tunnel, if a secondary area wasn't anticipated in the initial testing, more test setup, rerunning the tunnel test would be necessary.

Once built, vessels need to serve their mission for decades. HVAC systems take up an inordinate amount of space and must be designed as an integral component of the vessel structure, superstructure shape and interior space arrangements. They also use a significant portion of the power available. Sub-optimal design is inconvenient and annoying at least and, more significantly, may affect the health and safety of all persons onboard. Correcting sub-optimal ventilation design once installed is often challenging, invasive and expensive or may even be cost prohibitive or otherwise infeasible. CFD analysis of ventilation systems is a cost-effective tool that can be applied in initial design or in modification to assist the designer and operator in achieving and assuring all of the objectives of optimal HVAC system installation are met.

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Brian King joined EBDG in 1988 and in his last full-time position was President - Chief Engineer until retirement in May 2021. Brian now serves as Principal Emeritus supporting client relations and supporting strategic objectives.

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CMB.TECH, Damen ink Agreement for Four Hydrogen-powered Tugs

Image courtesy CMB.Teck/Damen

CMB.TECH and Damen will collaborate on hydrogen-powered ASD Tugs. Built by Damen, these vessels use CMB.TECH's innovative dual fuel hydrogen technology that will significantly reduce emissions.

The collaboration for the first four vessels was signed May 23, 2024, at Albwardy Damen in Sharjah. Earlier that day, Lloyd's Register presented CMB.TECH and Damen with an approval in principle (AiP) for the hydrogen solution that will be installed in the tugs.

Damen and CMB.TECH have previously cooperated on the development of a series Commissioning Service Operations Vessels (CSOV) - which are powered by hydrogen dual fuel generator sets - the so-called Elevation Series, that Damen is building for CMB.TECH's subsidiary Windcat.

The hydrogen dual fuel ASD Tugs 2812 FF-H2, with 80-tonnes bollard pull, that meets the most stringent IMO Tier III and EU Stage V standards, are a new step in the parties' cooperation. The vessels will feature four highspeed hydrogen dual fuel engines, designed to minimize NOx and CO2 emissions. They will also have modular storage systems for compressed hydrogen, ensuring safe storage below deck. Each tug can carry up to 16 hydrogen bottles, storing a total of 736kg of pressurized hydrogen at 350 bar.

While these tugs will primarily run on hydrogen, they're equipped to switch to traditional fuel if hydrogen isn't available and can operate on 100% traditional fuel if needed. The tugs feature a total of 160m3 fuel holds.

Fincantieri Launches Navy Logistics Support Ship

Image courtesy Fincantieri

A launching ceremony of the Logistic Support Ship (LSS) Atlante took place at Fincantieri's shipyard in Castellammare di Stabia.

Atlante will be delivered in 2025 and is the second unit of this type built for the Navy. The first, Vulcano, was delivered by Fincantieri in 2021.

The ships designed to provide logistical support to multiple national naval components. The LSS ships are designed to be flexible and multi-use, part of the Navy fleet renewal plan, commissioned to the Temporary Business Grouping (RTI) made up of Fincantieri and Leonardo, and stand out for their very high level of innovation which makes them extremely flexible and efficient in different usage profiles. Apart from military use, they are envisioned to deploy for multiple missions, including support of Civil Protection in humanitarian aid and rescue operations.

The LSS is a logistical support unit for the fleet also equipped with hospital and healthcare capabilities. The ship combines the ability to transport and transfer liquid cargoes (diesel, aviation fuel, fresh water) and solids (spare parts, food and ammunition) to other naval units and to carry out repair and maintenance operations at sea for other units. Defense systems are represented by command and control capabilities in tactical scenarios, communications and non-lethal dissuasive defense systems. The unit is capable of carrying even more complex defense systems and supporting intelligence and electronic warfare equipment.

In the Shipyard

Green Ship Designs & Deliveries

Eastern Shipbuilding Group/EBDG

ESG to Build Fisher Island Ferry

Eastern Shipbuilding Group (ESG) won a contract to build a new auto and passenger ferry for the Fisher Island Community Association, Inc. (FICA) in Florida. The vessel will be built at ESG's Allanton and Port St. Joe facilities and is expected for delivery in Spring 2026.

"Eastern Shipbuilding Group (ESG) delivered the vehicle passenger ferry HERON to the Fisher Island Community Association, Inc. (FICA) over 20 years ago, and we understand that she has been the most reliable ferry in their fleet. We look forward to delivering another robust and reliable ESG built ferry that will serve the residents of Fisher Island for decades to come," said Joey D'Isernia, Chairman and CEO of ESG. "In collaboration with FICA and Elliott Bay Design Group (EBDG), this ferry will be built with yacht style finishes and will provide safe and comfortable transportation for the residents of the Fisher Island Community."

Longer-Endurance CTV with 'Sleep Aboard' Capability Unveiled

Image courtesy NAV Engineering

NAV Engineering (NAV), a subsidiary of Newport Shipping established in 2023, unveiled its latest Crew Transfer Vessel (CTV) design, HybriNav35. At 35.4m long, HybriNav35 is designed to cater for increased endurance of up to two weeks, where crew will be able to sleep onboard the vessel. This design specification will enable the vessel to support infield transfers and transits between sites 24/7 in O&M and Construction on far-offshore locations.

The design shares some similarities with the previous HybriNav26 in that both vessel designs have a unique hull design, which allows them to be tailored to clients' requirements. The 26m design has waterjet propulsion, whereas the 35m design has a variable pitch propeller. Both vessels are designed for hybrid propulsion with a 300kWh battery and both can run on HVO biofuel.

Keel Laying for Methanol Tugs

Image courtesy KOTUG

On 8 May 2024, KOTUG Canada Inc., a partnership between KOTUG International B.V. and Horizon Maritime Inc., held a keel laying ceremony for two RAsalvor 4400-DFM dual fuel methanol escort tugs – Robert Allan Ltd. design – to service the Trans Mountain Expansion Project, at Sanmar Shipyards Altinova in Yalova, Turkiye.

The tug is expected to be delivered by mid-2025.

The tugboats, designed by Robert Allan Ltd., are the first of their kind to be powered by methanol and are engineered to provide the high bollard pull required for the Trans Mountain Expansion Project.

The tugs will escort tankers from the harbor limits of the Port of Vancouver to the open Pacific Ocean through the commercial shipping lanes of the Salish Sea. To provide this service, KOTUG Canada has partnered with the Sc'ianew First Nation from Beecher Bay, strategically located along the shipping route. These two innovative tugs, to be named SD AISEMAHT and SD QWII-AAN'C SARAH in honor of members of Sc'ianew First Nation, are scheduled to be the world's first large purpose-built high bollard pull methanol fuelled tugs when they enter service in 2025.

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