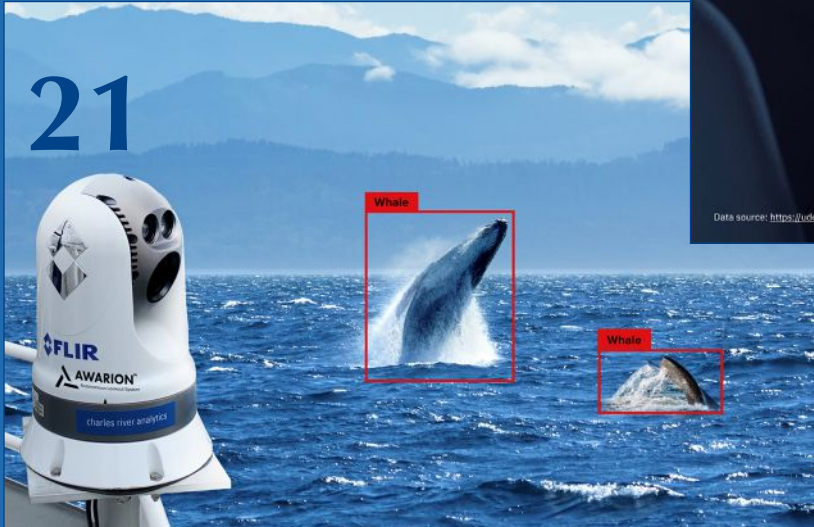




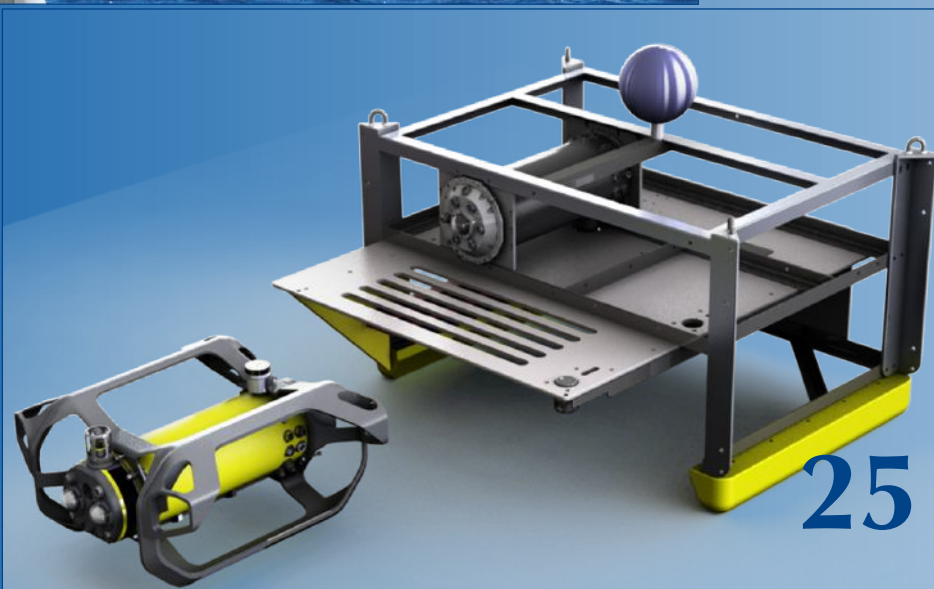
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Data source: <https://udemim.geomar.de/de>



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An AUV surveys a wind farm. The data gathered in surveys are growing exponentially with the growth of the offshore wind energy industry. See story on p. 15.

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)) Opening Private Sector Ocean Data to the Public. The Ocean Decade Corporate Data Group—co-chaired by Fugro and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organisation (IOC/UNESCO)—has officially launched in order to support the United Nations Decade of Ocean Science for Sustainable Development as a working group focused on creating frameworks and mechanisms to make privately owned ocean science data publicly available for the benefit of humanity. Joining the group as founding members are five private companies representing a diverse range of industries: Alcatel Submarine Networks, Ava Ocean, CGG, Equinor and Ørsted. Discussions are ongoing with other industry-leading companies who are expected to join the group at a later stage. Together with co-chairs, members will explore data sharing challenges and opportunities to develop solutions and best practices for making private sector ocean data publicly available. The UN Decade of Ocean Science for Sustainable Development (2021 to 2030) seeks to stimulate ocean science and knowledge generation to reverse the decline of the state of the ocean system and catalyze new opportunities for sustainable development of the massive marine ecosystem.

)) Developing GHG Monitoring, Reporting Framework for Offshore Wind Installation. DNV and partners have established the new joint industry project (JIP) EMRED to create a monitoring and reporting framework for assessing greenhouse gas (GHG) emissions in the offshore wind installation sector. The partners comprise the energy companies ScottishPower Renewables, RWE, Vattenfall and Ørsted, as well as the installation/operation companies Jan De Nul Group, DEME, Ziton, Cadeler, Van Oord, Fred. Olsen Windcarrier and DNV. The expansion of renewable energy generation is a key part of the global energy transition. In particular, offshore wind generation will be vital, with DNV's Energy Transition Outlook projecting that by 2050 it will supply about 15 percent of the world's total electricity generation and grow to 50 percent of ocean CAPEX. For this growth to be realized, there must be a massive ramp up in the development and deployment of offshore wind installation vessels. The JIP will run through 2023 to establish a set of emissions metrics that can provide a foundation to objectively measure GHG emissions. This will result in parameters and measurements of "work performed" that are appropriate for the individual ship types and common modes of operation, including DP operation, standby, transit and lifting. In addition, the EMRED partners will work to develop a set of reference values (baselines) that can be used as a benchmark for operations in the industry for both internal and external stakeholders, comparable to existing standards (AER - Annual Efficiency Ratio, CII - Carbon Intensity Indicator, EEOI - Energy Efficiency Operational Index) for other ship segments. The project will focus primarily on foundation installation vessels (floating and jackup), wind turbine installation vessels and cable-laying vessels. The EMRED JIP will provide a framework that will enable contractors and operators to document vessel performance and more easily set reduction targets. Charters and financial institutions will then be able to compare vessels on these GHG metrics and document the efficiencies in their projects that will then feed into regulations that are better tailored to the needs of the segment.

)) Toward a Sustainable Blue Carbon Market. The Blue Carbon Action Partnership (BCAP, bluecarbonactionpartnership.org) is a new initiative by the World Economic Forum's Ocean Action Agenda to work with countries to catalyze and amplify quality blue carbon efforts and pipelines to benefit coastal communities, biodiversity and the climate. BCAP builds on the High-Quality Blue Carbon Principles and Guidance launched with partners at COP27. The first national BCAP (NBCAP) was signed with Indonesia. The Blue Carbon Action Partnership is made possible thanks to a £4 million (\$4.86 million) grant from the U.K. government's new Climate and Ocean Adaptation and Sustainable Transition (COAST) program. Blue carbon is carbon captured and stored by the planet's ocean and coastal ecosystems. It offers a critical opportunity to conserve vital coastal ecosystems, maximize the ocean's potential as our main carbon sink, and raise funds to put in place robust ocean protection. This nascent global market needs careful governance to ensure it is ethical and sustainable. Meanwhile, countries also seek support in how to include blue carbon to achieve their national climate goals under the Paris Agreement.

)) First Net-Zero Vessel Voyage Using Bio-Methanol. Methanex Corp. and Mitsui O.S.K. Lines Ltd. (MOL) have announced that the dual-fuel vessel *Cajun Sun* has successfully completed the first-ever net-zero voyage fueled by bio-methanol. The voyage is an example of how Methanex and MOL are collaborating to demonstrate the viability of methanol as a marine fuel with a pathway to net-zero emissions. The *Cajun Sun*, operated by Methanex's subsidiary Waterfront Shipping and chartered from MOL, departed from Geismar, Louisiana, on January 17 and arrived in Antwerp, Belgium, on February 4. By blending ISCC-certified bio-methanol that has negative carbon intensity with natural-gas-based methanol, net-zero greenhouse gas emissions on a life cycle basis were achieved for the 18-day trans-Atlantic voyage. This innovative fuel solution offers shipping companies the ability to achieve net-zero carbon emissions today, supporting the industry's transition to a low-carbon future. The use of methanol as an alternative marine fuel was pioneered by Waterfront Shipping in 2016 when Methanex, Waterfront Shipping and MOL, with other partners, jointly built the world's first ocean-going methanol dual-fuel tanker, *Taranaki Sun*. **ST**

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17476 Slipper Shell Way, Ste. 6
Lewes, DE 19958
Tel: (302) 569-0019 (M)
rmahrjr@gmail.com

WESTERN U.S.A. & CANADA

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Barbara Sabo
Gregory Sabo
John Sabo Associates
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Hermosa Beach, CA 90254
Tel: (310) 374-2301
bsabo@jsaboassoc.com

EUROPE

John Gold
John F. Gold & Associates
"Highview"
18a Aultone Way
Sutton, Surrey, SM1 3LE, England
Phone/FAX Nat'l: 020-8641-7717
Int'l: +44-20-8641-7717
johnfgold@gmail.com



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Offshore Oil and Gas Needs Digitalization

Anticipating the challenges of the oil and gas industry has never been easy, especially during the last few years. The COVID-19 pandemic, Russia's invasion of Ukraine, and increased regulatory pressure regarding ESG (environmental, social and governance) issues are just some of the factors pushing the industry into uncharted territory.

These disruptions are contributing to several challenges. While the industry has a mature approach to health and safety (H&S), greater demand for energy puts offshore workers on the front line under pressure to produce more product as quickly as possible, which increases the likelihood of accident and injury. Offshore workers are already vulnerable to injuries caused by fire, falls, chemical exposure and impact from moving objects. The physical demands of the job, as well as the dynamic nature of the oil industry, make embracing an innovative safety culture a critical priority.

As regulators pay more attention to ESG issues, the oil and gas industry is facing greater scrutiny. Recent research from Princeton University shows that offshore platforms are responsible for more methane emissions than was previously thought. Offshore production also continues to face the challenges of limited physical space for new technology solutions, harmful emissions from venting and flaring, and pollution from wastewater disposal.

Meeting these challenges requires strong programs for data collection and analysis to capture information on emissions, accident rates and much more. As the world moves into Industry 4.0, technology solutions such as the Industrial Internet of Things (IIoT), big data and artificial intelligence (AI) are disrupting traditional approaches to frontline work. Yet oil and gas has typically been slow to adopt digitalization. Recent research has shown that among the larger oil and gas companies, only 7 percent had management members with the technology knowledge to support the digitalization and data analysis required for H&S and ESG programs for Industry 4.0. While offshore oil rigs continuously generate massive amounts of data on every function, the sophisticated data analysis techniques to reveal insights from big data are lacking.

The lag in digital adoption in offshore oil and gas has three significant impacts. First, without cutting-edge techniques for analyzing data, offshore oil is not living up to the market's expectation for ESG responsibilities. According to the Princeton researchers cited above, the emissions data collected came not from the rigs themselves, but from researchers in fishing boats using laser-mounted instruments. These are data that the industry should be able to produce in real time.

Second, real-time H&S data are critical to producing a safety culture that uses predictive analytics to anticipate and prevent H&S incidents. H&S practitioners are moving quickly to embrace predictive analytics as a primary foundation of safety culture, but without the digital solutions needed to understand the data, the oil and gas industry will find itself behind the times.

Finally, without embracing digitalization to support H&S and ESG, offshore oil and gas will continue to face a labor crisis. As older workers retire, young digital natives seek to use their technology skills to contribute to workplaces that embrace their values, including ESG. Younger workers, who see the oil and gas industry as conservative and old fashioned, will look elsewhere for job satisfaction, thus worsening the industry's labor crisis.

By increasing the pace of digitalization, offshore oil and gas can make progress in meeting the market demands for oil, regulatory demands for greater attention to H&S and ESG, and labor demands for satisfying work that recognizes the role of traditional forms of energy in the energy transition. **ST**

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Digitalization Drives Offshore Wind

The Convergence of Automation and Electrification

By Pedro Patacao

In 1991, the world's first offshore wind farm was built by the power company Ørsted off the coast of Denmark. Comprising 11 turbines, it generated just 5 MW—enough to power 2,200 households—and was initially viewed mostly as a demonstration project for the nascent wind energy industry.

A little over three decades later, the same company recently unveiled plans for four additional gigascale offshore wind projects in neighboring Sweden, which would boost Ørsted's portfolio in the Nordic country to 18 GW, enough to cover more than half of its total electricity consumption.





(Left) Wood Mackenzie predicts that almost \$1 trillion will flow into the offshore wind industry over the next decade. (Above) ABB's solutions in the offshore wind space also encompass the auxiliary systems that enable platforms to function and connect with operators onshore.

Wood Mackenzie (WoodMac) predicts that almost \$1 trillion will flow into the offshore wind industry over the next decade. By 2030, 24 countries are expected to have large-scale offshore wind farms (up from just nine today), while total capacity is forecast to reach 330 GW, up from 34 GW in 2020. According to WoodMac, by 2030, as much money will be invested in offshore wind as in its onshore equivalent.

Offshore wind's journey from niche industry to a critical component of the global energy mix and a major driver of the transition from fossil fuels to renewables has been underpinned by incremental technological advancements. As confidence in the technology has increased, so, too, have costs fallen. They fell by 50 percent between 2015 and 2020 and are expected to continue to do so. In 2021, the world's first fully unsubsidized off-

shore wind project contract was awarded (in Denmark, once again).

In this article, we will use real-life case studies to illustrate how the latest digital solutions—including the use of simulation and digital twins—and the convergence of automation and electrification are helping to enable offshore wind projects and how asset management and condition monitoring of offshore facilities can keep maintenance to a minimum. We will also look at new business/operating models.

The Advantages and Disadvantages of Offshore Wind

Offshore wind installations have multiple advantages compared with their onshore equivalents and other renewable energy sources, such as solar PV (photovoltaic), hydropower and nuclear. One major advantage is their ability to utilize the faster, steadier wind speeds at sea. Offshore wind farms require fewer turbines than onshore, and small increases in wind speed can yield large increases in energy production. For example, a turbine in a 15-mph wind can generate twice as much energy as one in a 12-mph wind.

Offshore wind farms also impact the surrounding environment less than their onshore counterparts since the infrastructure is built far away from housing, so community concerns are not a challenge.

Add to this the fact that both technology costs and the price of electricity per megawatt hour from offshore wind are falling dramatically—in the U.K., the price of offshore wind power reached a record low in 2022, with the contract price for offshore farms nearly 6 percent lower than the previous renewables auction in 2019—and the case



Hywind Tampen floating wind farm, Gullfaks platform. (Credit: Equinor)

for accelerating wind farm construction globally is a compelling one.

Two disadvantages of offshore wind projects are that they require more complex infrastructure, and, therefore, the initial installation costs are higher, and they are often located in remote, inhospitable environments at sea, making them challenging to maintain and repair.

This is where digitalization, automation and electrification solutions can add real value, optimizing efficiency and safety by facilitating the transition to remote, unmanned operations. Tools such as artificial intelligence (AI), machine learning and condition monitoring give operators end-to-end visibility and control over operations, enabling them to make informed, data-driven decisions that keep facilities cyber-secure, reduce costs and enable predictive rather than reactive maintenance.

For example, gathering and analyzing data inputs from cable arrays on wind turbines can be used to monitor and run core systems in an optimal way, improving both transparency and measurability.

Digital, automation and electrification solutions, then, can help offshore wind operators around the world achieve their goal: namely, the reliable delivery of power output from offshore facilities to onshore grids and the successful integration of clean and diversified energy into the existing power mix.

Digital Twins and Simulation

The use of simulation and digital twins—digital or virtual representations of actual physical objects or processes—both during the construction and ongoing operation of offshore wind farms gives the operator invaluable in-

sights into the performance of critical assets. The simulator is fed with data on the status, working condition and location of machinery and processes around the facility, and then uses simulations and AI to help personnel make data-driven decisions that optimize performance.

ABB's Process Power Simulator, for example, is being deployed at Equinor's Hywind Tampen floating wind farm in the Norwegian North Sea for operator training and to test the electrical control system. Creating a realistic real-world environment by using a replica of the electrical control system, the solution uses the same human-machine interface and technologies to integrate processing channels and electrical signals, enabling Equinor to make decisions around sustainability that help ensure energy supplies are clean and renewable. In the case of Hywind Tampen, that means preserving process integrity on the world's first floating wind farm to power offshore oil and gas platforms.

The benefits of the Process Power Simulator extend well beyond operator training. It can also help offshore wind companies ensure regulatory compliance, optimize electrical consumption and lower electricity costs, as well as verify and validate new control strategies, equipment and procedures.

Case study: DolWin5

Our solutions in the offshore wind space also encompass the auxiliary systems that enable platforms to function and connect with operators onshore. For example, we are providing a system for IT infrastructure, operational technology (OT) security, plant-wide condition monitoring, SCADA and remote access services to facil-



itate stable power transmission to the German grid as part of the DolWin5 project.

Using extra-high-voltage direct current transmission technology, DolWin5 is set to deliver 900 MW of zero-carbon power from three connected wind farms in the North Sea, 100 km off the German coast.

Specifically, ABB's scope of work includes a comprehensive OT system for the onshore and offshore substations based on recognized global security standards, including IEC62443; plant-wide condition monitoring; IT infrastructure; supervisory control and data acquisition (SCADA); OSIsoft PI historian; and remote access services. This OT system ensures the safety, security and reliability of the project's renewable assets, as well as stable power transmission.

A multiple users try to access data simultaneously, cybersecurity is a priority. ABB, in partnership with Aibel, is committed to delivering digital, remote, unmanned operations on DolWin5. In addition to load-balancing systems that stabilize the network, the solution offers a high degree of visibility by recording every operator that accesses the system and exactly what they are doing.

For DolWin5, remote monitoring takes place in multiple service centers, and the data are collected by secure cloud infrastructure. The condition monitoring system encompasses all the electrical, telecommunication, IT equipment and field instruments using smart solutions, and all the equipment has intelligent sensors for data acquisition to the ABB Ability Edgenius data platform.

Pushing the Boundaries at Dogger Bank

ABB is also providing the auxiliary systems (ESD/HVAC/IMAC/FIFI); IT infrastructure, including operational support systems; condition monitoring for the whole substation; and OT-Security, with an emphasis on maximizing uptime and cybersecurity at Dogger Bank, the world's largest offshore wind farm.

Once complete, the vast facility, which is located more than 130 km off the northeast coast of England, will increase current offshore wind capacity by 3.6 GW—equivalent to 5 percent of the U.K.'s estimated electricity generation. It will be capable of powering 6 million homes.

ABB also maintains telecom responsibility for the offshore and onshore substations at Dogger Bank. The package is vital to ensuring secure-access data are provided seamlessly by remote operating centers, which can be located anywhere in the world.

Furthermore, in June 2021, it was also announced that ABB would deliver 95 PCS6000 medium-voltage



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“The International Energy Agency expects global annual offshore wind installations to increase 50 percent to over 30 GW in 2027.”

converter units to GE Renewable Energy for installation in GE's giant Haliade-X 13-MW wind turbines at Dogger Bank, which will eventually produce 1.2 GW of power. The converters will take the power produced by the turbines and convert it to the correct voltage and frequency for the wind farm grid.

The Importance of Telecommunications

Dogger Bank will comprise three main substations surrounded by 285 giant turbines, in addition to moving assets, such as vessels and crews. In this environment, a robust telecommunications infrastructure is essential to ensure data are available and visible 24/7. This will prove particularly important as the number of unmanned offshore wind installations increases and wind farms grow in size and scale.

A wind turbine typically has a programmable logic controller (PLC), which acts as a communication gateway, gathering data for supervision, control and asset/condition monitoring, and connecting to the turbine assets via IO (input/output) and industry standard protocols.

This wealth of information is not just invaluable for operational purposes; it also enables maintenance teams to work more safely and efficiently as they remotely monitor, inspect and operate turbines, and reduces trips offshore.

For wind farms, communications between the turbines and substations can use a combination of radio, microwave, satellite or fiber to provide the required availability. For the off-to-onshore link typically between substations using HVDC or HVAC links, fiber can be laid in parallel with the power cable to provide robust high-performance communications. ABB is collaborating with 5G technology providers and offshore operators to explore its potential as an option for whole-farm coverage.

The Future of Offshore Wind: Digitalized and Collaborative

The EU is targeting 300 GW of offshore wind by 2050, which equates to just under 285 GW of new capacity, or roughly 10 GW every year for the next nearly 30 years. The International Energy Agency expects global annual offshore wind installations to increase 50 percent to over 30 GW in 2027.

Meeting these ambitious targets will require a combination of policy support from governments and industry; meaningful investment in digital, automation and electrification technologies; and, finally, effective collaboration and knowledge sharing between all offshore wind industry stakeholders.

For example, operators that can develop an end-to-end digitalized ecosystem that delivers timely, manageable insights from big data models for better decision making can look forward to securing competitive advantage over less innovative rivals that settle for “business as usual.”

A willingness to adopt new, disruptive working models and processes, and learn the right lessons from how these work in sectors such as oil and gas, also promises to pay dividends. An example of such a partnership is the project alliance between ABB and Norway's Aker BP, which employs a predefined partner model for specific projects. Time, costs and risks are set in stone, investment decisions are made together, targets are set, and then everyone is incentivized to perform better.

In April 2022, ABB and Ramboll signed a memorandum of understanding to work together in pursuing new prospects for offshore substations, with each company delivering a wealth of experience and deep domain expertise in multiple disciplines. ABB has a similar strategic partnership in place with Norwegian oil and gas services player Aibel; this time, to deliver voltage connections for offshore wind integration.

This type of collaborative thinking, coupled with advancements in automation (and its convergence with electrification) and digitalization, will continue to enable offshore wind projects worldwide, especially remote unmanned operations, and to meet the global demand for clean, reliable power.

References

For a list of references, contact: tori.brown@admiralconsultancy.com. **ST**

Pedro Patacao joined ABB in 1999 and has been working with the oil and gas team in Norway since 2008. He has held various positions within sales in Norway and the U.K., most recently operating as ABB's global sales manager for oil and gas. In 2023, he moved into the role of global manager for offshore wind. Patacao holds a master's degree in electrical engineering from the University of Coimbra, Portugal, and an executive MBA from the Porto Business School, Portugal.

Data Management for Offshore Wind

New Cloud Technologies for Marine Survey

By Jann Wendt • Frithjof Henneman

Global offshore wind capacity is projected to rise from 34 GW to 330 GW this decade, which will require the construction, transportation and installation of 82,222 new fixed or floating moored turbines (based on an average capacity of 3.4 MW).

A significant portion of new turbines will be installed by the U.S., China and Denmark, while Germany's Wind Energy at Sea Act (Easter Package), enacted in April 2022, aims to produce at least 30 GW of energy from offshore wind farms in the North Sea and Baltic Sea by 2030. Other countries with similar targets will contribute to the

growth of the industry, although, as of the end of 2022, progress wasn't as strong as many would have hoped.

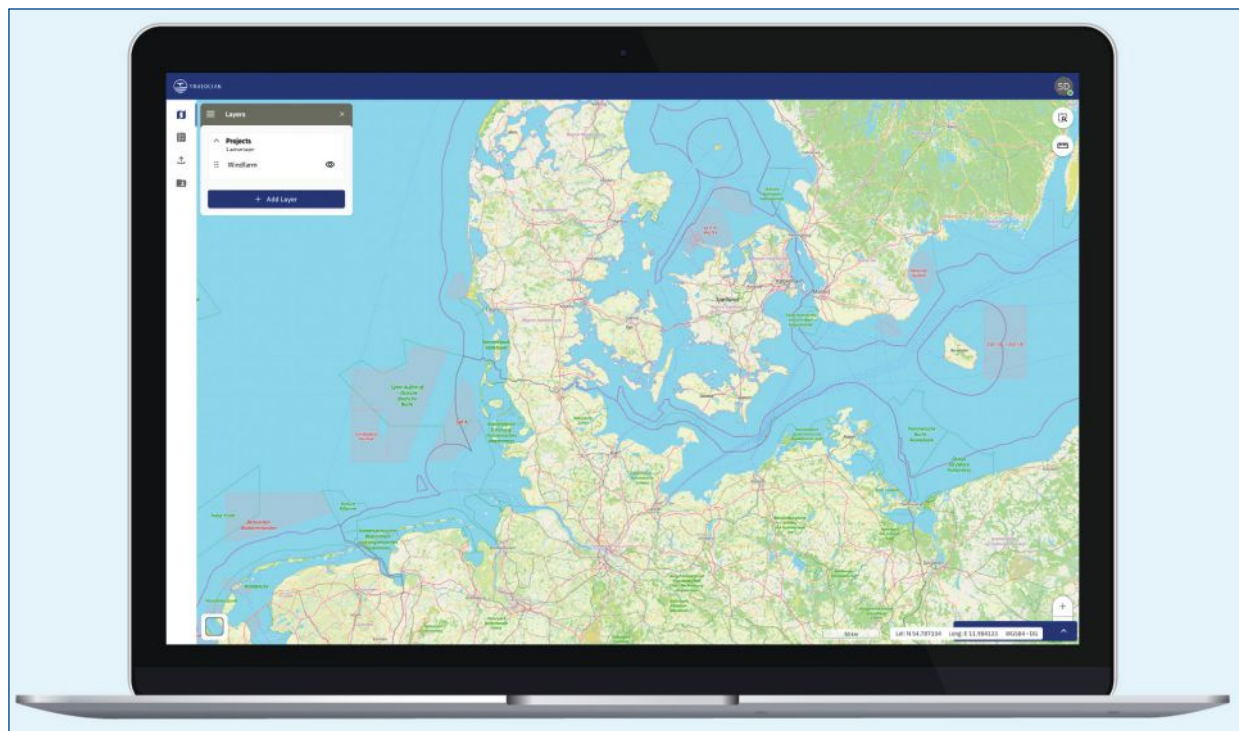
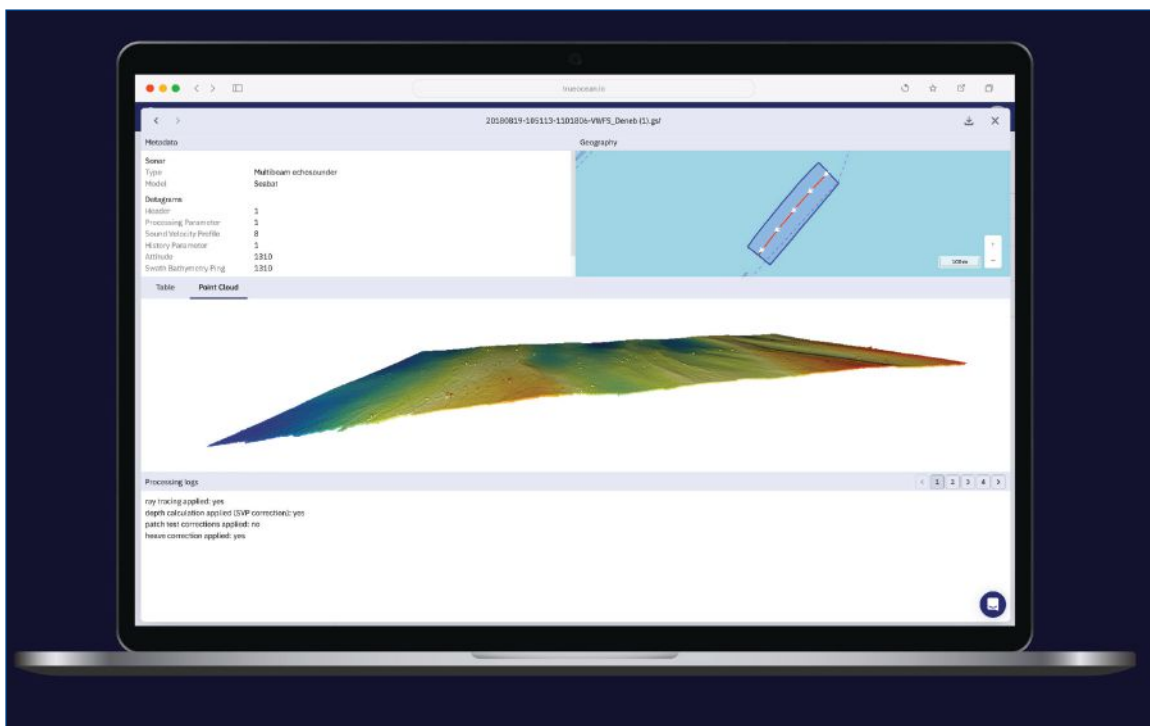
Picking up the Pace of Industry

The Global Offshore Wind Market Report by Renewables Consulting Group (RCG) reported in November that only three countries—Vietnam, Poland and Denmark—are on track to meet their offshore wind development targets for 2030 among a group of 15 countries investigated.

While the causes vary, political and administrative is-



An AUV surveys a wind farm. The data gathered in surveys are growing exponentially with the growth of the offshore wind energy industry.



The TrueOcean Marine Data Platform can be accessed via web browser.

sues are the principal barriers to accelerating the global energy transition. However, the global mission to reduce carbon emissions will also drive the need for increased subsea geophysical data to support the growth of clean energy production, which introduces technical challenges to the mix. In fact, there exists today a pressing need to improve the management of data across the entire ma-

rine survey value chain, from ping to cloud and beyond.

The problems arise from the fact that traditional data transfer processes in the marine survey industry are mostly manual, relying on emails and file transfer protocol (FTP) sites at best, and on the physical movement of hard drives, causing delays of weeks or even months before actionable data are available—at worst. To overcome the data bottlenecks inherent to the established marine survey workflows, a step-change toward a digital foundation will become essential.

Further, a more connected approach that incorporates modern technologies and methodologies will not only

benefit the survey companies, but also the wind farm operators and marine engineers relying on the data they acquire.

The Size of the Data Problem

From data acquisition to analysis and sharing, there is room for improvement in every aspect of marine survey. The transition to cloud-based solutions offers a tangible approach for modernizing the industry, providing a more efficient and streamlined way to manage data and meet demand.

With the accessibility of the cloud, service providers and energy companies alike can reap the rewards of a more advanced and sophisticated approach to marine data management. But beyond the functional, quality control, time-saving and error reduction benefits of digital data management, it is simply needed to ensure that the marine survey industry can accommodate the offshore wind industry. Simply put, more service capacity is needed, and digitalization will help.

The rise of offshore wind energy projects globally will result in a surge of new marine survey commissions, requiring an efficient and effective approach to handling the vast amounts of data generated, as reflected by recent news from Germany.

In January 2023, and as a result of the aforementioned Easter Package, the German government launched a tender for four new offshore wind farm sites in the North Sea

and Baltic Sea with a total capacity of 7 GW. This tender highlights the growth opportunities in the marine survey sector as much as the challenges it faces, as the sites have yet to be surveyed and therefore require updated bathymetric and environmental data even before any planning can take place. Subsequently, several further surveys will be required pre- and post-construction, while at least one survey a year will be needed under the wind farm's operations and maintenance regime.

Considering that a 1 km² multibeam survey can produce around 65,500,000 soundings and more than 2.5 GB of raw data, the needs of just a small portion of Germany's new offshore wind capacity will demand a concerted effort to acquire the bathymetric data that the winning bidders in this tender will require—and this is just the first 7 GW.

Germany's target's dictate tenders for a further 23 GW of production capacity, all of which will come with the same marine survey requirements immediately and in the long term. Scaling even further, the near 300 GW growth across the planet will demand similar intensive and ongoing marine survey operations globally. The scale of the requirement for new marine data amounts is like nothing the industry has ever seen before.

So, the question has to be asked: Can the global marine survey industry keep up with demand? The answer is: probably not, at least without significant efforts, including investing in a digital data management strategy

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Measurements from different sensors are visualized in a layered view in TrueOcean's MDP, and different detail levels can be reached by zooming in a digital map.

at the very earliest opportunity, along with offshore wind energy companies.

Digitalization from Ping to Cloud

While the accepted marine survey workflow is based on the most efficient techniques and processes available, digitalization and, therefore, management of marine data using the cloud can provide significant efficiencies across many of the phases, especially once data have been acquired.

The first area for improvement is the transfer of data from vessel to shore. The marine survey industry still re-

lies on basic digital transfer methods, such as email and FTP sites, once the survey vessel has docked, or wholly analog processes, such as sending data drives by courier. Regardless of the chosen method of getting data from the vessel to the office, current processes are outdated, prone to technical and logistical errors, and, at least in terms of physically transporting hard drives around, incredibly slow.

The journey can be accelerated by transferring raw or partly processed data directly to a data platform hosted in the cloud. Ideally, this would happen in almost real time from the vessel, but the satellite communication sector has yet to hit the right cost and availability for this to be wholly realistic. However, automatic and instant transmission when in range of cellular networks and the potential for fiber-optic networks with Wi-Fi access points at wind farms will enable data to be delivered faster than today.



The MDP uses the Parquet data format for all data, making it completely agnostic toward the original format of a file. This means that it can harmonize practically any data from all underwater sensors from pretty much all manufacturers, and make it available to approved stakeholders within the platform, so no special software is required.

In practice, multiple measurements (from different sensors) are visualized in a layered view, with different detail levels that can be reached via zooming in a digital map. This is all done within the platform, which is designed to work on any cloud infrastructure for any vendor that the client chooses. If you're focused on acquiring marine data, the cloud hosting aspect might not seem particularly exciting, but considering a growing tendency for governments to class marine data as a national concern, the ability to host a chosen marine data platform on a local cloud will become more important in the coming years.

Frictionless Sharing

While the immediate issue of global capacity for marine survey is a major driver in adopting digitalization through solutions such as the TrueOcean MDP, new data management functionality and optimized data sharing capabilities can introduce new ways of working more efficiently. For instance, massively improved data sharing allows the survey company experts to collaborate efficiently internally while enabling faster and easier access for consultants and third-party professionals to work on non-mapping data analysis tasks.

Whereas the current standard for data sharing post-survey and during processing is the same as initial data transfer—email, FTP or physical delivery—the cloud makes it possible to simply share a link with an approved collaborator so they can access the data and

do their jobs immediately. In terms of accelerating the journey from ping to cloud, providing such streamlined access can mitigate a lot of wasted time relative to the standard processes.

And for the very same reasons, delivery of the final data to the client can be instantaneous when using the cloud. In fact, because the marine survey company team, third-party experts and client staff can all access the same system, with respective permissions, of course, final delivery does not really mean final. Instead, relevant parties can be notified when the data has hit certain milestones and is ready for specific users to act on.

The gains of massively improved data sharing during the marine survey workflow carry over to the client's use of the data, too. While the survey and client company share the platform from ping to cloud, marine engineering and contracting firms can be invited to join as a wind farm development project progresses. The cloud makes

Should gains not be yet achievable in terms of real- or near-real-time transfers, the use of in-port Wi-Fi on arrival to access a cloud platform is still much more effective for data management than the more human-centered email and FTP approaches, which are often sporadic, decentralized and unreliable.

With digitalization, further efficiencies are found in the context of data processing. Aside from any processing done on board by sonar operating software or third-party processing suites, marine data may be pretty "raw" when it arrives in the office by hard drive, email or FTP. It will need to be manually loaded into the post-processing teams' chosen software before any processing can start.

Using a cloud ecosystem such as the TrueOcean Marine Data Platform (MDP), automation of quality control and initial processing gives data specialists a significant head start as they begin to clean and analyze the survey results.

this entirely frictionless: Stakeholders can access the TrueOcean MDP from any device with a web browser.

This even counts for the precision measurements needed for subsea engineering tasks. The energy company can provide the quality controlled and fully processed final data with its partners within the same platform, ensuring their ability to work at sea, with the confidence of much improved version control and the ability to further organize or analyze data according to demands that arise during construction and, ultimately, the operational life cycle of a wind farm.

New Business Models

The race to meet the offshore wind industry's need for exponentially more marine data and the moves toward greater digitalization it has catalyzed will unlock a huge amount of business for the global marine industry. And while the rewards will come through developing new ways to better manage and share previously unimagined amounts of marine data so that more work can be done effectively in less time, there is also potential to create new business models that could completely disrupt the marine survey status quo.

Alpha users of the TrueOcean Marine Data Platform are already looking at the potential to bring down the marginal costs of marine data acquisition while at the same time increasing their capacity to do more surveys and meet the needs of the offshore wind sector in the

coming years of massive expansion. The result of lowering the marginal costs of data is that, at some point, the costs of marine survey can be reduced enough that acquiring data from an area without a client commission is financially viable.

The collected and processed data can then be made available digitally so that potential end-users can access the data without having to commission a whole new survey. Compared to today, the price per megabyte of data could be as low as pennies in the pound, and just as importantly, the data will be available to clients immediately as part of a subscription or one-off license.

Such a data-as-a-service approach is certainly one of the more disruptive applications of the cloud and the TrueOcean MDP in the context of marine surveying. By ensuring the availability of services and improved sharing of high-quality data, both have an important role to play in enabling offshore wind to continue its expansion and delivering clean energy as part of the essential global energy transition. **ST**

Jann Wendt is the founder of TrueOcean GmbH.

Frithjof Hennemann is the CEO and co-founder of TrueOcean GmbH.



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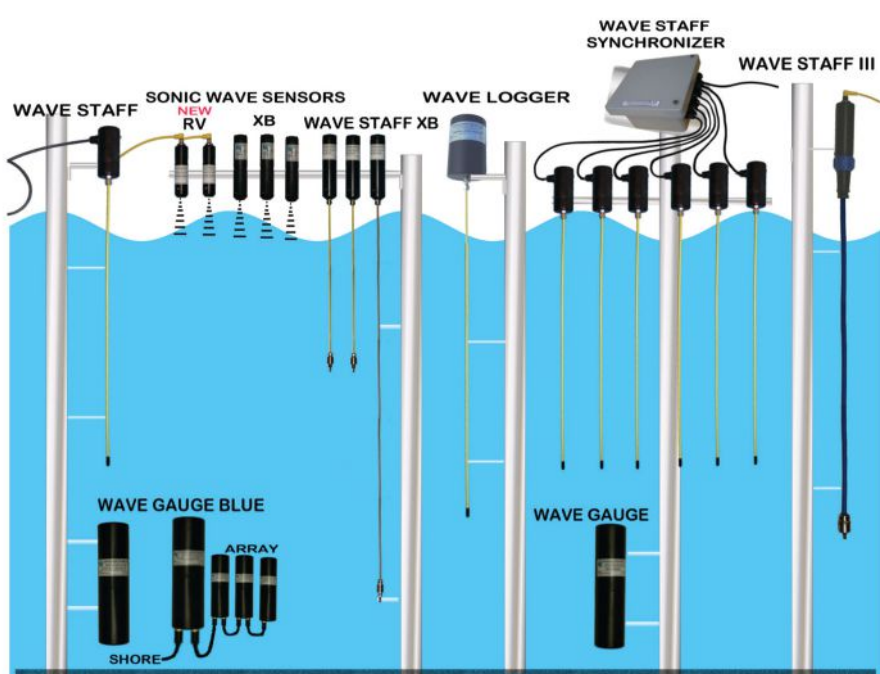


Diagram illustrating various Ocean Sensor Systems components deployed in water:

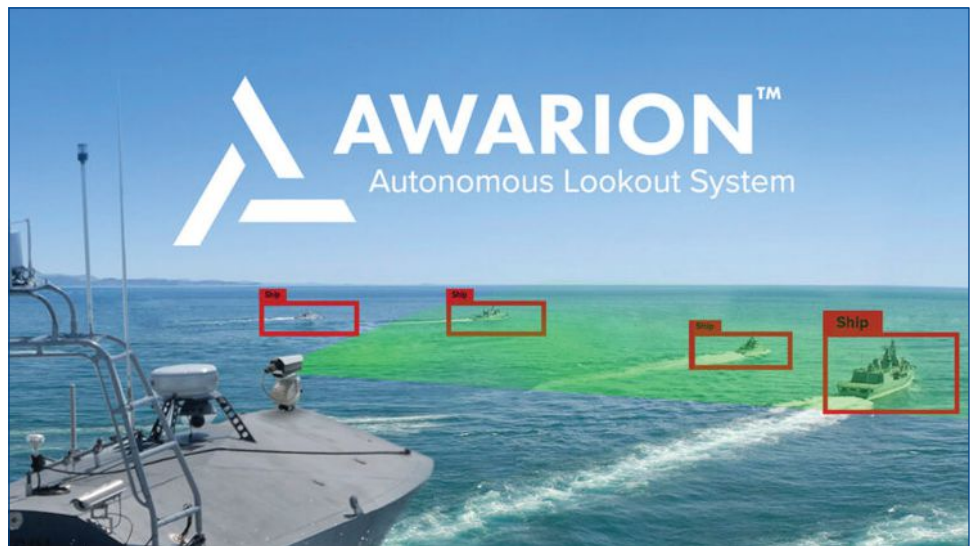
- WAVE STAFF
- SONIC WAVE SENSORS (NEW RV, XB)
- WAVE STAFF XB
- WAVE LOGGER
- WAVE STAFF SYNCHRONIZER
- WAVE STAFF III
- WAVE GAUGE BLUE
- WAVE GAUGE
- ARRAY (on shore)
- SHORE

Machine Learning to Protect Whales

AI Provides Lifeline to Endangered Species as Offshore Wind Develops

By Ross Eaton • Elaine B. Coleman

Offshore wind projects are gaining traction as a source of renewable energy in the United States. But in their wake, the safety of endangered marine mammals, such as North Atlantic right whales, is also becoming a focal point. Fortunately, we can strike a fine balance between these objectives with the aid of technology. Machine learning (ML) is providing an extra set of eyes to detect whales. In doing so, the technology is supporting responsible development of offshore wind projects.



Collision of Whale Protection with Offshore Wind Farm Development

Research firm Wood Mackenzie expects 24 countries to host large-scale offshore wind farms by 2030, up from nine today. Total capacity will likely increase tenfold by that time. While the growth of renewable energy is an exciting step in the fight against climate change, there is an undercurrent of worry about the projects' potential impacts on marine wildlife.

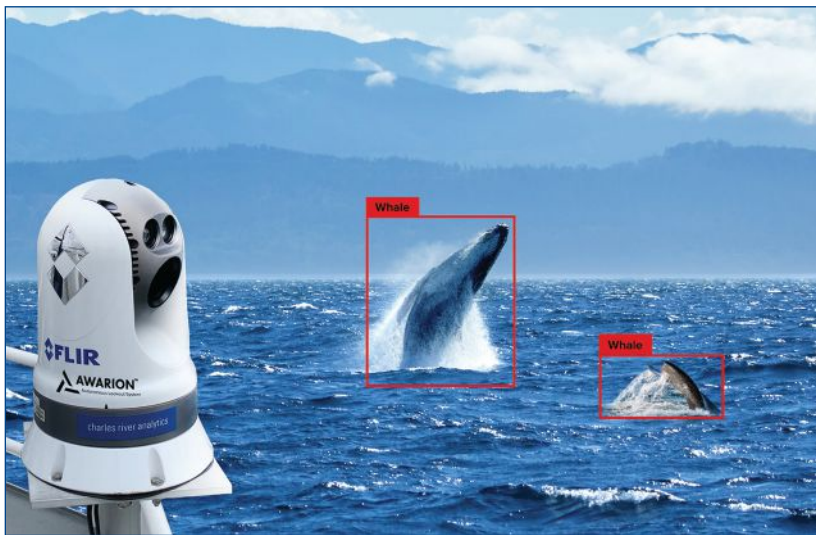
Whales and other marine fauna need to be protected for their own sake and for preserving biodiversity. These mammals also do their part to fight climate change: One whale sequesters an average of 33 tons of carbon dioxide. Yet whales are in a precarious state. The North Atlantic right whale, for example, is extremely vulnerable to vessel strikes. Given that there were just 336 of them left in 2020, measures are rightfully in place to protect them from further decline.

In 2022, NOAA's Fisheries division recommended a

Awarion is an AI and computer vision system that complements and supports human lookouts and marine radar systems.

modification to the North Atlantic Right Whale Speed Rule. According to the new rule: "All vessels 65 feet (19.8 meters) or longer must travel at 10 knots or less in certain locations (called Seasonal Management Areas or SMAs) along the U.S. east coast at certain times of the year to reduce the threat of vessel collisions with endangered North Atlantic right whales."

For the offshore wind industry this can mean significant costs because the traditional vehicle used by day crews, the crew transfer vehicle (CTV), has a limited range when constrained to 10 kt.; at this max speed, CTVs might not be fast enough to reach all wind farm development sites in a timely manner. Since CTVs are boats that need to get back to shore at the end of the day,



(Top) Awarion is uniquely designed to aid protected species observers' (PSO) efforts to detect and protect marine mammals. (Bottom) Vineyard Wind and Charles River Analytics are collaborating to advance machine learning to protect marine mammals.

they likely will be of limited use. More expensive service operations vehicles (SOVs) will have to be pressed into service. Regardless of the type of vessel used, speed will be constrained in consideration of North Atlantic right whale protection.

As work progresses on all fronts, technology promises to help offshore wind development companies conduct operations safely and efficiently. The Awarion Autonomous Lookout System from Charles River Analytics applies machine learning algorithms to electro-optical and infrared video streams to help crews detect, analyze, and report on the presence of whales, other animals and ships. Awarion produces results in real time, which, in addition to its detection range of 3+ km, should enable vessels to travel faster and get more done within the new speed limit while ensuring the safety of North Atlantic right whales and other species.

The Machine Learning Solution

In traditional offshore wind development projects,

humans designated as Protected Species Observers (PSOs) use binoculars and cameras to find whales and other animals to avoid collisions and noise exposure. Humans can intelligently balance multiple tasks and make judgment calls in real time.

Over the past decade or so, a few technological advances have played out in parallel that have made implementation of deep learning in all kinds of sectors, including at sea, a more achievable goal.

First, the processing power of computer chips has increased in orders of magnitude, enabling the kind of rigorous computing that deep learning algorithms require. In addition, even computers at the "edge"—those out there in the field—are now capable of performing such calculations. As a result, data need no longer be transferred to heavy-duty systems in the cloud to perform intensive analysis. We have outfitted a boat with the machine learning software and processing hardware to obtain insights in real time without having to wait for results.

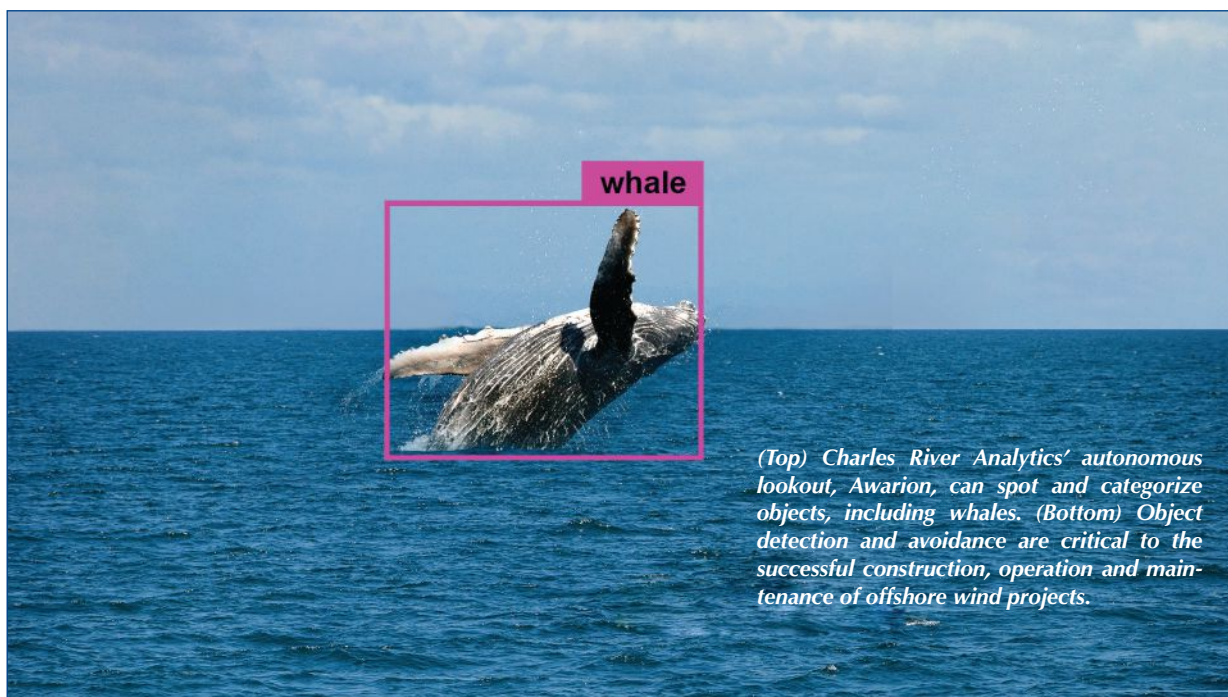
Second, there has been a proliferation of annotated data with which to train machine learning models. Training models involves feeding the algorithm images of the object of interest, drawing a "bounding box" around the target of interest and saying what's in the box—for example, "this is a whale" or "this is a boat." Under the hood, the trained machine learning algorithm leans on this bank of annotated images as a baseline. It then compares and contrasts incoming image streams against this set to see if there's a match and alerts humans if there is.

Annotating hundreds of thousands of images to get reliable learning models is a lot of work. But the ready availability of already annotated data sets has helped accelerate the adoption of machine learning and artificial intelligence. Such plug-and-play packages have been a game-changer in the field.

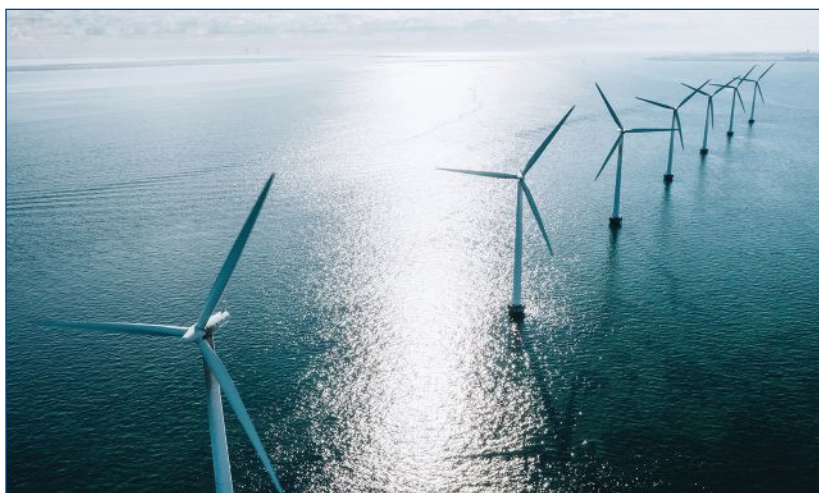
Autonomous Lookout

Awarion, the autonomous lookout system from Charles River Analytics, leans on machine learning. We designed it to aid human efforts to detect and protect marine mammals. With origins in research for the U.S. Navy, Awarion's image processing and control software delivers situational awareness at the sea surface. It not only detects whales but also assesses if the objects are near enough for the boat to take corrective action. Such "threat assessment" is key to maintaining whale health and safety while keeping day boats on schedule.

The special sauce for Awarion lies in the tedious task of category learning: gathering sufficient data that show the object cases we're interested in. While instant processing of data on the boat through powerful onboard



(Top) Charles River Analytics' autonomous lookout, Awarion, can spot and categorize objects, including whales. (Bottom) Object detection and avoidance are critical to the successful construction, operation and maintenance of offshore wind projects.



detect ships at 90 percent accuracy rate. As the program feeds on more data, we expect the rates to increase even further.

Awarion Configurations

Awarion works with both color and infrared video streams delivered by a mounted camera on a boat and can detect whales even in total darkness. The software closely parses every image that comes in at runtime and looks for features that match those in the database of annotated images to determine if any area within the image looks like a whale. A powerful graphics processing unit (GPU) crunches the information in real time.

Images that appear to have whales or other objects of interest are displayed on a user interface for crews to take further action as necessary. The key is that Awarion supports crew members' ability to spot objects: It functions as an extra set of intelligent eyes, augmenting human expertise with sensors that can see at different wavelengths than humans.

Organizations can incorporate Awarion's machine learning situational awareness analytics software into existing hardware and camera arrangements. Alternatively, they can use processing hardware and smart cameras provided by Charles River Analytics.

Fugro, a geodata company that was already exploring camera options, used Awarion for its monitoring capabilities, with the results transmitted via an existing satellite link for display in a remote operations center. In this instance, Awarion fit into infrastructure that was already in place. In another example, Open Ocean Robotics had a smaller platform with a camera on board, and Charles River Analytics helped the company explore what kind of performance it could expect from the hardware they had.

hardware—"is what I am seeing a whale or something else?"—is a game-changer, finding annotated images for whales is much more of a challenge. Images of whales underwater or leaping out of the ocean abound, but images of whales peeking just above the surface are much less abundant and are almost never annotated. To avoid collision with whales, we need the algorithm to understand what a whale on the surface looks like. Such image classification and detection are key, as the lives of a critically endangered species and the efficiency of offshore wind operations are on the line.

We have culled a large volume of video streams and infrared imagery and trained our detectors to find whales in the wild with high rates of accuracy. Our goal is to keep gathering data in conjunction with partners, such as the New England Aquarium, to install a continuous feedback loop and refine the detection rates. The more useful the annotated images of whales at the surface, the better the detection process. Today, Awarion is able to detect whales with an 80 percent accuracy rate and classify and

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The core Awarion software can be configured in various ways that work with existing infrastructure, so that partners can realize the benefits for their particular situation.

Partnership with Vineyard Wind

Awarion's ability to autonomously detect whales is helping Vineyard Wind, an offshore wind development company that is building the first commercial-scale offshore wind project in the United States, south of Martha's Vineyard, Massachusetts.

Our partnership with Vineyard Wind involves installing the entire pipeline—from the camera all the way to the processing computer and user interface—on a boat used for surveying. The user interface enables those on board to monitor where detections are being made in relation to the ship and to take action as needed.

Early results from Vineyard Wind have been promising: The system ran for six weeks without any downtime, and Awarion was able to detect vessels, buoys and other objects of interest. Vineyard Wind will continue pilot testing Awarion on their vessels in the coming year.

A Win-Win for the Future

Climate change is *the* existential crisis of our times. We must find alternative energy sources and ramp up production—quickly. Offshore wind energy shows plenty of promise in the renewable energy sector. The question we must address is: How do we responsibly develop offshore wind energy and protect whales and other marine animals?

Technology can help us do both. We can fight climate change while preserving precious biodiversity. Machine learning and computer vision technology, through software such as Awarion, are helping us realize a greener future. The human-in-the-loop artificial intelligence solution acts as an additional pair of eyes at sea. It augments—not replaces—human intelligence. Awarion is a key ally in the fight against climate change. It helps us swim toward a greener future. **ST**

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Ross Eaton, principal scientist and director of marine systems at Charles River Analytics, leads the development of the maritime perception product Awarion and various uncrewed surface vessel projects in the Sensing, Perception and Applied Robotics division. He also coordinates the company's maritime business development and execution. He holds a B.A. in computer science and psychology from Yale University.



Elaine B. Coleman leads Charles River Analytics' value creation and commercialization efforts. She is responsible for bringing exciting new products into the marketplace. This includes product strategy, management, customer experience and sales. She holds a Ph.D. in applied cognitive science from the University of Toronto and held a McDonnell Postdoctoral Fellowship at UC Berkeley.



Resident Underwater Drone

Fully Automated Small Vehicle Increases Ocean Accessibility

By Leif Hugo Arntsen • Craig Anderson

For over a half-century, ROV and AUV systems have given humanity rare access to the underwater world, revealing one small piece at a time of the obscured and valuable puzzle that is our ocean resources. Highly trained personnel operate these underwater robots from ships and rigs, mapping and exploring the depths, installing and maintaining structures, helping to document and recover a lost past, and increasingly helping in the process of growing our food.

The development and delivery of the ARV-i (Autonomous Resident Vehicle) system described here is enabling a reduction in cost and increase in accessibility of ocean exploration and commercialization by offering a resident system that is both affordable and easy to use, giving untrained operators the means to observe and interact with the underwater environment from anywhere in the world.

A Robot Living Underwater

“Pinless underwater connection” is a key element of the ARV-i vehicle.

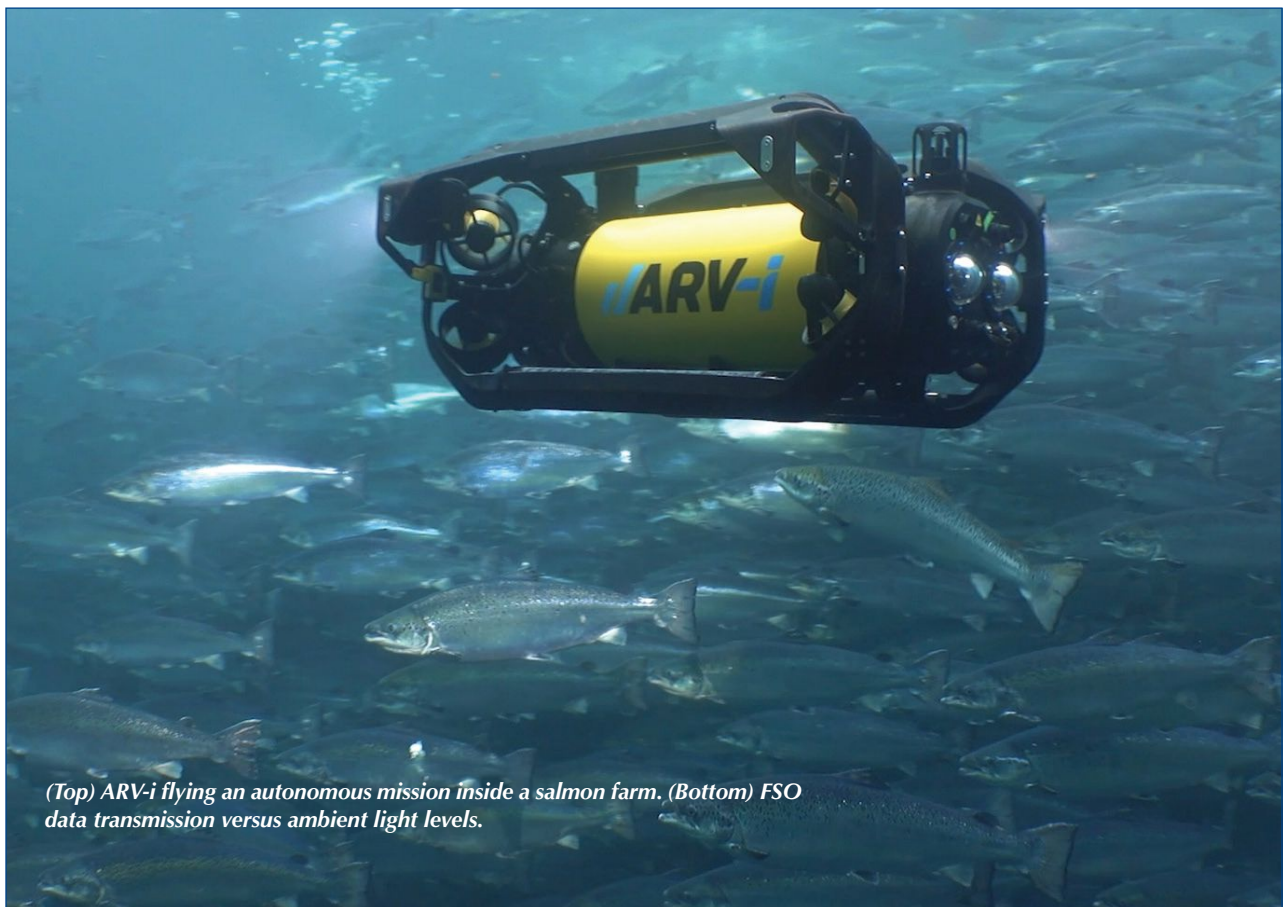
A device wirelessly transfers

power and data electromagnetically between two transducers placed very near each other. Such connection has been used by large-AUV builders such as Saab and Saipem to enable subsea residency of their vehicles, requiring several kilowatts of power transfer and high volumes of data transfer.

A niche for smaller resident vehicles seemed logical: lower-cost systems that could access tighter spots, though with shorter range and payload capabilities. Norway’s Transmark Subsea and New Zealand’s Boxfish Research conceived the merging of pinless connection and a small, battery-powered vehicle, respectively, to create the ARV-i.



ARV-i in front of its underwater resident dock.

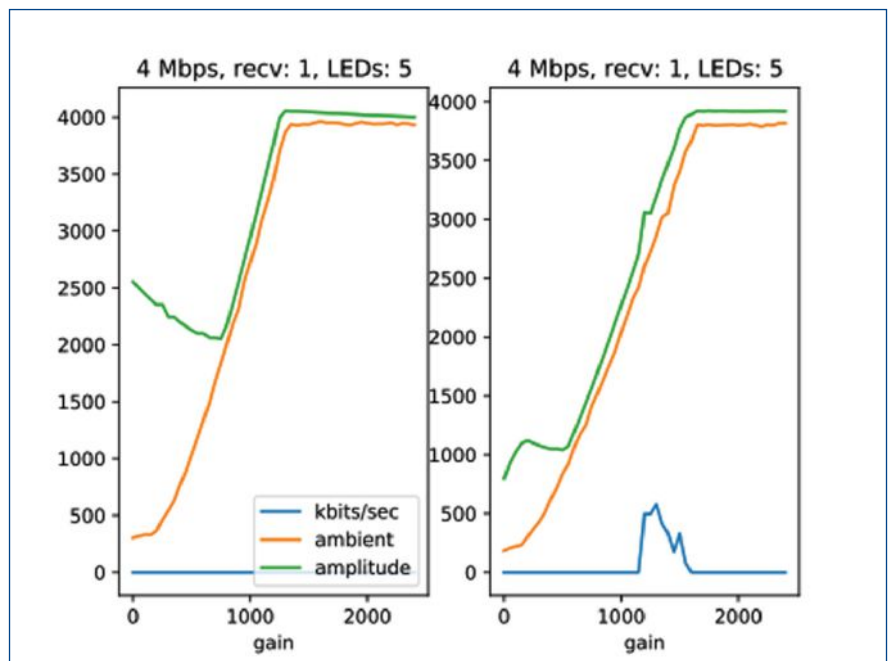


Fish Farm Monitoring

The first application of the ARV-i has been in salmon farming off the west coast of Norway, involving the integration of photogrammetry systems developed by SubC3D, based in Haugesund, Norway.

Monitoring the health of the fish, the environmental conditions in the cage/net, and feeding and growth yields important metrics for the responsible management of farmed fish. Current solutions employing fixed-location cameras have proven unsuitable for gathering the required data; consider that some cages contain over 200,000 fish each. Bringing the sensors to the fish, instead of having the fish come to the sensors, was the preferred solution—and the challenge.

To meet the fish farmer's needs, Transmark Subsea defined the specification of a small vehicle and dock, with command and control of the underwater drone to be achieved using free-space optical (FSO) modems; in other words, a “wireless tether” to enable the user to direct the vehicle's excursion live. Limited autonomy was specified for undocking and docking of the vehicle, mirroring the “return to home” feature that many commercial aerial drones offer. Once in the dock,



the specification called for fast transfer of acquired data and charging of drone batteries.

Limitations of FSO

When one sees the maze of ropes suspending various equipment in a salmon cage, the tangling hazard becomes apparent, and the need for a tetherless drone is obvious. Controlling the underwater drone via acous-

“The ARV-i system is demonstrating its ability to live off-grid through participation in the Renewables for Subsea Power (RSP) project.”

tics was deemed unsuitable due to a bandwidth so low that user navigation by video would be impractical. FSO seemed promising.

Wireless control via FSO was chosen primarily for the claimed 10-Mbps data speeds. Trade-off considerations included angular alignment of transducers, range, data throughput and, most notably, FSO's extreme sensitivity to ambient light. In the end, the FSO was no match for the Norwegian midnight sun; effective range and data throughput of these devices were significantly reduced and, in most conditions, completely inoperable. Based on this experience, a more reliable solution was sought.

From Wireless to Autonomous

The undock/dock feature was already in development when the decision to go fully autonomous was chosen; hardware and software were already available for positioning and control via USBL acoustic positioning, with machine vision cameras guiding the drone home. Having overcome these hurdles lent confidence to the decision to proceed toward full autonomy.

The next hurdles in developing and delivering a small autonomous vehicle would include training it to recognize objects, such as fish, and programming it to successfully navigate a path through the environment. Achieving these goals had specific challenges: how to compensate for varying ocean currents; plan missions within the vehicle's battery life; develop reliable docking to survive undesired motion from adverse weather; adjust for data storage constraints; carefully consider power budgeting; resolve acoustic positioning fidelity; and compensate for various other factors.

Off-Grid Residence and 3D Digital Twinning

The ARV-i system is demonstrating its ability to live off-grid through participation in the Renewables for Subsea Power (RSP) project. The vehicle and dock have been integrated to a wave power generator and a subsea battery, with operations off the Orkney Islands at the north end of Scotland. These open-water operations offer another opportunity to demonstrate the versatility and advantage of a system located at sea, with missions steered from shore, obviating the need for a 24/7 surface support crew on site. Equipped with its own power and generator, such a system could be deployed anywhere.

3D mission planning and the ability to compare virtual mission data to actual gathered data are also becoming a reality. Underwater-resident ARV-i data collection hard-

ware combined with analytic software enables a digital twin of the environment, which is useful, for example, in the continuous monitoring of subsea structures. Key software elements to enable this functionality are the product of GRI Simulations, based in Newfoundland, Canada. These tools are being further developed and demonstrated within the Digital Offshore Canada Project.

Conclusion

Developing an autonomous, untethered vehicle that lives as a resident in the ocean has had its share of challenges for the team, but the collaboration between Transmark Subsea in Norway and Boxfish Research in New Zealand has been successful in creating the ARV-i drone.

Developing and testing within a salmon farm cage offered the advantage of minimizing risks, such as the vehicle flying unexpectedly into the depths of a fjord, instead of into the embrace of its resident dock. Operating the drone at various field test sites along Norway's rugged west coast also contributed to development of ARV-i.

The result is that we have proven the world's first autonomous resident vehicle and dock of its class—a small, battery-powered system at lower cost—and brought it to market. We believe this system has the potential for significant impact and global adoption as a solution that will dramatically increase people's access to the ocean's resources and its secrets, which remain hidden in a frontier still very much unexplored. **ST**

Leif Hugo Arntsen is the CEO of Transmark Subsea, an underwater solutions provider based in Bergen, Norway, and Aberdeen, Scotland. The ARV-i and the technology involved in its operation add to the company's core technology within subsea distribution and pinless connector development.



Craig Anderson is a co-founder of Boxfish Research, and he specializes in control systems, software and electrical and electronic development. He has key skills in electronics, software, optics and telecommunications, and experience in delivering highly technological products to market, including advanced underwater camera and ROV solutions.



Deepwater Hoist

Reliable, Low-Maintenance Equipment for 152-m Depth

By Mark Koski

Working underwater is always complicated, and those challenges only multiply with increased depth. Salinity and high pressure are rough on people and equipment, but the underwater work has to get done: salvage and recovery, maintenance and repairs, and decommissioning subsea structures.

Without an option for subsea, air and hydraulic hoists have been used for these jobs, but the work has been highly inefficient and costly. Air and hydraulic hoists are designed to work above the surface and have serious deficiencies when deployed below it. Seawater fouls gearboxes and often drives equipment failure; water pressure limits productivity and compromises safety.

To compensate for these known deficiencies, companies sometimes rent or purchase multiple hoists to overcome the inevitable equipment issues. The added costs for backup equipment can quickly add up. As each hoist fails, repairs become more costly, as the company must rebuild corroded gearboxes and perform other repairs, with price tags sometimes exceeding \$40,000.

The financial impact associated with ruined equipment doesn't just bear a financial cost; it also has a significant implication on a project or company's sustainability. To address these challenges and make underwater work efficient, the U.S. Navy commissioned Ingersoll Rand to develop a subsea hoist in 2018. Combining customer input with rigorous engineering expertise, the company developed a unique subsea hoist that worked effectively at 30 m.

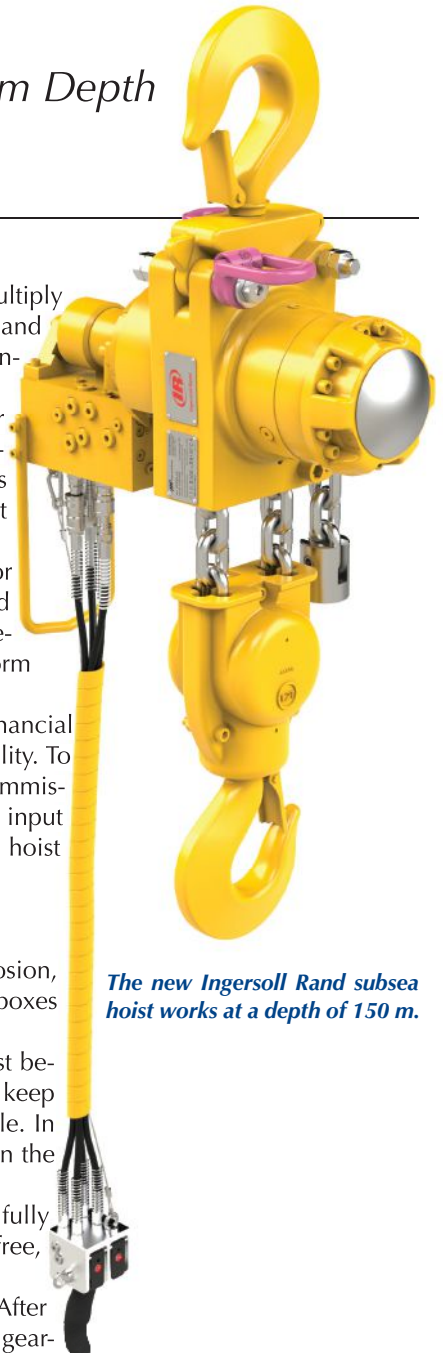
Protecting Critical Components from Seawater

The most significant threat to hoists and other underwater equipment is corrosion, which dramatically reduces reliability and longevity. Seawater seeps into gearboxes and other critical systems, a problem that only worsens with greater pressure.

In time—often before a project has been completed—a regular surface hoist becomes unusable, and a backup piece must be brought in. Companies often keep these backups close at hand because they know equipment failure is inevitable. In addition, regardless of whether the hoist is leased or purchased, they will be on the hook for repairs.

The first step Ingersoll Rand took to develop the subsea hoist was to use fully waterproof gearboxes and corrosion-resistant materials to keep them saltwater-free, even under great pressure.

Keeping sensitive equipment protected dramatically reduces maintenance. After a surface hoist is used underwater, workers must completely disassemble the gearbox, replace damaged parts, and put it back together. With the subsea hoist, operators only need to hose it off, spray it with WD-40 and rack it. They can breathe easier until the next deployment.



The new Ingersoll Rand subsea hoist works at a depth of 150 m.

A full-page photograph showing a diver in a dark, murky underwater environment. The diver is positioned in the upper right, reaching down towards a piece of equipment, which is the hoist mentioned in the text. The water is a deep teal color, and there are some bubbles and light reflections visible. The overall mood is mysterious and technical.

Ingersoll Rand designed a hoist that a diver can easily manipulate.

In mid-2022, Ingersoll Rand received a call from a defense contractor for a special underwater application, asking if this subsea hoist would work at a depth of 152 m (500 ft.). Knowing the dynamics of ocean physics, the hoist would have to be tested. The total pressure at 30 m is around 4 bar, or 58 pounds per square inch (psi). At 152 m, the pressure increases to about 16.4 bar (238 psi), significantly impacting how people, hoists and other equipment function. The engineering team had the proper facilities and equipment to test the hoist at the unprecedented depth of 150 m, so they plunged into the quest.

The Challenges of Going Deeper

To illustrate how pressure impacts the functionality of hoists and other equipment, consider the rigors decompression divers must endure. First, they are placed in a hyperbaric chamber—their living quarters—and lowered into the water. Over several days, the pressure is increased until they are ready to leave the tank and go to work.

The divers stay underwater for weeks; then they must slowly ascend, gradually reducing the pressure to keep painful and deadly nitrogen bubbles out of their bloodstream. Great care must be taken to adjust to the pressure descending and ascending, or the results will be detrimental.

The ocean's tremendous pressures also challenge equipment, and equal care must be taken to develop tools that can be used safely and effectively at increas-

ing depths. The deeper the hoist goes, the greater the hydrostatic pressure. Unlike gravity, which only comes from one direction, water pressure completely surrounds equipment and workers, applying force in all directions.

As engineers tested the original design at lower depths, they found that higher pressures on the return line made it sluggish, reducing the usable torque and lowering the hoist's capacity and speed. It quickly became apparent that a hoist designed for 30 m must be extensively redesigned to operate safely and effectively at 152 m.

Several critical components had to be re-evaluated and replaced to maintain functionality. A more powerful motor was needed to compensate for the ocean pressure and move the hydraulic fluid through the system. To successfully reach 152-m depth, engineers discovered the motor needed to power 50 bar, or 725 pounds of pressure, on the return line.

The hydraulic hoses also had to become thicker and stronger, and fittings and O-rings inside the motor had to be modified to contend with increased pressure. The changes also extended to the controls on the pendant. Engineers learned that the additional pressure forced seawater into the hydraulic fluid, so seals had to be redesigned to keep corrosive saltwater away from the system.

Stainless steel was used to cover vulnerable areas; however, that was not a complete solution. Even stainless can corrode in time. To meet this challenge, the subsea hoist needed an extra layer of protection: zinc. These sacrificial plates protect gearboxes and bottom blocks



in a state-of-the-art hydrostatic test chamber to measure the functionality, ergonomics and safety of the subsea hoist as they changed the various components. They finally achieved success, and the next generation of Ingersoll Rand subsea hoists is now available to operate at a depth of 152 m.

Improving Economy and Efficiency At Increasing Depths

Navies, oil companies, salvage groups, utilities and others all conduct operations at increasing depths. The latest development of the Ingersoll Rand subsea hoist is designed to be used often, without having to undergo costly maintenance after, or even during, each job. This increased reliability gives companies new options, allowing them to pursue projects that might not make financial sense with less sustainable equipment.

A hoist that works reliably underwater is a massive benefit for a growing industry. Companies can more easily plan operations, knowing their hoists aren't likely to fail in deep saltwater. In addition, having a reliable subsea hoist will change how companies approach some jobs. Repairs once reserved for drydock can now be conducted at sea, potentially saving thousands

of dollars and lost time.

This reliability, and other features, translate into greater safety for workers (particularly compression divers), who won't have to spend extended periods underwater, waiting for a new hoist to be rigged up.

The Ingersoll Rand subsea hoist provides capabilities that simply did not exist before. Now, rather than using equipment that is ill-suited for the job, companies can bring in a tool designed specifically to thrive in the sea's high-salinity, high-pressure environment. As a result, commercial operations, governments and militaries now have a flexible choice of subsea hoists that can work at great depth, and they no longer need to be overly concerned about damage from saltwater corrosion or high pressure.

This subsea hoist story also highlights the importance of not accepting limitations. When the original 30-m hoist was insufficient for great depths, Ingersoll Rand engineers refined the equipment to make it work for these more challenging applications. Innovation is an iterative process. As problems are presented, new approaches and equipment can be developed to overcome them. **ST**

from corrosion and can be easily replaced without major overhauls. The same care was taken with the pendant, which is made from stainless steel overlaid with zinc anodes as the sacrificial metal.

Understanding Underwater Ergonomics, Ease of Use and Safety

Corrosion is just one of the sea's many challenges. Designing a hoist that a diver can easily manipulate was another unique challenge.

Divers often wear thick gloves to protect their hands, which reduces dexterity. This can be a significant problem when using the paddle controls on a pendant to make a hoist ascend or descend because divers can have trouble pushing the buttons. To overcome this, the subsea hoist's pendant was redesigned with larger paddles, going from 0.75 to 1.5 in.

In addition, Ingersoll Rand engineers designed hydraulic fluid supply and return lines and other hoses with quick connects, rather than threaded connections, to make them easier to swap out. Hoists are often used for different undersea applications, and each one may be deployed at a different depth and require a different hose. The quick connects make these transitions much easier.

Another advantage of hydraulic motors over air hoists is that they don't produce bubbles, which can interfere with spotting operations. In addition, the hoist has several safety features: manifold overload protection, quick-down valves as limit switches, and a 5:1 safety factor on all load-bearing parts and the load chain.

The engineering team conducted high-pressure tests

Mark Koski, CEM, CDSM, is the North American commercial leader for Ingersoll Rand Material Handling, responsible for commercializing the company's solutions for classified and unclassified military applications and mining, shipyard, and maritime industries. He is a life member of numerous engineering associations and holds certifications from the Association of Energy Engineers.



international

EIB Record Financing for Sustainability Projects

The European Investment Bank Group (EIB) has signed a record amount in new financing for renewables, efficiency, storage and grids in 2022. Total EIB financing signed for sustainable energy projects in the European Union reached €17.06 billion, as the bank began rolling out a special package of support for the REPowerEU plan to end dependency on Russian fuel imports.

First-Ever Inline Shaft Generator Retrofit

Wärtsilä has successfully retrofitted an inline shaft generator system on the *Berge Toubkal*, a cape-size bulk carrier owned by Singapore-based Berge Bulk. This is the marine industry's first-ever shaft generator retrofit, and its successful completion will improve the vessel's Energy Efficiency Existing Ship Index (EEXI) while reducing overall carbon footprint.

The retrofitted shaft generator will also provide power to an air lubrication system installed at the same time, which includes a Wärtsilä control system, as well as a converter to allow the generator to operate over a broad span of rpm. The existing intermediate shaft and bearings were replaced to accommodate the increased weight.

New Company to Offer ETS Management

Wilhelmsen Ship Management (WSM) and Affinity Shipping have signed a memorandum of understanding to jointly establish an independent company that will provide comprehensive compliance services related to the EU ETS (European Union Emission Trading System).

The company will offer a complete outsourcing service for shipping ETS management. The service integrates technical ship management and carbon allowance procurement to support shipowners, managers and operators in the new era of emissions compliance.

Following the agreement in December among EU negotiators to include maritime shipping in the EU ETS, shipowners and operators will need to acquire emission permits for 40 percent of their applicable emissions in 2024, increasing to 70 percent in 2025 and 100 percent in 2026 and every following year.

Opsealog Calls for 'Data Democratization'

French digitalization expert Opsealog has launched a whitepaper calling for greater data sharing across supply chains to help achieve shipping's decarbonization and sustainability ambitions. The report calls for a more collaborative approach to digitalization in the maritime sector, so that all organizations can contribute their data insights and collectively share the benefits. It argues for the importance of putting the right architecture in place to make data easier to collect, share and analyze by organizations, big or small. This includes the need to standardize data formats to break siloes and make data accessible. To obtain a copy of the whitepaper, visit <https://opsealog.com/harnessing-technology-for-ship-environmental-compliance>.

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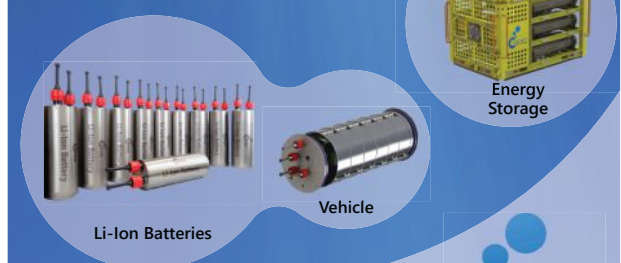
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Brookes Bell Acquires Tribology Specialist

Brookes Bell, a multidisciplinary technical and scientific consultancy to the maritime industry, has acquired Neale Consulting Engineers, a provider of tribology consultancy services. Neale Consulting Engineers has over five decades of experience providing consultancy services related to tribological issues, machinery failure, product design improvements and more.

Tribology is the science of interacting surfaces in motion and how friction, wear, and lubrication affect these surfaces. Tribology in engineering requires a deep understanding of how moving parts of machines function (or malfunction). Typical tribological components are bearings, gears, seals and other machine parts, which are often a source of unreliability and failures.

RTS Adds Gaps M5 USBL to Rental Pool

Rental Technology & Services (RTS), a provider of rental equipment for the subsea industry, has added Exail's Gaps M5 USBL acoustic positioning and communication system to its rental pool of equipment. The move comes as part of the company's ongoing effort to offer the latest and most innovative solutions to its customers from its newly established U.K. offices. Available for RTS customers globally, Gaps M5 addresses accuracy and performance needs for vertical and horizontal tracking applications.

The latest addition to Exail's USBL product range, Gaps M5 is a compact, export-free and omnidirectional system that can accurately locate and track subsea assets in real time down to 995-m depth.

OceanTools Chooses Exclusive Reseller

OceanTools Ltd. has appointed Norwegian company Innova as exclusive reseller of OceanTools' subsea cameras, lighting and dye detection systems. Innova, a provider of multidisciplinary engineering services, products and solutions to the international underwater industry, now also includes OceanTools' product lines in its subsea rental catalog.

Marine Fuel Software Acquisition

ZeroNorth has acquired BTS Pte. Ltd., a software platform for marine fuel suppliers, headquartered in Singapore. The acquisition includes BTS's flagship suite of services, iBMS (Intelligent Bunker Management System), which is software specially tailored for the marine fuel supply chain. iBMS helps to increase the efficiency and profitability of marine fuel suppliers, traders and brokers by digitalizing their business processes. This eliminates unproductive tasks, automates work processes, increases information sharing and enhances decision making.

Samson to Acquire Spanish Rope Manufacturer

Samson, a Wind River Holdings company, has entered into a purchase agreement with Folch Ropes S.A.

For 144 years, Samson has specialized in the development and manufacture of high-performance ropes. Today, Samson engineers continue to pioneer the use of new fiber technology and the development of innova-

tive coatings and constructions to produce ropes with unprecedented performance characteristics in diverse markets. Samson is based in Ferndale, Washington.

Folch Ropes is a manufacturing company based in Llinars del Vallès, Spain.

Corvus Opens Battery Factory in US

Corvus Energy has opened its new battery factory in Bellingham, Washington. The new battery plant is located in Fairhaven at the Port of Bellingham and is a key step in the expansion of Corvus's U.S. operations. The Bellingham plant will produce the modules for Corvus Energy's Orca ESS, enabling battery-powered marine propulsion.

SEAMOR Marine Expands in Canada

Nanaimo-based tech company SEAMOR Marine has opened a new office space in The Centre for Ocean Ventures and Entrepreneurship (COVE) on Canada's East Coast. This location will position the company to engage in new entrepreneurial ventures, such as Invest Nova Scotia, and provide opportunities for collaboration that features SEAMOR's ROVs, such as collecting critical data for marine research.

US Tug Operator Relies on Caterpillar

SAAM, the largest tug operator in the U.S., and Caterpillar teamed up via a global value agreement (GVA) a year ago that expands services and coverage for more than 200 Cat engines. A Caterpillar specialist, along with the global dealer network, provides planned and preventative maintenance for SAAM Towage's fleet, supported by Cat digital solutions.

With the GVA, the SAAM Towage fleet manager has identified opportunities to perform more effective overhauls based on condition monitoring rather than complete overhauls.

With a growing global fleet, the GVA will enable SAAM Towage to provide the same safe, reliable services with tugs in new waters.

Ocean Plastic Depot for Marine Recycling

Ocean Legacy Foundation (*Sea Technology*, March 2023), a nonprofit organization that develops and implements worldwide plastic pollution response programs with the goal to end ocean plastic pollution, has opened, in partnership with the Regional District of Mount Waddington, a new Ocean Plastic Depot at 7 Mile Landfill & Recycling Centre in British Columbia, Canada. This ocean plastic diversion program is funded by the Ghost Gear Fund and Department of Fisheries and Oceans.

The 7 Mile Ocean Plastics Depot accepts materials such as abandoned, lost, discarded fishing gear; marine debris; and equipment, including netting and rope, styrofoam, hard plastic and select buoys. Materials collected at the depot are sent to the Ocean Legacy processing center at Steveston Harbour for further sorting, cleaning and recycling. The 7 Mile Ocean Plastics Depot is the fourth depot of its kind in British Columbia, helping to develop the marine plastic circular economy. **ST**

MacArtney Provides Winch, Crew Member in Arctic

MacArtney has supplied and fitted a containerized MERMAC winch to *Oden*, the Swedish Maritime Administration's icebreaker and research vessel, for an expedition to the North Pole. The Synoptic Arctic Survey 2021 expedition also included MacArtney's Sales Director for Ocean Science Hans-Jørgen Hansen, who participated as a fully fledged crew member.

The data and samples collected during the voyage are currently being studied, documented and cataloged for further research on the Arctic ecosystem, including data acquired from the water column via the bespoke MacArtney MERMAC winch.

The *Oden* continues to use the customized solution for water column profiling and revealing data from the ice-covered Arctic Ocean.

Flow Monitors for NOAA

AW-Lake is supplying flow monitors to NOAA for use on its research vessels to measure the temperature and salt content of the world's oceans.

NOAA previously was unaware that a pump had clogged while taking in saltwater as part of its measuring process. Sea plankton and natural seawater debris congested the pump, creating inaccurate seawater readings. An AW-Lake MX 9000 Panel Mount Process Monitor was brought in to track the amount of seawater flowing into the pump, with output to the ship's computer. The monitor will trigger an alarm on board the ship if water flow rate drops below a specific level.

NIOZ Buys Osprey AUV

The Royal Netherlands Institute for Sea Research (NIOZ) has ac-

quired a new Teledyne Gavia Osprey AUV to add to its growing fleet for scientific projects, such as understanding the significant impacts of climate change on the seas and oceans (i.e., temperature increase and acidification). The ocean environment is changing rapidly due to external pressures that will affect the diverse but poorly understood ocean processes that play an essential role in marine ecosystems and the future climate.

The Osprey AUV is Teledyne's latest underwater vehicle, with longer endurance and greater payload capacity while maintaining modularity. The Osprey has operational endurance of over 24 hr. (configuration dependent), combined with high-performance payloads such as synthetic aperture sonar and Teledyne Reson SeaBat series multibeam.

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and restoration of marine plants and animals worldwide, particularly in shallow coastal systems such as the Chesapeake Bay. Research at the Virginia Institute of Marine Science has revealed that the “clarity” of a water parcel depends on the method used to measure it and that different research questions and management decisions merit different clarity measuring tools and techniques. The research appears in *Lim-*

nology and Oceanography Letters.

In coastal and inland waters, the methods used to gauge water clarity can misrepresent the underwater light climate used to determine restoration goals, such as the potential habitat available for underwater grasses. Underwater grasses serve many key ecological functions and are among the most closely monitored habitats in the Chesapeake Bay. They provide food and shelter

for numerous marine species, help oxygenate the water, and can mitigate global warming by removing carbon dioxide from the air. To do so, they need clear water for photosynthesis and growth.

In areas of Chesapeake Bay with high levels of both light-scattering particles and light-absorbing solutes, the water is dark. In areas with lots of light-scattering particles but few light-absorbing solutes, the water is cloudy yet bright. Areas with few particles or solutes are clearest.

Though advances in electronics and materials have reduced the cost and increased the use of light sensors, analog Secchi discs remain common. Problems arise when practitioners apply a traditional one-size-fits-all equation to estimate light attenuation from Secchi depth values. For example, in the turbid waters of the York River, a major Chesapeake Bay tributary, use of the traditional conversion factor would underestimate the light available for seagrasses, and thus short-sell potential restoration targets.

The researchers recommend changes in how water clarity is measured and reported. Clearly communicating the method used is key: whether a Secchi disk, light attenuation, or another method. Measures of light attenuation with depth are most relevant in the majority of research in aquatic ecosystems. The authors recommend use of a separate, scalar measure of light attenuation when studying phytoplankton.

Wolf Diet Shifts to Sea Otters

Wolves on an Alaskan island have caused a deer population to plummet before switching to eating sea otters in just a few years, a finding that scientists at Oregon State University and the Alaska Department of Fish and Game believe is the first case of sea otters becoming the primary food source for a land-based predator.

In 2015, deer were 75 percent of the wolves’ diet, while sea otters were 25 percent. By 2017, and through 2020, the numbers were 7 and 57 percent, respectively.

The research has expanded to Katmai National Park & Preserve. **ST**

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Design Approval for High-Wave Offshore Solar Farm

Bureau Veritas has given an approval in principle to Oceans of Energy for its system design of a high-wave offshore solar farm. The system is supposedly the world's first offshore solar farm proven in high waves. It has been operating in the North Sea since 2019. This system is modular and scalable to any size.

The farm currently installed has a size of 0.5 MW. Rather than using heavy structures above sea, which are normally used for offshore technology, the system is lightweight and uses the sea surface directly as support, like a waterlily resting on the water surface. In order to withstand high waves and rough seas, it uses a system combining rigid and flexible structures to ride on waves.

Since its deployment, the system has withstood many heavy storms, with waves as high as 9.9 m. The system was successfully basin tested with 13-m-high waves.

Drone Survey for Floating Solar Farm in Israel

TOPODRONE, a Swiss-based designer and manufacturer of high-precision surveying equipment, has synchronized airborne photogrammetry, LiDAR and bathymetric surveying methods to study a floating solar farm upon request from Israeli drone service provider ERELIS. This is part of a pilot project of reservoir surveying with a UAV for ETZ HADEKEL Ltd. in northern Israel. The surface of the reservoir is covered by solar panels, which made it difficult to carry out work using standard methods of surveying from a boat.

ERELIS performed two-stage drone surveying to deliver a high-precision 3D model of the reservoir. First, aerial photogrammetry and LiDAR surveys were done using a DJI M300 drone equipped with a TOPODRONE camera P61 and LiDAR to determine the location of possible obstacles. LiDAR scanning provided accurate detection

of cables in the water. Second, an underwater bathymetric survey using a TOPODRONE AQUAMAPPER mounted to the same drone was conducted, avoiding detected obstacles (cables, solar panels and other objects). The flight mission was planned and executed with the UgCS software by SPH Engineering.

The collected LiDAR and bathymetry data were processed by TOPODRONE software, resulting in a georeferenced orthophoto map; a 3D model of the relief and objects; and a 3D model of the bottom of the reservoir, contour lines and isobaths. Such 3D models can be used for high-precision assessment of sediment volumes, general monitoring of reservoir banks and visual monitoring. In addition, surveying with a TOPODRONE AQUAMAPPER made it possible to estimate sludge deposits of the reservoir.

Roxtec Seals for Floating Wind

Saitec Offshore Technologies in Bilbao, Spain, has specified Roxtec cable seals for its SATH floating wind turbine concept for shallow and deep waters, a 2-MW project.

Roxtec's round seals and rectangular and compact cable and pipe transits were used to seal off cable ducts for low-voltage and medium-voltage cables, as well as for closing off refrigeration ducts from the exterior offshore environment. Roxtec seals adapt to cables and pipes of different sizes, and, in this case, are used for marine power cables ranging from 4 to 150 mm and for pipes from 15 to 25 mm. Roxtec also created a customized seal to help Saitec seal flat cables.

Streamlined Consenting Process for EMEC

The European Marine Energy Centre (EMEC) has been awarded a site-wide section 36 consent at its grid-connected Billia Croo wave test site off the west coast of Orkney, Scotland. This further streamlines the consenting process for EMEC's clients, reducing the time and cost associated with offshore demon-

stration. The site has also been expanded by an area of 2.6 km² to the northwest, enabling access to deeper water. Maximum installed generating capacity has been increased to 20 MW, and a wider envelope of device types and operations has been approved. Technologies over 1 MW can now demonstrate at the Billia Croo test site without having to apply for individual section 36 consents. The site-wide consent lasts until 2040, future-proofing the consenting process for clients accessing EMEC's facilities.

Subjected to the powerful forces of the North Atlantic Ocean, Billia Croo has some of the highest wave energy potentials in Europe, with an average significant wave height of 2 to 3 m. The site comprises five cabled test berths in up to 70-m water depth. A nearshore berth is set up for shallow-water projects.

Partnership to Pursue Microgrid Renewable Power

Oceaneering International Inc.'s Norwegian subsidiary, Oceaneering AS, has signed a memorandum of understanding with Kontiki Winds AS (a Havfram AS company) to jointly pursue the application of floating offshore wind for remote microgrid renewable power generation to electrify offshore assets such as oil and gas production, as well as other small-scale power generation opportunities among island states currently producing electricity by fossil fuel. Both companies recognize the market need created by an increasing requirement on oil and gas producers and remote island states to electrify their operations.

TDI-Brooks Chosen for Offshore Wind Survey

TDI-Brooks was awarded geophysical, geotechnical and benthic sampling survey campaigns to study seabed conditions in a project lease area and potential export cable corridors off the U.S. East Coast. The data will support safe and responsible project design and engineering and identify potential geohazards and benthic habitats. This is TDI-Brooks' sixth offshore wind project award in the past couple years. **ST**

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Offshore Wind Support Vessel



FLOW-SV is specially designed to install ground tackles for offshore turbine floaters. The vessel can load the immense lengths of chain needed to install and secure nine anchors or suction piles. Instead of mooring one floating windmill in a mission, three can be secured. It also applies sufficient proof loading on the anchors to make the installation more efficient. The ship is 150 m long, with a 32-m beam. Damen Shipyards Group.

Modular Autonomy

OPENSEA Edge offers the next level of operator capability. While OPENSEA provides the software capabilities of navigation, control, autonomy, perception and long-range communications, OPENSEA Edge provides a modular, hardware-agnostic processing platform that converts a traditional ROV into one with autonomy, AI, vehicle perception and tetherless, over-the-horizon, communication and control. Greensea Systems Inc.

BWTS Cybersecurity

Like any networked system or control software on board ship, the ballasting process, including the treatment system, can be susceptible to a cyber attack, with hackers looking for an entry point to a vessel's operational technology systems. New software for the BIO-SEA ballast water treatment system (BWTS) is in compliance with two IACS Unified Requirements set to enter into force next year that highlight cyber resilience for ships. BIO-UV Group.

Small Leak Detection System

D5 is ultracompact with a 1,000-m

depth rating (optional 6,000 m), specifically designed for installation on AUV systems with free-running data and low-power electronics and for use on smaller observation-class ROVs. D5 is the first dye detector of its kind to meet the increasing use of AUVs for pipeline surveys. It may be supplied to detect Rhodamine, Fluorescein or UV dyes. OceanTools Ltd.

Spiral Binding Range

Produced from polypropylene, the spiral offers higher levels of protection for cables against environmental conditions. Strong, flexible and lightweight, the new range defends against mechanical stress and has a high resistance to abrasion, water, and oils in order to protect and prevent the damage of cables and hydraulic hoses used in shipbuilding. HellermannTyton.

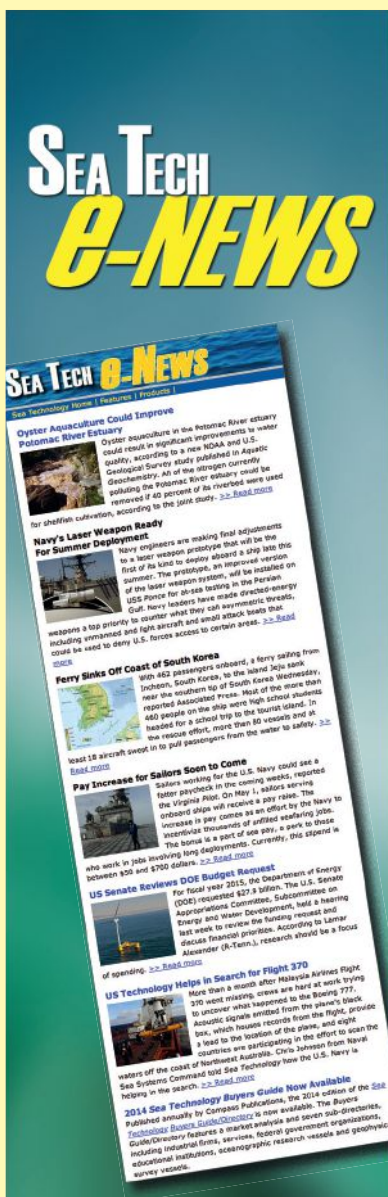
Robot for Wind Turbine Repairs



Rain can erode longer rotor blades that generate tip speeds of over 380 kph. BR-8 restores turbine power output quickly and is safe for technicians to use in all but the most inclement weather conditions. Technicians no longer have to abseil from the nacelle to the blade and work with harmful chemicals in a high-risk work environment vulnerable to weather. Rope Robotics.

LiDAR Real-Time Workflow

Galaxy Onboard enables airborne surveyors to deliver quality-controlled processed data in real time. It provides faster than ever turnaround time for government-wide area programs and engineer-



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ing-grade corridor applications. In addition, life-threatening situations, such as hurricanes, storms, power outages and floods, will benefit from real-time 3D data processing to support recovery, rescue, and restoration deployment while the plane is still in the air. Teledyne Geospatial.

GNSS-Aided INS



Quanta Plus combines a tactical MEMS IMU with a high-performance GNSS receiver to get reliable position and attitude in harsh GNSS environments and in surveying applications, where size and weight are critical. New features include built-in motion profiles that optimize the INS for each application; ethernet and PTP (or PPS) for easy integration with external sensors such as LiDAR; and a complete suite of integration tools for OEM. SBG Systems.

Battery Sensor for Power Data

The LinkUp Intelligent Battery Sensor makes it easy to monitor a vessel's current energy status on any OceanLink, AcquaLink, glass cockpit or NMEA 2000-networked display. It measures six critical parameters: voltage, current, temperature, state of charge, health and function. With this real-time information, users understand charge/discharge status, how the battery is aging, and future engine cranking ability based on the measured current and voltage. Veratron US Inc.

Synthetic Aperture Sonar

Sea Scan Ranger is an SAS designed for small AUVs. It provides constant 5x5-cm resolution at ranges of 150 m per side, making it ideal for applications that require ultrahigh-resolution imagery for detecting very small targets in the first survey pass

without sacrificing area coverage rates. Marine Sonic Technology.

Wi-Fi Buoy

Remotely controlled, RUBHY offers a range of applications in the field of underwater noise measurements, such as autonomous real-time noise surveying of harbor construction, pile-driving operations and seismic surveys. It acquires data from four wide-band hydrophones and simultaneously sends and displays real-time noise information, such as SEL, SPL and third-octave band levels, within a 10-km range. This robust buoy is particularly suited to offshore conditions. RTSYS.

Triaxial Accelerometer

Model 356A19 is a low-outgassing ICP that makes accurate high-frequency measurements to 13 kHz ($\pm 5\%$). It can be used to measure vibrations caused by water flow, gearboxes and cavitation, with a resonant frequency of ≥ 55 kHz, sensitivity of 10 mV/g and measure-

ment range of ± 500 g pk TEDS capability. PCB Piezotronics Inc.

Deepwater Rope

LankoDeep rope, endorsed by DNV for end-to-end rope splice, is based on Dyneema DM20 XBO, optimized for cyclic bending. It is made up of 12 strands; each strand comprises a three-strand rope. This construction, combined with the proprietary yarn coating, reduces internal heating and abrasion. Lankhorst Offshore.

Vessel, Off-Grid Mini Vibrocorer

The 2-m coring system, with battery capacity of 4 hr. of continuous use, suits sampling dense or compacted sediments in off-grid areas or from small vessels of opportunity with a winch or davit system (deployment/recovery height is only 2.75 m). The vibrocorer has a rotational barrel joint, anti-return valves and variable speed control of the 5.72-kN vibration force for easy recovery of samples. OSIL. **ST**

Partnership for Vessel Performance Monitoring

Vessel monitoring and control solutions provider Reygar has won InnovateUK funding to develop new features for its BareFLEET product in collaboration with Singapore-based Penguin International Ltd., a designer, builder, owner and operator of high-speed aluminum craft. The FleetVision project will build on BareFLEET technology to offer live feedback on various aspects of vessel performance.

Machine learning tools will be jointly developed to identify operating efficiency and cost reduction opportunities and to monitor machinery health, alongside adaptations that will enable more vessel types to benefit from the system.

Both Reygar and Penguin envisage long-term, mutual benefits, with the project acting as a potential launch pad for access to new technology and target markets.

FleetVision kicked off toward the end of 2022 and is expected to run over the next two years. It is funded by Innovate UK, part of UK Research and Innovation, and in partnership with Enterprise Singapore.

LYTT Joins AWS Network

LYTT, a provider of a real-time, sensor analytics platform and applications suite, and Amazon Web Services (AWS), the world's most comprehensive and broadly adopted cloud platform, have collaborated to enrich and scale LYTT's sensor fusion insights platform using AWS's cloud infrastructure.

LYTT offers a cloud-based, end-to-end data analytics platform that transforms petabytes of sensor data into connected and actionable insights visualized via an intuitive user interface. Industrially proven in oil and gas, LYTT has helped customers worldwide address flow, solids, integrity and seismic operational challenges, unlocking millions of dollars in value. LYTT's sensor-fusion-enabled solutions are applicable across sectors and are also being applied to carbon capture storage

(CCS) and water utilities. As a result of joining the AWS partner network, LYTT can take advantage of AWS's global reach, scalability, and expertise to expand its customer base and identify new opportunities to deploy its platform.

HST Marine Receives Second Hybrid CTV

HST Marine, a subsidiary of Purus Wind, has welcomed the arrival of its second U.K.-built hybrid electric crew transfer vessel (CTV), *HST Frances*, to support domestic and global offshore wind operations. The 25-m vessel can carry up to 24 personnel, and its hybrid electric propulsion system cuts fuel consumption by 30 percent compared to similar CTVs with diesel engines.

This follows the delivery of *HST Ella* in 2021, the industry's first vessel of this type. Both vessels were designed by U.K. naval architect Chartwell Marine and built at U.K. shipbuilder Diverse Marine on the Isle of Wight. The *HST Frances* will also be British crewed for domestic projects.

Collaboration to Optimize Maritime Logistics

Seaber.io, a Finnish maritime technology company, has announced a cooperation with Neste, a producer of renewable and sustainable fuels. Neste is using Seaber's software for planning maritime logistics activities, such as shipping schedules and port calls. Seaber's SaaS (software-as-a-service) application is designed for both shipowners and cargo owners to optimize efficiencies and deliver transparency.

Seaber's intelligent technology provides data-led decision support that optimizes fleet time charter equivalent and reduces costs per ton mile, decreasing shipping's environmental impact. In addition to single cargo voyages, it supports multi-parcel and multi-port voyages, where unnecessary ballast voyages and low utilization rates are common.

UK Approves Fugro USV/eROV

Fugro has received approval from the U.K. Maritime and Coastguard Agency (MCA) to operate its 12-m USV Blue Essence, the first USV with an electrical ROV (eROV). USVs play a vital role in the future of the maritime sector by improving safety, reducing carbon emissions and delivering data more efficiently.

The MCA granted Blue Essence category 2 approval, meaning the vessel can be operated within 60 nautical miles of a "safe haven." The next stage in the U.K. regulatory process will be to obtain Category 0 MCA approval, which will allow the vessel unrestricted service, subject to agreement of relevant port authorities.

The USV, developed with SEA-KIT International, is equipped with Fugro's Blue Volta eROV and geophysical equipment for subsea inspection and site characterization surveys. Blue Essence enables project delivery from Fugro's onshore remote operations centers.

Compared to large ROV support vessels, the USV yields 95 percent reduction in carbon emissions and enables real-time data delivery for faster and more informed decision making.

Funding to Continue Seagrass Seabed Mapping

HydroSurv has won funding from Innovate UK to continue working with the University of Plymouth to enhance its technique of using USVs to map seagrass coverage on the seabed. Building on previous collaborations with the university and Valeport, the project will generate a comprehensive picture of seagrass meadows, characterize their environment and enable determination of ecosystem health.

HydroSurv's fully electric USV data acquisition platform will be developed further to deliver comprehensive, seagrass monitoring with an acoustic ground discrimination system coupled with video and environmental data collection from new hull-mounted and underwater sensor arrays. The six-month project will culminate in a system demonstration. **ST**

SpaceX Starlink Internet Via Elcome

Elcome International, a provider of maritime systems and integration solutions, is providing SpaceX's Starlink internet services to its global maritime and mobility customers. Starlink enables maritime customers to connect from the most remote waters in the world.

Powered by the world's largest constellation of satellites in low Earth orbit, Starlink's high-speed, low-latency broadband internet service for all types of maritime and offshore assets provides speeds up to 100 times faster at a fraction of the cost of traditional satellite internet services.

Gas-to-Power in Greece

Houlder, a design and engineering consultancy focused on sustainability, is collaborating with Blue Sea Power, a gas-to-power company based in Athens, to develop three innovative floating LNG-to-power barges (FSRPs), set to be operational by 2025. They will efficiently provide greener, lower emission base-load and peak power to the non-interconnected islands of Kos, Chios and Lesbos. This power will be used when existing renewable solar and wind energy utilization is at technical limits. The barges will replace the diesel and heavy fuel oil power generation infrastructure while meeting EU and Greek regulations.

In the current phase, Houlder will complete the barge designs for approval in principle by Lloyd's Register and will support Blue Sea Power with the design package for securing suitable tenders from shipyards. In a previous phase, Houlder completed the key decision studies on the main power generation engine selection, a cargo containment system, design standardization, greenhouse gas (GHG) reduction and efficiency options, and CAPEX, as well as an environmental study.

The technical solutions include maximizing waste heat recovery from the exhaust and using waste heat recovery from the engine's

cooling water system for freshwater generation for export. The barges will also maximize cold energy recovery from the LNG evaporation and use variable-frequency drives to improve the efficiency of motors.

The team expects to use a cryogenic carbon capture system on board the power barges. The engines will be hydrogen production blend ready, and there will be scope to factor and blend bio-LNG and renewable synthetic e-LNG into the supply chain to further reduce GHG emissions.

E-Course on How to Avoid Collisions with Whales

Ocean Technologies Group (OTG) has partnered with World Cetacean Alliance (WCA) to make the e-learning title "Becoming Whale Aware" available through the Ocean Learning Platform (OLP).

Collisions with ships are a major threat to whales, dolphins and porpoises. Such ship strikes pose a significant risk to large whale species, including critically endangered species such as the North Atlantic right whale.

The WCA-designed course supports commercial vessel operators by educating crews on how to avoid collisions with whales and dolphins. This helps improve the safety of crew, passengers, vessels and the wider marine environment. This will be the first course in OTG's Ocean Learning Library specifically developed to help shipowners and operators educate crew on measures to reduce the risk of ship strikes.

AiP for Ammonia-Fueled Ship

ClassNK has issued an approval in principle (AiP) for a large ammonia-fueled 210,000-dwt bulk carrier jointly developed by Mitsui O.S.K. Lines Ltd. (MOL) and MITSUI & CO. LTD.

Ammonia is expected to be a ship fuel for decarbonization since it does not emit CO₂ when combusted. Adequate safety measures are imperative because ammonia is toxic to humans and corrosive

to materials. ClassNK has issued its "Guidelines for Ships Using Alternative Fuels" as a necessary standard to minimize the risks related to ammonia-fueled ships.

Washington State Adds Seaeye Falcon for Survey

Scientists at the Washington Department of Fish and Wildlife (WDFW) have acquired a second Saab Seaeye Falcon underwater robot to conduct surveys of marine fish and invertebrates in Washington's Puget Sound, where some rockfish populations were fished to levels that threatened extinction.

The surveys are used primarily to monitor the recovery of rockfish listed under the United States Endangered Species Act. They also provide information on the unique geological features in Puget Sound. Additionally, WDFW has used the Falcon to survey the habitat surrounding U.S. Navy bases in Puget Sound to meet federal permitting requirements, locate and recover lost equipment, and conduct special studies of sea urchins and sea cucumbers.

The new Seaeye Falcon is a 300-m-rated system equipped with a high-definition, fiber-optic video system to collect higher resolution imagery than WDFW's original Falcon, which has been in use for over 4,000 hr. since 2007.

Developing Carbon Capture System for Offshore Industry

ProSep has signed a test and co-operative agreement with Moreld Minox Technology for a new carbon capture system. ProSep's offerings in the carbon capture value chain include three post-combustion solutions covering quenching, CO₂ capture/dehydration and CO₂ processing. One of these offerings will be implemented alongside Moreld Minox, Repsol Norge and the University of South-Eastern Norway on the proof of concept of the Minox compact CO₂ capture system.

The system will be optimized to capture 200,000 tons of CO₂ per year from offshore gas turbines and can be scaled to suit a wide range of CO₂ emissions. **ST**

people

General Oceans has appointed **Omer Poroy** as CEO of Strategic Robotic Systems Inc., one of its four operating companies. Poroy has over 25 years of experience in the ocean technology space with expertise in sensors, robotics, autonomy, and the interplay of multi-domain maritime systems. At General Dynamics Mission Systems, he led enterprise-level strategy and business development initiatives. Prior to General Dynamics, he held leadership positions at Bluefin Robotics and Teledyne Technologies.



Cynda Maxon has joined TDI-Brooks as a senior environmental scientist, broadening the company's environmental capabilities and services. She has over 30 years of experience as a program manager, environmental chemist, field supervisor, and risk assessor encompassing a wide range of offshore and coastal projects worldwide. For the last 17 years, she was presi-

dent of Maxon Consulting, a small woman-owned environmental consulting firm. TDI-Brooks has also named **Paul Walker** as director of laboratory operations for its geotechnical, geochemical and environmental labs.

Matt Giacona is NOAA's new vice president of government affairs. He was previously the director of government and industry affairs at the International Association of Drilling Contractors. His extensive experience managing the full portfolio of government relations activities includes shaping and implementing legislative and regulatory strategy, lobbying Congress, and engaging with the administration.

Hans Dieteren has been appointed a member of the board of the International Marine Contractors Association (IMCA). He is group director for the Offshore Energy Division and member of the executive committee of Royal Boskalis Westminster BV, where he is responsible for the business portfolio of offshore heavy lifting, subsea cables and global engineering.

MacArtney has announced **David Marchetti** as the successor to retiring U.S. Operations President **Lars Hansen**. Houston-based Marchetti will cover North and South America. He comes from a senior director position at Ocean Power Technologies and has over 20 years of experience. **ST**

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contracts

Strategic Marine, Singapore, has an order for four hybrid StratCat 27 (SC27) crew transfer vessels (CTVs) for a new customer. Delivery is scheduled for the first and second quarters of 2023. If the options for two additional vessels are exercised, the additional pair will be delivered in the third quarter of 2023. HST Marine.

Ashtead Technology, Westhill, U.K., has signed a multi-year agreement to be a rental partner for Otter USVs for high-quality maritime data acquisition. The Otter's robust catamaran design and the tightly integrated survey sensors are ideal for bathymetric surveys in sheltered waters. Maritime Robotics.

The Nippon Foundation-GEBCO Seabed 2030 Project, London, U.K., has added new partners to advance the field of ocean science and obtain a complete map of the entire global ocean floor. Ministry of Information, Communications and Transport for the Republic of Kiribati; ecoSUB Robotics; and Orange Force Marine Ltd.

RINA, Genoa, Italy, has signed a memorandum of understanding to collaboratively develop new concepts to reduce emissions in shipping for various vessel types. The will include the development of commercially viable solutions, including fuel cell systems with carbon capture; promoting the use of hydrogen; and the introduction of modern approaches to ship propulsion. ABB.

EdgeTech, Wareham, Massachusetts, has received an order for its 6205s2 bathymetry systems, 4205 and 4125 side scan sonar systems, 3400-OTS sub-bottom profilers, and 2050-DSS combined side scan and sub-bottom deep-tow systems. ECHO81.

METS Technology, Uddevalla, Sweden, has, together with main contractor Ö-VARVET AB, decided on

the new Octopus Series battery system for the retrofitting of the MS *Hamnen*, a Gothenburg Port security vessel built in 1979. The diesel engine will be replaced by a parallel hybrid system. EST-Floattech. **ST**

meetings

Note: The coronavirus (COVID-19) pandemic could affect event dates. Check event websites for the latest updates.

MAY

May 1-3—Intelligent Ships Symposium, Philadelphia, Pennsylvania. www.navalengineers.org/Symposia/ISS2023.

May 1-4—Offshore Technology Conference, Houston, Texas. <https://2023.otcnet.org>.

May 8-10—World Utilities Congress, Abu Dhabi, United Arab Emirates. www.worldutilitiescongress.com.

May 8-11—XPONENTIAL, Denver, Colorado. meetings@auvsi.org or www.auvsi.org/events/xponential/xponential-2023.

May 9-11—UDT, Rostock, Germany. team@udt-global.com or www.udt-global.com.

May 10-12—FOWT 2023, Nantes, France. www.fowt-conferences.com.

May 17-19—OceanTech Expo, Zhoushan, China. www.oceantech-ap.com.

May 17-19—Subsea Technology Eastern Mediterranean, Limassol, Cyprus. www.subseatechnologyconference.com.

May 23-24—Blue Food Innovation Summit, London, U.K. www.bluefoodinnovation.com.

JUNE

June 5-8—OCEANS 2023, Lim-

erick, Ireland. <https://limerick23.oceansconference.org>.

June 6-8—Capitol Hill Ocean Week, Washington, D.C. <https://marinesanctuary.org/chow-2023>.

June 13-15—Seawork, Southampton, U.K. <https://seawork.com>.

June 20-22—INMARTECH, Barcelona, Spain. <https://sites.google.com/view/inmartech-2023>.

AUGUST

August 20-24—World Water Week, Stockholm, Sweden. www.worldwaterweek.org.

August 28-September 1—IMAGE 2023, Houston, Texas. <https://tinyurl.com/uc2db9k3>.

SEPTEMBER

September 11-15—London International Shipping Week, London, U.K. <https://londoninternationalshippingweek.com>.

September 12-13—International Antifouling Conference, Gothenburg, Sweden. <https://antifouling-conference-2023.confetti.events>.

September 13-14—International Antifouling Conference, Gothenburg, Sweden. <https://antifouling-conference-2023.confetti.events>.

September 18-20—FWS – South America Offshore Wind, Rio de Janeiro, Brazil. andrew.chadderdon@questfwe.com or <https://fws.southamerica.com>.

September 25-28—OCEANS 2023 Gulf Coast, Biloxi, Mississippi. <https://gulfcoast23.oceansconference.org>.

OCTOBER

October 3-5—International Boat-Builders' Exhibition and Conference, Tampa, Florida. www.ibexshow.com.

For more industry meetings, visit sea-technology.com/meetings. **ST**

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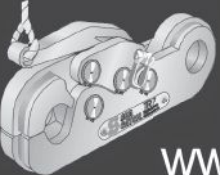
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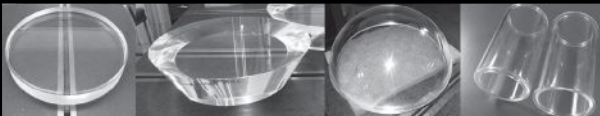
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Dr. Tim Smyth is the head of science for marine biogeochemistry and observations at Plymouth Marine Laboratory (PML). Since joining PML in 1997, his research lies in theoretical and experimental atmospheric and in-water optics. He focuses on developing innovative technologies for automated marine measurements and, more recently, on the impacts of artificial light at night on coastal marine organisms.



Amegacity is defined as having over 10 million inhabitants, or, in the case of urban areas with 8 to 10 million inhabitants, a population density of over 2,000 per square kilometer. A key development aspect of coastal megacities is artificial light at night (ALAN).

The first quantification of ALAN has shown that for eight globally distributed coastal megacities, surface ALAN dosages are up to a factor of six times greater than moonlight. (See light pollution in action in this time-lapse video: <https://tinyurl.com/44d2wyas>.)

The marine ecosystems likely to be affected most are those caught in the not-so-shadowy depths of megacities such as Los Angeles, New York, Buenos Aires, Shanghai and Mumbai.

Plymouth Marine Laboratory (PML), alongside our colleagues from the University of Plymouth and the University of Strathclyde, have developed a comprehensive optical model that includes solar (daylight and twilight), lunar and ALAN data sources, alongside seasonal and tidal changes in light distribution (<https://doi.org/10.1525/elementa.2022.00042>).

The model shows that ALAN irradiances in coastal megacities exceeded moonlight for the majority of each month, except on the days immediately around the full and brightest moons.

This is significant for coastal ecosystems because underwater ALAN can affect multiple aspects of marine organisms' life stages. In addition to decreasing the effectiveness of camouflage at night for prey species, it can also cause the following: alter the bodily processes and function of animals; reduce reproductive success in fish and turtles; delay the production of gametes in corals; change ecological communities; disrupt migration in zooplankton, sandhoppers and highly photosensitive species; alter population growth in marine rock- and seabed-living communities; shift cross-species interactions in estuarine fish, symbiotic reef-building corals and intertidal invertebrates; and change phytoplankton abundance.

Accelerated coastal development is increasing marine ecosystems' exposure to artificial light, and our new atlas of ALAN under the sea shows that the extent of ALAN in marine ecosystems covers an astonishing 1.9 million km² of the world's coastal seas (<https://doi.org/10.1525/elementa.2021.00049>).

Natural sources of light at night have seasonal cycles, but artificial light sources have a fixed intensity throughout the night. In many instances, the natural variations of moonlight are completely masked by city lights, and this can prove highly disruptive to organisms that rely on detecting moonlight in order to prompt migration or other important activities.

Quantifying ALAN in nature is challenging but necessary in order to facilitate a better understanding of the ecological impacts on animals and ecosystems; provide biologists with guidance on future research; and provide the information necessary to reduce the damaging impacts of ALAN on marine life.

Although suitable urban lighting is vital for night visibility, aesthetics, safety, security and reducing

criminal behavior, there are recommendations for urban planners to help reduce the impact of ALAN on marine life. One is to reduce the blue element of the light spectrum in lighting near the coast. There is evidence that LED lighting, with a peak in the blue end of the spectrum, is more harmful to our biological rhythms than traditional sodium lighting. Blue photons are more energetic, and in general, they also pass deeper into water than red photons, so they have a greater impact on marine ecosystems.

Other ways to decrease the effects of ALAN on marine life are: reducing spotlights and floodlights near the coast; using directional fixtures; lowering and/or shielding lights to illuminate only areas essential for safety; installing motion-sensitive lights; limiting the illumination of civic buildings and offices near the coast; instigating "dark hours" with increased surveillance; and directing lighting away from the coast.

In addition, planting native vegetation could create a natural buffer between the light source and the marine environment.

Furthermore, in terms of surveying and planning, performing regular light pollution surveys of land and marine light sources and including a light pollution assessment in all new coastal development plans would be useful to mitigate ALAN's impact on marine ecosystems.

ALAN pollution is widespread and pervasive, and its reach is expanding. It should be recognized as a major 21st century global anthropogenic issue, alongside climate change, chemical pollutants, plastics pollution, wastewater discharge and the overexploitation of natural resources. Its effects must be actively monitored, understood and considered, so that marine life does not have to suffer inadvertently with coastal use and development. **ST**

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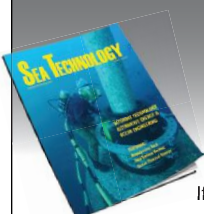
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