



March 2020

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## ESSENTIAL INTELLIGENCE

Artificial Intelligence Will Revolutionize  
The Royal Navy pg. 10

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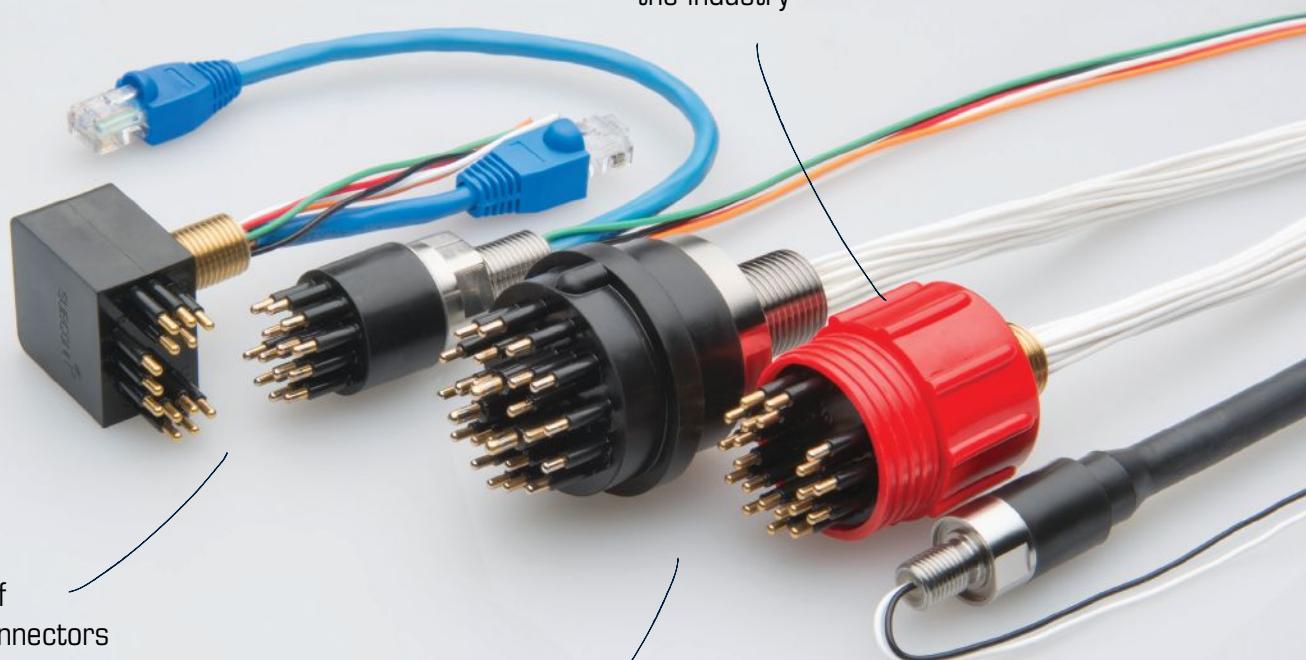
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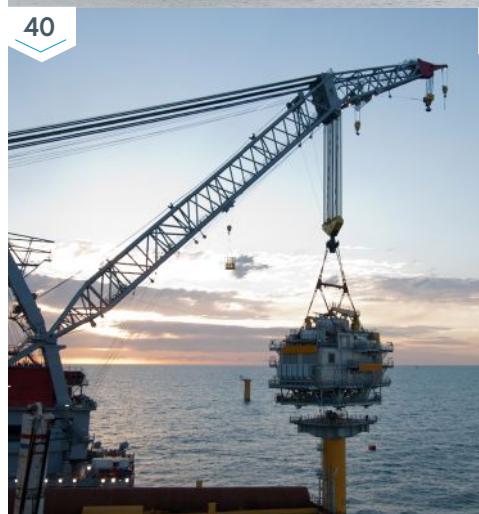
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A GE Haliade wind turbine at Deepwater Wind's Block Island Wind Farm reflected against the smooth surface of a helicopter at sunset. Photo credit: Tyson Wheatley/GE Reports.

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## WHAT OFFSHORE WIND CAN LEARN FROM THE SUBSEA FIBER INDUSTRY

BY JOHN MANOCK,  
*Editor and Consultant, SubCableWorld.com*

In January, *SubCableWorld*, a sister publication of *Ocean News & Technology*, and the Business Network for Offshore Wind, jointly conducted the first conference focused specifically on the offshore wind cable market in the United States. Called *Subsea Cables: A Critical Connection*, it was held for a standing-room only audience at the Houston Aquarium.

There is little doubt that the biggest concern for offshore wind cable is reducing the number of outages caused by cable issues. As has been widely reported, the chief cause of insurance claims in offshore wind has traditionally been failures of the submarine cables. Many of the cable problems were traced back to a design issue that has since been resolved. Yet statistics revealed at the conference showed that this has not had a huge impact on the number of insurance claims for cable-related issues. Claims are just about at the same level they were prior to this resolution.

In discussing offshore wind cable outages, it was noted that the submarine fiber optic cable industry had a long history of dealing with such issues and suggested that there are lessons that could be learned from them.

Having served in the subsea fiber industry for many years before becoming a journalist, here are my observations on this issue.

The subsea fiber people accept that there will be cable outages. They spend a lot of time studying ways to mitigate them. Competitors work together to deal with outages, sometimes at the direction of national governments. An industry organization has been created—the International Cable Protection Committee (ICPC)—that brings people together to find solutions. There have been Cable Maintenance Agreements (CMAs) for decades that include a comprehensive repair strategy with cable ships strategically located throughout the world to respond as quickly as possible.

There are a lot of differences between the offshore wind and subsea fiber industries—the global scale and deep ocean installation of fiber being the most obvious, but there is still a lot that the former can learn from the latter. The ICPC is not just for subsea fiber and accepts members from the offshore wind industry. The CMAs will accept offshore wind as well. In 2019, Ørsted signed an agreement under the Atlantic CMA to cover repairs

of its UK offshore wind cable assets.

Offshore wind in the US will be a multi-billion dollars market. The stakes are high and it needs to get done right. Collaboration may prove to be the key to prevent repeating mistakes. The subsea fiber industry may have some of the solutions.

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# ARTIFICIAL INTELLIGENCE WILL REVOLUTIONIZE THE ROYAL NAVY

The astonishing pace at which global threats are evolving requires new approaches and fresh-thinking to the way we develop our ideas and technology. The funding will research pioneering projects into how AI and automation can support our armed forces in their essential day-to-day work," UK Defence Minister, James Heappey.

With thousands of sources of data, intelligence, and information, vessel crews are already facing information overload. However, by combining automation, autonomy, machine learning and artificial intelligence (AI) with the real-life skill and experience of trained men and women, UK Defence leaders believe they can revolutionize the way future fleets are put together and operate.

## AI WARSHIPS

The Defence and Security Accelerator (DASA)—a part of the UK Ministry of Defence (MoD)—is tasked with finding and funding innovative defense and security capabilities. As part of this mandate, DASA is committed to revolutionizing the way warships make decisions and process thousands of strands of intelligence and data by using Artificial Intelligence (AI). Toward this goal, DASA has announced the first wave of funding as part of their Intelligent Ship—The Next Generation competition.

The competition, currently backed by a total of £4 million over two phases, has the potential to transform the way the Royal Navy, British Army and Royal Air Force equipment platforms are designed, work together, operated and manned by the 2040s. It is focused on inventive approaches for Human-AI and AI-AI teaming for defense platforms—such as warships, aircraft, and land vehicles—in 2040 and beyond. Although

titled Intelligent Ship, a warship is just the prototype demonstrator for this competition—the project will inform development relevant to all defense equipment and military services.

As part of the Intelligent Ship competition, nine projects will share an initial £1 million to develop technology and innovative solutions to overcome increasing 'information overload' faced by crews. On behalf of the Defence Science and Technology Laboratory (Dstl), DASA is looking at how future defense platforms can be designed and optimized to exploit current and future advances in:

- ⌚ Automation
- ⌚ Autonomy
- ⌚ Machine Learning
- ⌚ Artificial Intelligence

These key areas of research will look to address the complex and constantly evolving threats to UK national security. The work will inform requirements then

develop applications essential to the future force in an increasingly complex and AI driven environment. Innovations developed in phase 1 of the competition could later help determine the different platform types, size and role of future platforms as well potentially being adapted and integrated into the existing fleet.

DASA Delivery Manager Adam Moore said, "DASA brings together the brightest minds in science, industry and academia to turbocharge innovations to keep the UK, as well as those who protect us, safe from emerging and evolving threats to our way of life."

Julia Tagg, technical lead from Dstl, said, "This DASA competition has the potential to lead the transformation of our defense platforms, leading to a sea change in the relationships between AI and human teams. This will ensure UK defense remains an effective, capable force for good in a rapidly changing technological landscape."



» DASA is committed to revolutionizing the way warships make decisions and process thousands of strands of intelligence and data by using Artificial Intelligence (AI).

## WHAT DOES AI MEAN IN DEFENSE SCENARIOS?

To meet future threat capabilities, decision times will need to be reduced. This challenge is both helped, but also complicated, by growing volumes of data and available sources of data. There is therefore a need to more effectively and more efficiently use human-based analytical and decision-making skills in conjunction with greater machine intelligence and automation, to both increase military advantage while not over-stretching human commanders. In 2018, during a previous round of funding, Dstl provided an example scenario in which a future Intelligent Ship system operated by the Royal Navy may be involved:

The Royal Navy's latest innovative "smartship" *HMS Perceptive* is deployed, conducting operations away from UK waters. It has an Intelligent Core, comprising of AI supported decision aids and advanced automation. *HMS Perceptive* is on a patrol mission taking her through a channel (natural choke point) between two land masses. The Command team require the most complete understanding of the recognized picture around them, across all environments and spectrums to make effective decisions.

*HMS Perceptive* is tracking all detected surface and air contacts within sensor range, and monitoring the underwater space. Among all the traffic, she has identified 10 individual, separate, challenging air, surface and sub-surface contacts. They are all dispersed, have separate origins, yet have courses which converge (or come close) with *HMS Perceptive*. This behavior seems to be suspicious, not seen in regular Patterns of Life (PoL) and is potentially threatening.

In this scenario, the challenge for the Command team is to ascertain the intent of these contacts priorities responses to decide if they are exhibiting normal behavior or pose a potential threat. This decision-making process should be aided by the Intelligent Core. The aim for AI technologies in this scenario would be to assist the Command team in making their decisions, utilizing numerous information sources including (but not limited to) on-board, off-board and networked sensors.

## WHAT ABOUT FOR 'PUTTING FLEETS TOGETHER'?

The term Intelligent Ships does not just apply to operational scenarios. AI also impacts the management of information necessary for designing and producing better ships. For example, AI could be used to ensure that production aligns with relevant regulations, guidebooks, best practices, lessons learned, and so forth. It could also prove valuable in helping shipyards learn on the job, even as they turn a design into a working vessel.

Just as importantly, it means building a fleet where both manned and unmanned systems operate together securely and seamlessly. For example, in 2019, DASA released an RFP looking for innovative solutions that inform future capability and understanding of utility of extra-large unmanned underwater vehicles (XLUUVs).

The competition supported the Royal Navy's efforts to better understand and shape cutting edge capabilities; a strategy of

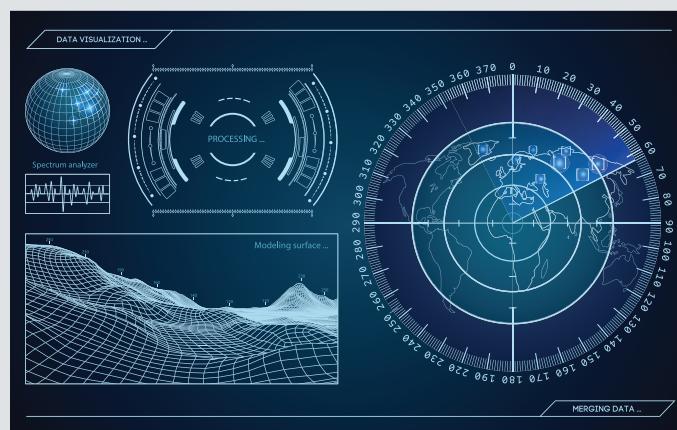
exploration and analysis has been adopted to inform capability and requirements of 'Maritime Autonomous System' use for future Royal Navy operations. Clearly, the relationship between unmanned and autonomous systems and large Intelligent Ships is part of an overall strategy to develop a more robust AI-based maritime domain awareness capability for the Royal Navy.

In order to integrate and analyze the huge amounts of data that such an autonomous fleet could gather, AI and machine learning technologies will be required, along with the internet of things (IOT), big data, and blockchain. Ideally, the evolving capability would allow for the intelligent and rapid coordination of data from a diverse suite of devices and systems, such as radar, vessel monitoring systems (VMS), satellite supported systems, unmanned and autonomous vessels, open source intelligence (OSINT), vessel profile databases, and so forth. Intelligently integrating this level of data granularity supports automated early threat evaluation at sea, including the capability to quickly identify suspicious ships or other threats. In short, the more information the Royal Navy has available in real-time, the more likely it is that a threat can be avoided or eliminated.

## IMI DEVELOPS AI ALGORITHMS TO MAP AND CLASSIFY MARINE ENVIRONMENTS

The UK's vast marine territories are monitored by the Royal Navy using high tech sonar equipment. Sonar systems emit and receive acoustic signals which can be analyzed to detect underwater objects and map our subsea environments. Due to the importance of such monitoring, DASA contracted the Institute for Mathematical Innovation (IMI) at University of Bath and Systems Engineering & Assessment Ltd. (SEA) to develop an AI algorithm capable of automatically classifying underwater environments directly from sonar measurements.

Underwater environments vary hugely in terms of water temperature, salinity and depth as well as seabed slope and composition, all of which affect sonar. The IMI and SEA first analyzed the many characteristics of underwater environments and classified them into different types. Next, they reviewed various AI techniques to determine the most effective classification approach. The selected method (Probabilistic



» The developed AI model can automatically classify underwater environments directly from sonar measurements.



» Built by BAE for the Royal Navy, the Destroyer HMS Diamond is one of six Type 45 destroyers to be fitted with an analytical tool known as System Information Exploitation, or SIE, which is capable of processing tens of thousands of equipment data samples per second. Photo courtesy of BAE.

Generative Modelling) was then adopted as a framework to develop three different AI algorithms for identifying underwater environments.

A Probabilistic Principal Component Analysis (PPCA) model proved to be the basis for the most effective algorithm. The IMI and SEA developed the model further through rigorous experimentation to achieve the highest possible classification accuracy.

After developing the AI algorithm, they tested its performance on a wide range of simulated acoustic data representative of a broad spectrum of underwater environments. The tests demonstrated that the team's PPCA algorithm can classify underwater environments from simulated sonar measurements with an average accuracy of 93%. Classification accuracy remained high even when they used a short spatial interval of the test data, which is promising for the practical use of the technique. An alternative Latent Variable Gaussian Process (LVGP) model also showed strong performance and enabled the team to achieve an even higher classification accuracy of 96%.

#### REAL-TIME ANALYTICAL TOOLS

One technology that is already making a positive impact was developed and funded by BAE systems. Their analytical tool known as System Information Exploitation, or SIE, is capable

of processing tens of thousands of equipment data samples per second. The information is securely sent for immediate assessment and diagnosis from the ship to shore.

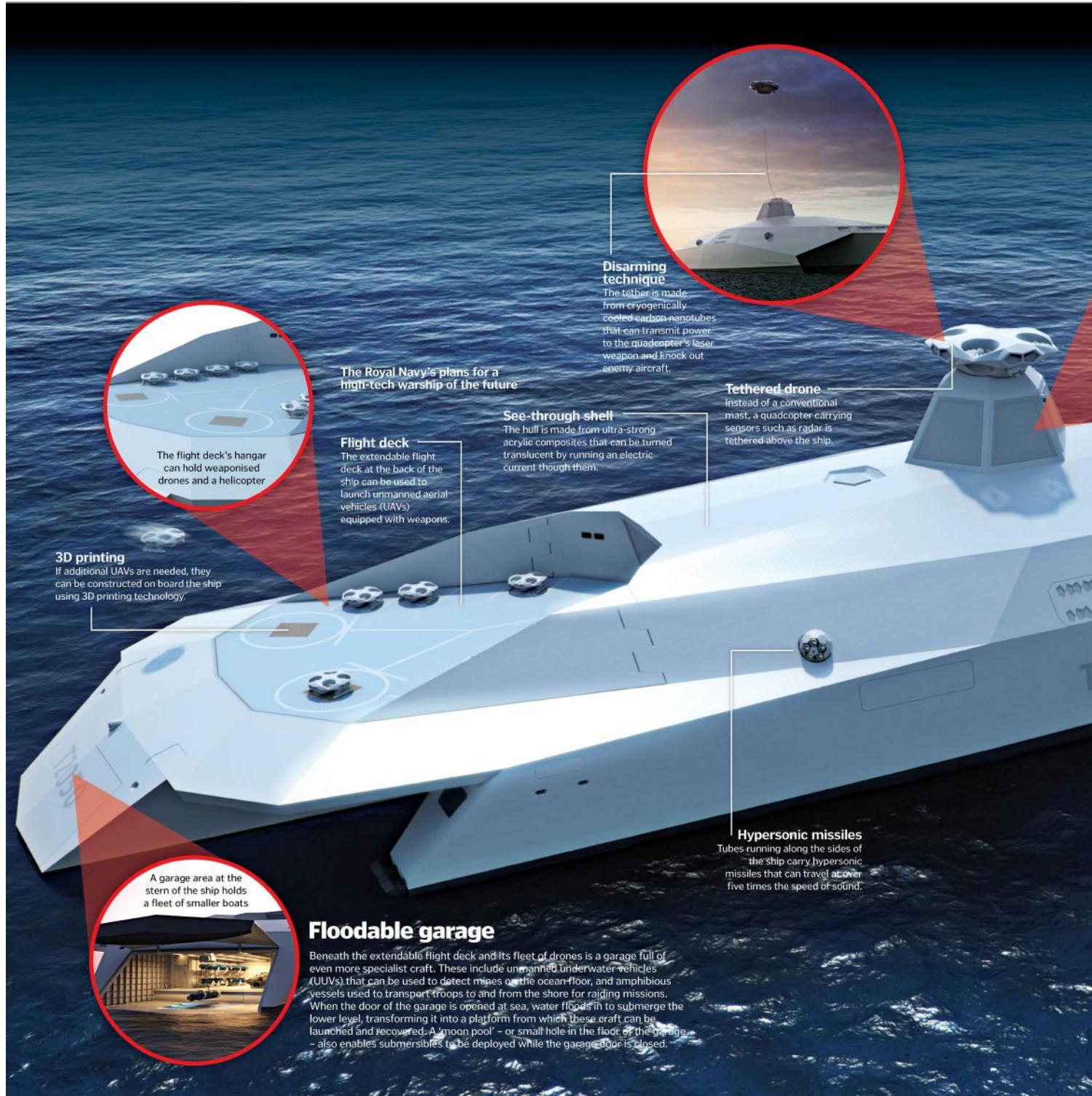
The system was installed on *HMS Daring* as part of the roll-out program, which BAE says marked the first time that any navy in the world installed this technology on a warship. Subsequently it was installed across all six Type 45 destroyers built by BAE.

Intelligent monitoring of big data allows BAE Systems and the Royal Navy crew to monitor the health of a ship's equipment and allows them to prepare for the ship's return to port, saving both time and money.

Matt Albans, SIE Innovator at BAE Systems said: "SIE is like having an automated watch-keeper able to record and analyze vast amounts of data on a constant basis. As the system does this in real time, we can identify potential faults and resolve them before they become an operational issue . . . Having the capability to predict when small problems could eventually impact a naval ship's performance is extremely beneficial to the Royal Navy."

#### A BIG PICTURE VIEW

DASA has a big picture view of defense technologies and a great relationship with its allies. For example, Dstl is currently partnering with the US Naval Research Laboratory (NRL)

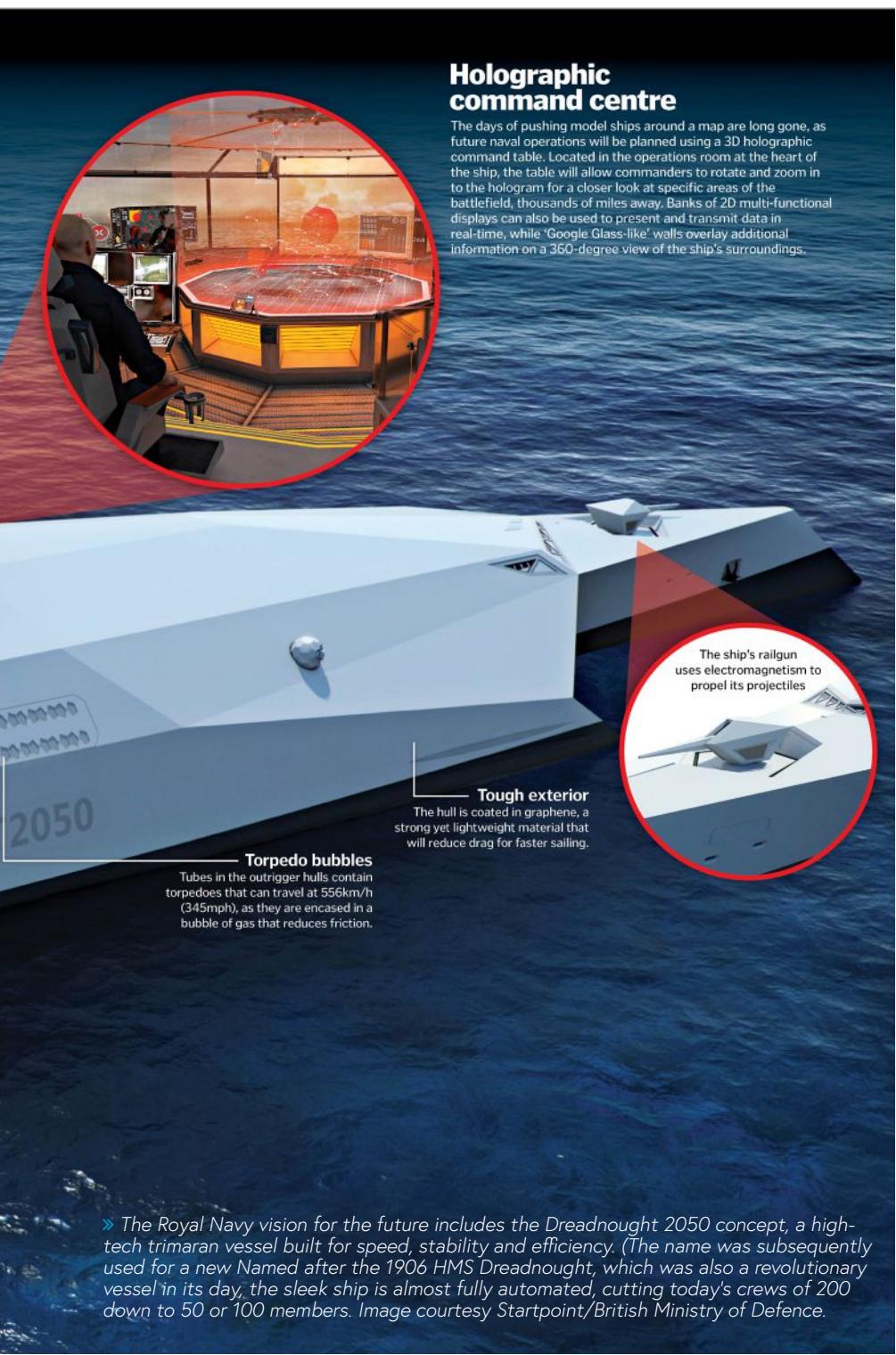


on a joint mission to launch miniature sensors that will advance Space weather measurement and modelling capabilities. The UK contribution to CIRCE is the In-situ and Remote Ionospheric Sensing (IRIS) suite, complementary to NRL sensors and comprising three highly miniaturized payloads. CIRCE will characterize a region of the space environment, the

ionosphere, which is important for a range of defense and civil applications and can impact GPS, communications and sensing technology, all of which are essential to the concept of Intelligent Ships.

Another competition funded by DASA aims to develop a semi-autonomous reconnaissance and survey system to

help troops safely and stealthily advance into enemy territory over water. The concept envisages a semi-autonomous remote system that can collect the required measurements without the need to deploy personnel to the potential crossing location. Such a system could enable the survey of a greater number of crossing locations, increasing the choices



available to the commander and giving an opportunity to surprise the enemy.

Often, the technology and best practices developed via Dstl support don't just improve the security for defense vessels, they have applications in the civilian sector as well. In 2017, for example, Dstl teamed with the Institution of

Engineering and Technology (the IET) and the Department for Transport (DfT) in developing a *Code of Practice: Cyber Security for Ships*, which provides a management framework that can be used to reduce the risk of cyber incidents that could affect the safety or security of a ship, its crew, passengers or cargo.

According to a study by Allianz, between 75% and 96% of maritime-related accidents are caused by human error. With Intelligent Ships emerging in the commercial sector, it's expected that technologies and practices developed with support from DASA will help reduce risk for ferries, cargo ships, oil tankers, and more. Areas where AI can help include reducing crew costs, increasing energy efficiency, improving operational safety, and of course, improving data collection and supply chain connectivity.

In fact, the International Maritime Organization (IMO) included autonomous ships as part of a key strategic direction, in its Strategic Plan (2018-2023) with the aim to take a leading role for the development of regulations for what the call Maritime Autonomous Surface Ships (MASS), which would include technologies like artificial intelligence. Their aim is to complete scoping for this guidance in 2020.

## CONCLUSION

Intelligent techniques and automation will have a significant impact across all aspects of defense in the future. It is therefore essential that the Royal Navy embraces the potential of intelligent systems, approaches and technology. Such capabilities have the potential not only to change how data and information is used, presented and interacted with, but also in how ships are designed, work together, are operated and manned. There is potential with these new technologies and approaches to envisage future fleet options made up of fundamentally different platform types, sizes and roles than of those seen in today's Royal Navy, as well as influencing refit and continual improvement of the existing fleet.

# KONGSBERG DIGITAL TO DELIVER ADVANCED FIREFIGHTING SIMULATOR TO SEA SAFETY SOCIETY



» An equipment fire, as simulated by the K-Sim Safety Advanced Fire Fighting Simulator (AFFS).

Kongsberg Digital (KDI) is pleased to announce that it has just been awarded its first K-Sim Safety simulator contract with the Norwegian Sea Rescue Society (NSRS). Under the terms of the agreement, KDI has committed to deliver a brand-new, cutting-edge K-Sim Safety Advanced Fire Fighting Simulator (AFFS) to the NSRS for installation in its Horten-based training center in Norway. As a long-term customer, the new simulator joins several KONGSBERG simulators already being used to train NSRS personnel.

The full-mission K-Sim Safety AFFS is a new simulator solution designed in accordance with the objectives and stipulations of STCW Advanced Firefighting courses. Specifically, it addresses regulation VI/3, section A-VI/3, table A-VI/3-1, which covers methods of organizing and training fire teams, inspecting and servicing fire detection and extinguishing systems and equipment, and controlling onboard firefighting operations.

As a realistic representation of the layout on a real crude oil carrier, the simulator's interactive 3D 'WalkThrough' software engine combines precise object and

equipment models with immersive visuals, exposing trainees to all conceivable scenarios and situations related to preventing and dealing with onboard fires.

The full mission K-Sim Safety AFFS accommodates an instructor station, a debrief area, a bridge/safety command center, two fire team muster stations and two smoke diver areas. Up to three separate teams—usually, a management team and two firefighting teams—can be trained at the same time. In exercises designed to replicate onboard emergencies, the management team (typically consisting of the captain, chief engineer and chief officer) will be expected to assemble at the bridge/safety command center, from where their priority will be to manage firefighting operations by communicating with the other internal teams and conducting external communications via radio.

The management team can oversee how the fire teams are handling the emergency situation as the bridge/safety command center is equipped with an Integrated Automation System (IAS) and safety panels, while recording, replaying and detailed debriefing tools will allow teams

to evaluate how effective their decision-making and consequent plan of action has been in each exercise.

"We're very proud of the fact that our K-Sim Safety AFFS is the first in the world to attain a DNV-GL certification," says Tone-Merete Hansen, Senior Vice President, Kongsberg Digital, "which speaks volumes about the quality of training it provides. Being commissioned to deliver this solution to the NSRS is of course another resounding vote of confidence for KONGSBERG, but more importantly, the AFFS' contribution to the prevention and containment of shipboard fires in the future will be invaluable."

"Where hands-on, onboard fire control and safety training would up to present have been costly, time-consuming and potentially hazardous, KONGSBERG's K-Sim Safety simulators have ushered in a new era whereby trainee officers can attain mandatory advanced firefighting competence and confidence in conditions of total safety," adds Martin Fuhr Bolstad, Managing Director at the NSRS training center. For more information, visit [www.kongsberg.com](http://www.kongsberg.com).

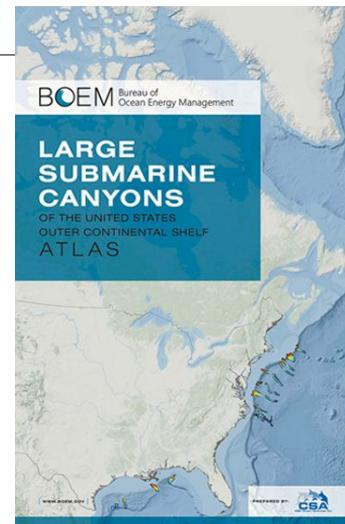
# BOEM AND CSA RELEASE ATLAS OF US WATERS SUBMARINE CANYONS

CSA Ocean Sciences Inc. (CSA), a marine environmental consulting firm that specializes in multidisciplinary projects concerning potential impacts of activities in coastal and marine ecosystems, has announced that the U.S. Bureau of Ocean Energy Management (BOEM) in collaboration with CSA Ocean Sciences Inc. (CSA) has released a new atlas of the major submarine canyons within US waters.

This Atlas improves environmental management of the Outer Continental Shelf (OCS) by having a single depository of maps and information on major submarine canyons of the OCS. The Atlas is also intended as a resource for the public, educators, and the science community. It was designed to present a consistent way to define canyon boundaries, provide large scale bathymetry for each included canyon, note protected areas, and include notable facts for each canyon.

Submarine canyons in federal waters were inventoried, delineated, described, and categorized using a methodology consistent with terrestrial watershed mapping. A criteria-based algorithm generated spatial canyon polygons from which slope, length, and depth were calculated. After conducting a literature review and using existing published information and data, a synopsis of the history, known archaeological sites, anthropogenic impacts, alternate names, geography, size, geology, biology, water quality, currents, and any official designation of each canyon was generated.

As a result, CSA was able to provide BOEM with a single depository of maps and supplemental information on United States OCS submarine canyons to inform both long-term and near-term analyses. Dr. Mark Fonseca, CSA's Vice President—Science, commented that "This project was an exciting collaboration among the CSA and



» The Atlas will help improve the environmental management of the Outer Continental Shelf (OCS).

BOEM scientists. We worked together to develop a defensible and repeatable process through the application of methods developed in other ecosystems. This has already been applied to begin explaining marine mammal fidelity to canyon ecosystems."

For more information, visit [https://espis.boem.gov/final%20reports/BOEM\\_2019-066.pdf](https://espis.boem.gov/final%20reports/BOEM_2019-066.pdf).

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| FEATURE |

# BIONIC JELLYFISH SWIM FASTER AND MORE EFFICIENTLY

RESEARCHERS AT CALTECH AND STANFORD USE MICROELECTRONICS TO ENHANCE JELLYFISH SWIMMING

By Robert Perkins, Caltech

Engineers at Caltech and Stanford University have developed a tiny prosthetic that enables jellyfish to swim faster and more efficiently than they normally do, without stressing the animals. The researchers behind the project envision a future in which jellyfish equipped with sensors could be directed to explore and record information about the ocean.

Jellyfish use a pulsing motion to propel themselves forward, swishing their tentacles as they move to capture prey. The new prosthetic uses electrical impulses to regulate—and speed up—that pulsing, similar to the way a cardiac pacemaker regulates heart rate. The device, which is

neutrally buoyant in water, is about two centimeters in diameter and is attached to the body of the jellyfish via a small wooden barb.

The research—led by Caltech's John Dabiri (MS '03, PhD '05), Centennial Professor of Aeronautics and Mechanical Engineering, and Stanford graduate student Nicole Xu (MS '15)—was published in the journal *Science Advances* on January 29.

Typically, jellyfish swim at a rate of about two centimeters per second. Although they are capable of moving more quickly, doing so does not aid them in ensnaring prey, their typical reason for using the tentacle-waving "swimming" motion.

In the research described in the paper, Dabiri, Xu, and colleagues equipped jellyfish with a microelectronic controller pulsing at a frequency three times faster than the animals' usual body pulses. The animals' pulsing sped up, producing a corresponding increase in their swimming speed to around 4–6 centimeters per second.

In addition to making the jellyfish faster, the electrical jolts also made them swim more efficiently. Although the jellyfish swam three times faster than their usual pace, they used just twice as much energy to do so (as measured by the amount of oxygen consumed by the animals while swimming). In fact, the prosthetic-equipped jellyfish were over 1,000 times more efficient than swimming robots, Xu says.

"We've shown that they're capable of moving much faster than they normally do, without an undue cost on their metabolism," Xu says. "This reveals that jellyfish possess an untapped ability for faster, more efficient swimming. They just don't usually have a reason to do so."

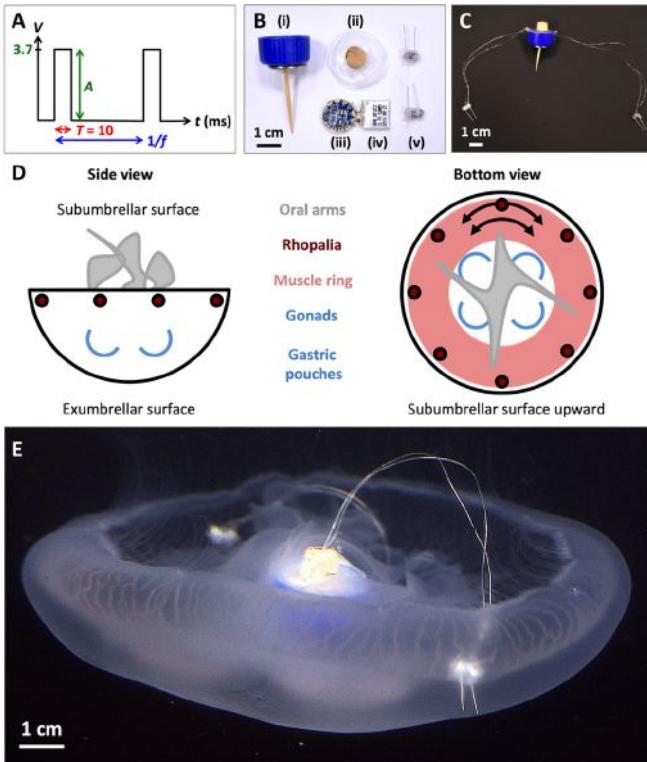
It should be noted that the jellyfish were closely monitored to make sure that they were not harmed. Jellyfish do not have a brain or pain receptors, but they have been found to secrete mucus when stressed, and no such secretion was observed in this experiment. In addition,

the jellyfish went back to swimming normally once the prosthetic was removed.

The research represents a "middle ground" between two veins of bio-inspired robotics work that Dabiri has been involved in for the past decade, both at Caltech and Stanford. One involves the use of purely mechanical components and the other purely biological materials.

With purely mechanical systems, Dabiri has had success building robots that look like real animals but require much more energy to accomplish the same tasks. "We haven't captured the elegance of biological systems yet," he notes. However, although they are more elegant than robots, purely biological systems are a lot more fragile. Indeed, in collaboration with colleagues at Harvard University, Dabiri has shown that rat heart cells can respond to electric fields—which potentially makes them useful building blocks for biological devices—but the cells only survive under laboratory conditions.

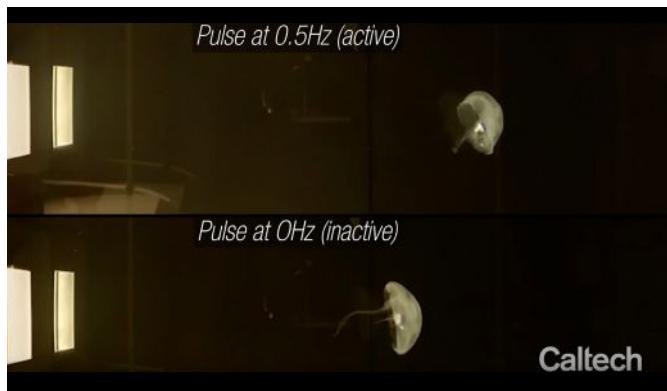
The effort to add mechanical controls to jellyfish began in 2013 at Caltech when Xu was an undergraduate student doing a Summer



» A. aurita swim controller design.

(A) Square wave signal generated by the swim controller. (B) Swim controller components. (C) Fully assembled device, with the processor and battery encased in the housing. (D) Simplified schematics of *A. aurita* anatomy, highlighting the subumbrellar (top) and exumbrellar (bottom) surfaces, rhopalia, muscle ring, and circumferential muscle fiber orientation, oral arms, and gonads/gastric pouches. (E) Swim controller (inactive) embedded into a free-swimming jellyfish, bell oriented subumbrellar side up, with the wooden pin inserted into the manubrium and two electrodes embedded into the muscle and mesogleal tissue near the bell margin. Photo credits for (B), (C), and (E): Nicole W. Xu, Stanford University. Other credits: Nicole W. Xu, Stanford and John O. Dabiri, Caltech.

Illustration: Image credit: Rebecca Konte/Caltech.



» The race is on. Jellyfish equipped with an active microelectronic controller swam three times faster than those with inactive controllers, but they used just twice as much energy to do so. The jellyfish in this screen capture were moving left to right. Image credit: Caltech.

Undergraduate Research Fellowship (SURF) in Dabiri's lab. Dabiri was interested in leveraging jellyfish for ocean exploration and sensing because of their abundance: the species used in the current experiments can be found throughout the earth's oceans, at depths ranging from the surface to the bottom of deep trenches.

"Only five to 10 percent of the volume of the ocean has been explored, so we want to take advantage of the fact that jellyfish are everywhere already to make a leap from ship-based measurements, which are limited in number due to their high cost," Dabiri says. "If we can find a way to direct these jellyfish and also equip them with sensors to track things like ocean temperature, salinity, oxygen levels, and so on, we could create a truly global ocean network where each of the jellyfish robots costs a few dollars to instrument and feeds themselves energy from prey already in the ocean."

Currently, the prosthetic can direct jellyfish to start swimming and control the pace. The next step will be to develop a system that guides the jellyfish in specific directions and that allows them to respond to signals from onboard sensors, says Dabiri, who hopes to develop even smaller electronic controls that could be completely embedded in the jellyfish's tissue, making them permanent but unnoticed prosthetics.

This research was funded by the National Science Foundation.

#### Reference:

Xu, Nicole W. and Dabiri, John O. (2020) Low-power microelectronics embedded in live jellyfish enhance propulsion. *Science Advances*, 6 (5). Art. No. eaaz3194. ISSN 2375-2548.

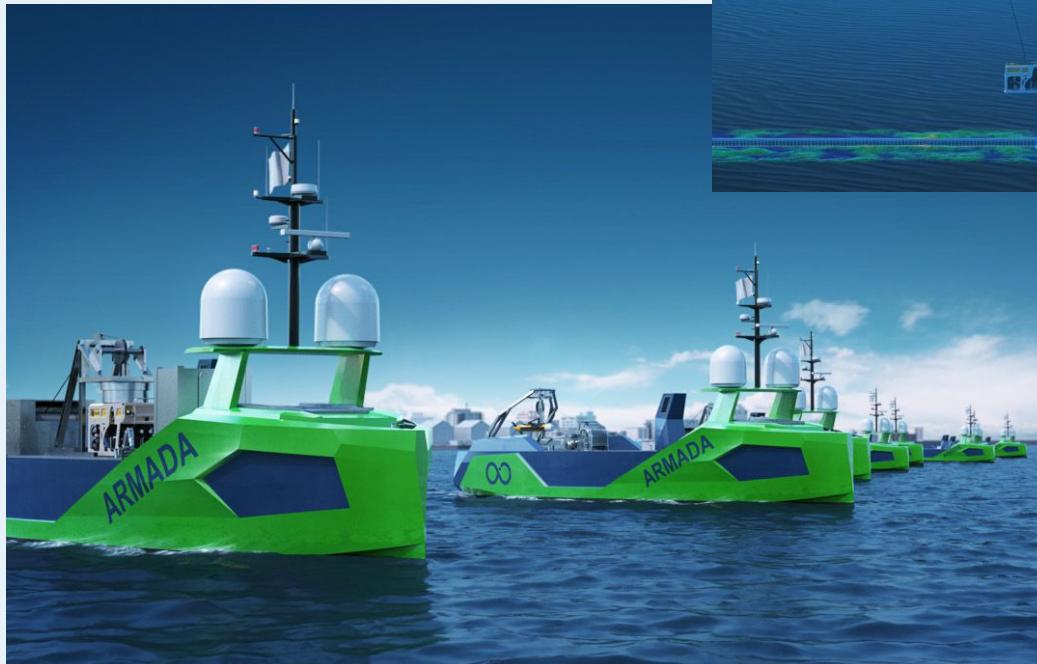
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# OCEAN INFINITY LAUNCHES PIONEERING MARINE TECHNOLOGY AND DATA COMPANY

Ocean Infinity has announced the launch of a new pioneering marine technology and data company, Armada. The launch marks a major technological advance in the industry. Each unmanned surface robot will serve a wide range of industries by being fully equipped to perform a multiplicity of offshore data acquisition and intervention operations down to a depth of 6,000 meters. These robot ships will be capable of remotely deploying a wide range of the latest sensors as well as AUVs and ROVs for visual and acoustic data acquisition.

With a focus on combining technology and sustainability, Armada will initially add fifteen bespoke designed marine robots to Ocean Infinity's current fleet of autonomous underwater vehicles. The fleet is currently under construction and is expected to be deployable by the end of 2020.

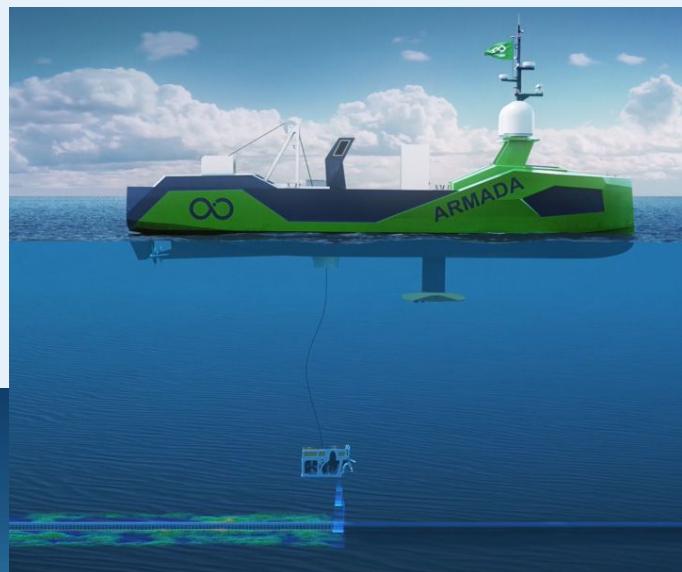
Armada's fleet requires neither people on board nor a host vessel nearby. Instead they will be controlled and operated by experienced mariners via satellite communications from state-of-the-art onshore facilities in both Austin (Texas) and Southampton (England). With zero people required at sea Armada operations are set to be the safest the industry has seen. The fleet approach produces up to 90% less CO<sub>2</sub> than other conventional survey vessels, also making it the most environmentally sustainable company in the industry.



Oliver Plunkett, CEO for Ocean Infinity, said, "We've been driven to innovate by a desire to further reduce our impact on the environment and the time people spend at sea. We have built an outstanding team who boast world leading expertise to take this next stage of our business forward for the benefit of our clients and all those who work with us. The launch of Armada re-confirms Ocean Infinity as the leading marine robotics and ocean data company in the world."

Dan Hook, Managing Director for Armada, said, "We are very excited to be launching Armada, which perfectly complements the other service offerings in the Ocean Infinity Group. The pioneering technology makes our operations world leading in terms of environmental sustainability and safety, whilst still achieving the very highest levels of data quality and value for our clients. With no requirement for a host vessel, we are breaking new ground in the area of sub-sea technology and data. We look forward to providing our existing and new clients with a best in class solution that will be revolutionary for the industry."

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» Largest fleet of unmanned surface robots and most environmentally sustainable company in the industry.

# NOAA JOINS OCEANX TO ADVANCE OCEAN EXPLORATION AND MAPPING

NOAA and the exploration initiative OceanX have forged a formal agreement to advance cutting-edge ocean exploration and scientific research that increases public understanding of the importance and value of the ocean.

Through a new memorandum of understanding, NOAA scientists will advise and join OceanX on missions aboard specially designed high-tech OceanX vessels to advance their shared goals to explore and characterize the deep ocean.

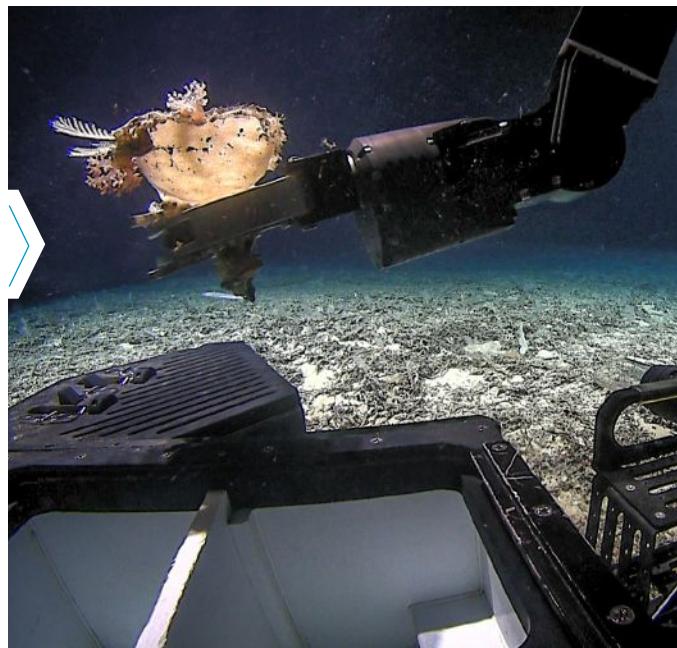
"We are living in a new age of ocean discovery with today's ocean explorers working together to better understand the vast mysteries of the global ocean," said RDML Tim Gallaudet, Ph.D., USN Ret., assistant secretary of commerce for oceans and atmosphere and deputy NOAA administrator. "NOAA is forging new partnerships such as the one with OceanX to accelerate our mission to explore and characterize the ocean, understand its key role in regulating our weather and climate, and sustainably manage and use its valuable resources to power the American Blue Economy."

NOAA's memorandum of understanding with OceanX is another example of NOAA's increased effort to create partnerships that help NOAA advance ocean science and new technology, fully map the nation's Exclusive Economic Zone and strengthen the American Blue Economy, which includes maritime commerce, domestic seafood production, healthy and sustainable fisheries, coastal resilience, energy production, tourism and recreation, environmental protection, and national security.

"We are thrilled to partner with NOAA, our nation's leading science agency, and can think of no more important partner to support our core mission at OceanX, which is to create a global community that is engaged with understanding, enjoying, and protecting our oceans," said Vincent Pieribone, vice chairman and chief scientist at OceanX. "We are looking forward to combining the efforts of NOAA's world-class ocean scientists and OceanX's science, technology and media teams to produce critical scientific research and impactful ocean media."

OceanX was created in 2018 with a mission to explore the ocean and bring it back to the world. OceanX combines next-gen technology, science, and storytelling to educate, inspire, and connect the world with the ocean. OceanX does so by convening leading scientists, media entities, global leaders, and philanthropy partners to drive towards greater understanding and protection of our oceans.

The collaboration will support the recent Presidential Memorandum on Ocean Mapping in the U.S. Exclusive Economic Zone and Shoreline and Near Shore of Alaska and the goals announced at the November 2019 White House Summit on Partnerships in Ocean Science and Technology. The MOU with OceanX comes on the heels of two other partnerships with the technology company Ocean Infinity and Viking Cruises.



» Pilots on board NOAA Ship Okeanos Explorer guide ROV Deep Discoverer's manipulator arms to grab a sample of a sponge (porifera) and its associates during Dive 01 of the 2019 Southeastern U.S. Deep-sea Exploration expedition. Image courtesy of the NOAA Office of Ocean Exploration and Research, 2019 Southeastern U.S. Deep-sea Exploration. Photo credit: NOAA.

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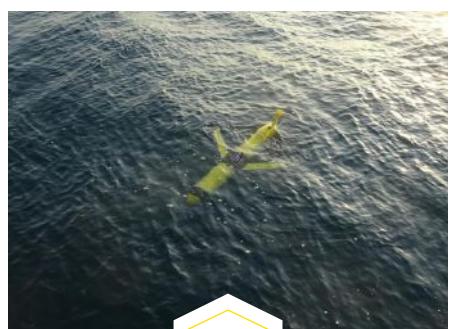
» The US Navy maintains a large fleet of ocean gliders for environmental measurements. Ocean gliders are slow-moving, long-endurance, underwater vehicles that gather data as they travel through the ocean's interior using high-efficiency buoyancy engines. Photo credit: US Naval Research Laboratory.

Scientists from the U.S. Naval Research Laboratory's Ocean Sciences Division are optimizing the placement of ocean gliders and the usage of glider data to improve the Navy's ability to predict ocean conditions.

Researchers frequently use gliders—slow-moving, long-endurance underwater vehicles—to collect data on ocean conditions such as temperature, depth, and salinity; in effect, observing the ocean's weather.

"Predicting the ocean's interior weather is challenging, yet it has important implications for all those who sail and operate on its waters," said Jeffrey Book, Ph.D., an NRL oceanographer. "To help mitigate this problem, the ocean observing community has been developing new techniques for autonomously measuring the ocean's interior and reporting data back in real time."

We know the equations of motions for geophysical fluids quite well, so why is the



» Ocean gliders are one of the Navy's many tools for collecting data on the internal structure of the ocean for assimilation into ocean models. Gliders surface periodically to transmit data via satellite and are capable of collecting numerous types of data, including currents, temperature, salinity, pressure and optics. Photo credit: US Naval Research Laboratory.

## CHECK THE TECH: SMART SEA GLIDERS IMPROVE OCEAN OBSERVATION AND OCEAN PREDICTION

By Daniel Parry, NRL Corporate Communications

task of predicting the weather on or in the ocean so difficult? Over land, meteorological services around the world have established a worldwide network of weather stations and satellite systems that provide the needed data for fairly accurate four-day weather forecasts. However, in the ocean, satellite systems can only observe the ocean's surface, and coverage from sea-born instruments for measuring the ocean's interior is very limited.

Because of the ocean's vast volume, efficiently placing a relatively small number of gliders to capture observations of a dynamic environment can be tricky. Recently, NRL researchers have been looking at ways to optimize glider placement, including using them in teams.

### The Benefit Of Teams

The current paradigm in deploying ocean gliders calls for placing them far away from each other to maximize their limited spatial coverage. However, Book said a slowly moving, single glider by itself cannot tell the difference between a stationary, kilometers-long ocean feature and a traveling ocean feature that oscillates over several hours. On the other hand, a team of gliders working together can provide spatial context and potentially help resolve this issue.

Placing gliders in teams required a change in piloting techniques, adding complexity to the project. To enable piloting gliders together, researchers built on an existing automated piloting tool developed by NRL called Guidance for Heterogeneous Observation Systems or GHOST. GHOST had the ability to optimize single glider use with user-defined conditions. For example, users could specify ocean areas to avoid and GHOST

would provide reasonable paths under these restrictions. Book and the research team adjusted GHOST to employ glider teams by adding two rules.

"The first rule was gliders should not be too close together, because current models can't use data collected too close to each other," said Charlie Barron, Ph.D., head of NRL's Ocean Data Assimilation and Probabilistic Prediction group. "The second rule was they shouldn't be too far apart. This is because an individual glider moves too slowly to correctly identify and measure most major ocean features, and a team of gliders is needed to provide enough data for the model to correctly initialize features such as eddies, filaments, and fronts."

### Taking Glider Teams Into The Field, But Where?

With GHOST upgraded, Book and the team took to the field to test the teaming concept.

A first big decision was location, and the team decided to go to North Carolina.

"Because of the complicated ocean circulation in the area, it's an interesting place to test our ability to observe and predict the ocean environment," Book said. "The warm transport of tropical water northeastward along the continental shelf break by the Gulf Stream current creates some complex structures."

Book explained the additional dynamic of how some Gulf Stream water spins off the main stream onto the shelf where it can sink below coastal water. Even though Gulf Stream water is warmer, its salinity makes it denser than the fresher but colder shelf water. Ocean gliders provide vital measurements in these

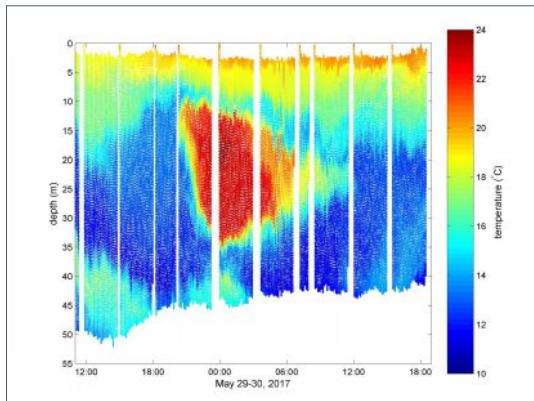
conditions because the colder waters above mask the warmer waters below.

Finding and predicting such features can be important to many different types of naval operations. In this example, the warm salty waters create a subsurface pocket with very different acoustic properties, which can create acoustic shadows.

#### Grading The Glider Teams

For 18 days off the coast of North Carolina, NRL researchers tested six gliders in different team configurations near the Gulf Stream. Overall, the gliders collected more than 13,000 conductivity, temperature and depth profiles used in two ocean forecast models.

Because of the volume of closely spaced glider data collected, Book's team also created and tested new ways to use the data in ocean forecast models. Prior assumptions based on the idea of single gliders collecting data far apart from each other had to be relaxed or removed before the models could begin to use glider team data effectively.



» Red colors show a warm and salty pocket of submerged Gulf Stream water on the North Carolina shelf as measured by an NRL glider on May 29-30, 2017. The dots, which make up the graph composite are individual temperature measurements taken as the glider descends and climbs in depth. The gaps in measurement occur when the glider is on the surface transmitting recent measurements back to Stennis Space Center for use in correcting the forecast model for this region. Photo credit: US Naval Research Laboratory.

"We found that there is little to no benefit in using teams without improving the way you assimilate the data," said Book. "There was some benefit to just improving the assimilation method for the models, but this benefit was greatly increased if we used glider teams instead of single gliders. What we saw overall was that it is important to do both." The overall improvement Book's team observed was 9 to 12 percent, a measurement of improved accuracy of the ocean weather models.

This effort was completed through base program funding provided by the Office of Naval Research in collaboration with the National Science Foundation. The intense level of field effort was made possible by a team of 12 researchers and technicians from NRL's Ocean Sciences Division, two reservists from the ONR Reserve Component program for support on meteorology and oceanography related projects, as well as collaborative help from a postdoctoral scientist, technicians, and students representing five separate academic institutions.

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## RTSYS UNVEILS LOW-POWER UNDERWATER ACOUSTIC RECORDERS SYLENCE-LP

After intense R&D investment, underwater acoustics specialist RTSYS has released long-lasting and cost-effective acoustic recorders SYLENCE-LP.

In order to respond to underwater acoustics market's demand aiming for cost-effective devices, French-based company RTSYS has developed off-the-shelf low-power acoustic recorders called SYLENCE-LP. Two recorders were developed: a smaller one named SYLENCE-LP 220 (22 cm high, 35 days of autonomy) with one fixed hydrophone, and a longer one also known as SYLENCE-LP 440 (44 cm high, up to 180 days of non-stop recording) with one fixed or loose hydrophone.

While being cost-effective, RTSYS managed to give these recorders large bandwidth (up to 256 kHz) and memory (2 Tb on 4 nano SD cards). SYLENCE-LP recorders will help offshore engineers and scientists reliably monitor underwater life up to 250 meters depth, while being affordable. These recorders will be displayed at Oceanology International in London on stand J551.

For more information, visit  
[HTTPS://RTSYS.EU/EN](https://RTSYS.EU/EN)



## EXPLORING THE POTENTIAL OF ROBOTICS IN THE OIL AND GAS INDUSTRY

Aker BP and Cognite have announced a strategic initiative to explore how robotics systems can be used to make offshore operations safer, more efficient and more sustainable.

Cognite, a global industrial AI software-as-a-service (SaaS) company and Aker BP will do several tests using robots and drones on the Aker BP operated Skarv installation in the Norwegian Sea during 2020.

The robotics systems will be tested to gauge their performance in autonomous inspection, high-quality data capture, and automatic report generation. Tasks may include aerial and underwater inspections, responding to leaks, performing work that takes humans out of harm's way, and providing onshore operators with telepresence on offshore installations.

Among the robots involved in the initiative is Spot, the quadruped robot developed by Boston Dynamics (pictured). Cognite and Aker BP have tested Spot's mobility in simulated oil and gas environments to ensure that it can access locations in these facilities too difficult to access through traditional automation. Spot was showcased at Aker BP's Capital Markets Update February 11, 2020.

"Digitalization will be one of the differentiators between the oil companies of the world, in order to be able to deliver low cost and low emissions. Our vision is to digitalize all our operations from cradle to grave in order to increase productivity, enhance quality and improve the safety of our employees. Exploring the potential of robotics offshore underpin our digital journey", said Karl Johnny Hersvik, CEO of Aker BP.

Cognite's main software product, Cognite Data Fusion (CDF), will serve as the data infrastructure for the initiative. CDF, a cloud-based industrial data operations and intelligence platform, integrates seamlessly with existing IT and OT applications in the cloud, edge, and on-premise. CDF contextually enriches industrial data, providing an open, unified industrial data model that is easily accessible for humans and applications, enabling better analytical operations and data-driven decisions.



# Digital Edge Subsea Offers Industry First

A world leader in offshore digital video recording (DVR) and inspection systems, Digital Edge Subsea develops and manufactures DVR products for use throughout the offshore oil and gas industry including diving, remote operated vehicle (ROV) and topside operations. Led by John Benson and his 20 years of subsea industry experience, Digital Edge works with clients of any size to provide the system that best suits their needs.

## The Best Is Now Better

With the release of their new Version 5 Edge DVR, the company proudly offers an industry first. Digital Edge's team of hand-picked specialists have not only created an even better DVR product that brings improved efficiency and usability, they have even housed it in a laptop.

For more than a decade, Digital Edge has supplied the oil and gas industry with a proven digital video recording system. As a result, the company has nurtured strong customer relationships. These relationships have allowed for honest customer feedback, which has been incorporated into the development of the new Version 5 Edge DVR.

The new Version 5 follows the Digital Edge mandate of being simple to use and most of all, reliable. Version 5 has 3 levels, EdgeLite, Edge and EdgePro.



**EdgeLite** software is the most basic of their recording systems and is an entry level unit. This is suitable when there is no requirement for eventing and will record 4 channel video overlay. Clients range in size and come from all over the world, and this product has been developed to provide their smaller clients with the same great recording capability at a fraction of the cost.

The Edge is their mid-range system and allows for the recording of 4 HD channels simultaneously. Eventing, work packs and offline editing are all included features.

**EdgePro** has further features including an extended database that

allows tasks to be assigned to components under inspection.

All versions are available on the laptop, which comes in its own custom PELI case. The laptop has a total storage capacity of 3TB and provides the same capabilities as rack mounted systems. The laptop version is ideal for customers who need portability or are short on space.

Digital Edge continue to exhibit at various shows around the world and they're pleased to confirm they'll be at Oceanology International 2020 in London. Please visit them at stand K501 where the team can answer any questions you have and show you Version 5 in action.

If you're unable to see them in person but you'd like to learn more or arrange your own demonstration of the Version 5 Edge DVR, please contact [info@digitaledgesubsea.com](mailto:info@digitaledgesubsea.com).



## SONARDYNE'S SUBSEA SENSORS TO SUPPORT PIONEERING TSUNAMI RESEARCH

High-accuracy, long-endurance underwater instrumentation from Sonardyne Inc. is set to play a major role in helping scientists across the US better understand and possibly predict earthquake and tsunami risk at a far greater scale than has been possible before.

Scripps Institution of Oceanography, through a US\$5.5 million grant from the US National Science Foundation (NSF), is procuring equipment to be used by the broader scientific community to study seafloor deformation. Comprising of more than 50 Sonardyne Fetch subsea sensor logging nodes, this major new equipment pool will also include Sonardyne's advanced acoustic positioning modules fitted to three Liquid Robotics Wave Gliders.



These will, for the first time, make highly precise seabed monitoring capability—at scale—available to the entire US earth science community using a technique known as GNSS-A. GNSS-A combines GNSS-derived surface platform positions with acoustic ranging to seafloor sensors, enabling scientists to make centimeter-level and globally referenced measurements of movement across geological features such as subduction zones, which can cause potentially catastrophic earthquakes and tsunamis.

Unlike on land where these observations are easily acquired using the GNSS network, this level and type of measurement has been either too costly or too impractical to acquire subsea. This has resulted in there being almost no seabed geodetic information, which has limited understanding of the geological mechanisms at work.

"This lack of seabed geodetic data has been a real challenge for scientists," says Geraint West, Global Business Manager Oceanographic, at Sonardyne. "With access to Wave Gliders, to make the highly accurate measurements to our Fetch sensors, the ability to link subsea measurements within a global reference frame is now practical and affordable. What's more, we're able to do this over long periods of time, taking the detailed measurements that are needed over decadal timescales."

"To date only one prototype vehicle and approximately a dozen seafloor transponders have been available for the scientific community," says David Chadwell, Research Geophysicist at the Marine Physics Laboratory at Scripps. "This project will add 51 additional seafloor instruments together with three new robotic platforms for making the required measurements. This will approximately quintuple the equipment available to the research community to make these important measurements."

"Seafloor geodesy is poised to be transformative. It will allow for a broad community of existing and next-generation earth scientists to study active deformation on the seafloor. Improved access to these instruments will foster and communicate knowledge of the new methods and science outside of the current and very small marine community, to a much larger scientific community primarily consisting of highly-skilled land-based geodesists, and an inclusive next-generation scientific workforce."

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## NOAA FINALIZES STRATEGIES FOR APPLYING EMERGING SCIENCE AND TECHNOLOGY

NOAA has released final strategies to expand the agency's application of Unmanned Systems, Artificial Intelligence (AI) and 'Omics. Their Unmanned Systems Strategy aims to provide requirements-driven, safe, cost-effective, and compliant Unmanned Systems services across the agency.

It also prioritizes strategic investments in Unmanned Systems applications and technologies that fuel innovation and strengthen operations, and accelerates and enhances capabilities through partnerships. The goal of the AI strategy is to utilize AI to advance NOAA's mission priorities. The 'Omics Strategy provides a framework to advance the application of 'omics to address mission priorities. The term "'Omics" refers to a suite of advanced methods used to analyze material such as DNA, RNA, or proteins.

# SEATRONICS ADDS MIROS WAVE MONITORING SOLUTIONS TO ITS RENTAL FLEET

Miros, a trusted provider of wave and current data to the maritime industry, has established a new distribution agreement with Seatronics, global leaders in the rental and sale of marine electronic equipment, to introduce their range of radar-based solutions to the Seatronics global rental pool.

With over 35 years' experience measuring the ocean surface, Miros delivers real-time insights about local sea state and marine conditions, without the need for any equipment submerged in water. The Miros product range includes the likes of the RangeFinder and WaveFinder. These robust sensors are purpose built for accurate wave measurements from fixed and floating installations, respectively. The compact stand-alone instruments have embedded processing and storage, enabling easy and secure access to data, both locally and remotely, by utilizing modern IoT technologies. The rugged and reliable solutions have been designed with ease of installation in mind, only requiring power and an Internet connection to begin delivering real-time data to



all relevant stakeholders, anywhere, anytime and on any device.

In addition, Miros' flagship, the Wave & Current Radar, is a unique high-performance remote sensor for the measurement of directional wave spectra and surface currents. The Miros Wave & Current Radar calibrates automatically, eliminating the need for any reference equipment, and has a significant track record of operating in the most punishing conditions, all across the globe.

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# EQUINOR AIMING TO REDUCE NET CARBON INTENSITY BY 50% BY 2050



Equinor has launched a new climate roadmap aiming to ensure a competitive and resilient business model in the energy transition, fit for long term value creation and in line with the Paris Agreement.

Equinor aims to:

- reduce the net carbon intensity, from initial production to final consumption, of energy produced by at least 50% by 2050,
- grow renewable energy capacity tenfold by 2026, developing as a global offshore wind major, and
- strengthen its industry leading position on carbon efficient production, aiming to reach carbon neutral global operations by 2030.

"Today we are setting new short-, mid- and long-term ambitions to reduce our own greenhouse gas emissions and to shape our portfolio in line with the Paris Agreement. It is a good business strategy to ensure competitiveness and drive change towards a low carbon future, based on a strong commitment to value creation for our shareholders," says Eldar

Sætre, president and CEO of Equinor.

"We are now looking 30 years into the future, and it is not possible to predict an exact shape and pace of the transition. Not for society and not for us. But we know there will have to be significant changes in the energy markets, and our portfolio will change accordingly to remain competitive. We will produce less oil in a low carbon future, but value creation from oil and gas will still be high, and renewables give significant new opportunities to create attractive returns and growth," says Sætre.

"Equinor's strategic direction is clear. We are developing as a broad energy company, leveraging the strong synergies between oil, gas, renewables, CCUS and hydrogen. We will continue addressing our own emissions in line with the emitter pays principle. But, we can and will do much more. As part of the energy industry, we must be part of the solution to combat climate change and address decarbonization more broadly in line with changes in society," says Sætre.

The ambition to reduce net carbon

intensity by at least 50% by 2050 takes into account scope 1, 2 and 3 emissions, from initial production to final consumption. By 2050 each unit of energy produced will, on average, have less than half of the emissions compared to today. The ambition is expected to be met primarily through significant growth in renewables and changes in the scale and composition of the oil and gas portfolio. Operational efficiency, CCUS and hydrogen will also be important, and recognized offset mechanisms and natural sinks may be used as a supplement.

In 2026, Equinor expects a production capacity from renewable projects of 4 to 6 GW, Equinor share, mainly based on the current project portfolio. This is around 10 times higher than today's capacity, implying an annual average growth rate of more than 30%. Towards 2035, Equinor expects to increase installed renewables capacity further to 12 to 16 GW, dependent on availability of attractive project opportunities.

## WHITE HOUSE PROPOSES \$5M BOOST IN OFFSHORE RENEWABLE ENERGY EFFORTS

On February 11, 2020, the White House called for increase spending on efforts to manage the growth of offshore renewable energy development—including offshore wind energy—in the U.S. The government's proposed FY2021 budget includes a nearly \$5 million budget increase earmarked for offshore renewable energy in the Bureau of Ocean Energy Management (BOEM), a division of the Department of the Interior, to \$26.5 million over the current \$21.3 million. This increase could allow for greater development of offshore wind along U.S. coastlines and additional resources to maintain project reviews.

According to BOEM, this proposed FY2021 budget advances the White House's America-First Offshore Energy Strategy. It also includes \$60.5 million to advance oil and gas energy activities, approximately \$8.8 million for BOEM's Marine Minerals Program, and \$75.9 million for BOEM's Environmental Programs.

Liz Burdock, president of the Business Network for Offshore Wind, commented: "The White House's focus on offshore renewable energy as an economic development opportunity shows they

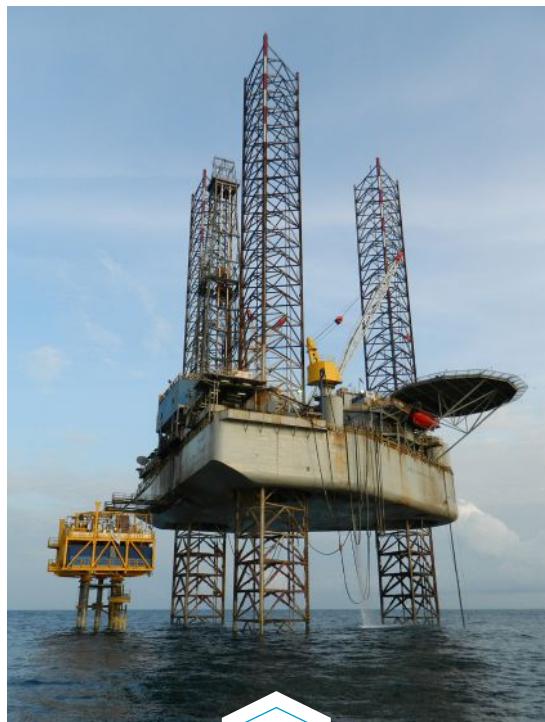


understand America's growing demand for offshore wind energy. As Americans increasingly support renewable energy to power their towns and cities, offshore wind is capable of not only meeting those needs but powering the world 18 times over. In the last decade, the Network has seen how this new growing industry has attracted a deep and diversified supply chain from every region in the country and we appreciate the incredible day to day efforts BOEM has invested in the future of energy in the U.S."

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## CHEVRON CHOOSES SEA SWIFT OFFSHORE PLATFORM FOR ANGOLA

Aquaterra Energy, a leader in global offshore engineering solutions, has secured a significant agreement from Chevron, through its wholly owned subsidiary in Angola, Cabinda Gulf Oil Company Limited (CABGOC), to design and support installation of a Sea Swift offshore platform solution off the coast of Angola.



Destined for the Lifua-A field, the conductor supported platform (CSP) will be designed and installed in 60m of water. Sea Swift was chosen for its modular design to minimize build and implementation time and for the ability to fabricate the platform locally in Cabinda, Angola. Aquaterra Energy will manage the entire project scope via its in-house engineering and project management teams and will employ both Angolan fabrication and installation support.

Stewart Maxwell, Technical Director at Aquaterra Energy said: "CSPs are sometimes misunderstood and can often be overlooked for more traditional jacketed platforms. However, CSPs like Sea Swift can be installed by jack-up, so that operators can take advantage of the infrastructure they have available in the field, without the need to mobilize other assets—saving valuable time and resources."

Sea Swift is a minimum-facility offshore platform for rapid returns in shallow waters. Using well conductors as the structural support for the topside, Sea Swift minimizes build and implementation times. The platforms offer a low-risk, low-cost route to reduced time to first oil and lower capital investment.

"This will be our fifth Sea Swift platform in West Africa and highlights the growing importance of flexible platform fabrication that can not only help local content rules but also reduce environmental impact via innovative installation options," adds Maxwell.

## UK LEADS THE OFFSHORE WIND FOUNDATION TREND

The global offshore wind projects that are set to start-up this year will make 2020 the year with the highest ever use of steel jacket foundations for new developments, a trend led by the UK and that is here to stay, a recent analysis by energy knowledge house Rystad Energy showed.

A total of 258 turbines to be installed this year will have a jacket foundation, the most ever in a single year and representing about 20% of all offshore turbines to be commissioned globally, our latest data show.

A British project, ScottishPower Renewables' East Anglia ONE, accounts for 102 turbines, all to be installed with jacket foundations. It is the sole European project that will start-up in 2020 and use this technology, yet the world's largest ever in number of turbines with such foundations.

The project's jackets are being manufactured by Navantia (42), Lamprell (36) and Harland & Wolff (24), and will be installed by Van Oord. Another British project, Moray East, will use 100 jacket foundations and is set to become operational in late 2021.

Jackets are foundations that use a lattice framework and which usually have three or four anchors set on the sea floor, making it safer to anchor a wind farm's towers. They are common for projects that are installed in waters deeper than 30 meters,

and the increase is an indication that European developers are increasingly pursuing such depths.

From 1990 to 2019, around 75% of all commissioned wind farms were in water depths of 30 meters or less. Rystad Energy expects only around 55%-60% of new wind farms to be commissioned in such shallow water in the 2020-2025 period.

"The higher share of jacket foundations follows the trend of offshore wind farms being placed in deeper waters in more mature regions. As shallow-water areas get more populated, countries that look to increase their offshore wind capacity must look to deeper waters," said Alexander Flotre, Rystad Energy's Vice President & Product Manager Offshore Wind.

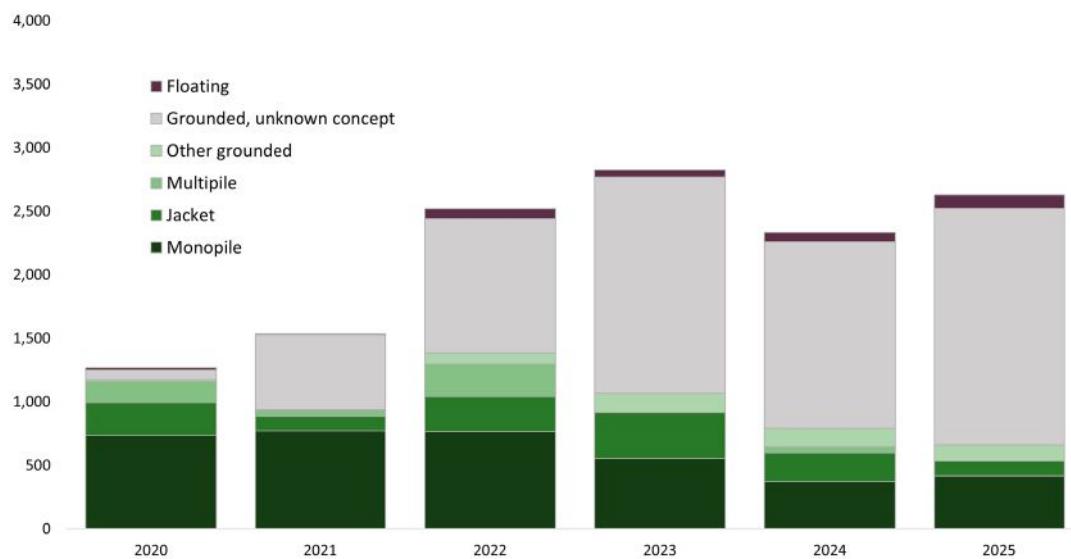
"Our data show that at least 479 more offshore turbines with jacket foundations are going to start-up in Europe between 2021 and 2025. Our global estimate for that period is of at least 1,083 jacketed turbines, including Europe, making it the second most popular ground-based foundation type after monopile."

"While the market for monopile manufacturing has been dominated by specialized players such as Sif Group and EEW, the jacket market is much more open to the general steel construction manufacturers whose business has historically centered on offshore oil and gas projects or other industries," Flotre added.

[WWW.RYSTADENERGY.COM](http://WWW.RYSTADENERGY.COM)

### Global amount of turbines to start-up yearly by foundation type

Number of turbines



Source: Rystad Energy research and analysis



# GLOBAL LNG MARKET SEES DEMAND BUILD FOR CLEANER-BURNING ENERGY

Global demand for liquefied natural gas (LNG) grew by 12.5% to 359 million tones in 2019, according to Shell's latest annual LNG Outlook published today—a significant increase that bolsters LNG's growing role in the transition to a lower-carbon energy system.

2019 saw key developments that are helping to reshape the industry:

- an industry record of 40 million tones of additional supply becoming available and being consumed by the market.

- the belief in long-term demand growth triggering record investment decisions in liquefaction capacity of 71 million tones.

- an increase in diversity of contractual structures, providing a wider range of options to LNG buyers.

- the growing role of gas in improving air quality through coal-to-gas switching in the power and industrial sectors, with coal generation phase-out announcements more than trebling.

Natural gas emits between 45 and 55% fewer greenhouse gas emissions and less than one-tenth of the air pollutants than coal when used to generate electricity.

"The global LNG market continued to evolve in 2019 with demand increasing for LNG and natural gas in power and non-power sectors," said Maarten Wetselaar, Integrated Gas and New Energies Director at Shell. "Record supply investments will meet people's growing need for the most flexible and cleanest-burning fossil fuel."

"While we see weak market conditions today due to record new supply coming in, two successive mild winters and the Coronavirus situation, we expect equilibrium to return, driven by a combination of continued demand

growth and reduction in new supply coming on-stream until the mid-2020s." Europe absorbed the majority of 2019 supply growth as competitively-priced LNG furthered coal-to-gas switching in the power sector and replaced declining domestic gas production and pipeline gas imports.

New spot-trading mechanisms and a wider variety of indices used for long-term contracts point towards LNG becoming an increasingly flexible commodity.

There was a modest rise in imports to Asia in 2019, compared to the previous two years, a result of mild weather and rising electricity generation from nuclear power in Japan and South Korea, two of the three largest global importers.

In China, LNG imports increased by 14% in 2019 as efforts continued to improve urban air quality. Also notable was LNG demand growth in South Asia. In total, Bangladesh, India and Pakistan imported 36 million tones, an increase of 19% over last year, pointing to emerging growth countries in Asia.

Over the longer-term, global LNG demand is expected to double to 700 million tones by 2040, according to forecasts, as gas plays a significant role in shaping a lower-carbon energy system. Asia is expected to remain the dominant region in the decades to come, with South and South-east Asia generating more than half of the increased demand.

View Shell's LNG Outlook 2020 at  
[WWW.SHELL.COM/LNGOUTLOOK](http://WWW.SHELL.COM/LNGOUTLOOK)

## HYPACK® LiDAR Payload

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The advertisement features a blue background with a white HYPACK logo at the bottom left. The logo consists of a stylized bird icon inside a circle, with the word "HYPACK" in bold capital letters and "a xylem brand" in smaller letters below it. To the right of the logo is a laptop screen showing a 3D point cloud visualization of a terrain. Above the laptop is a large, compact LiDAR payload unit mounted on a tripod-like stand, with a cable extending from its side. The overall theme is advanced surveying technology.

 [HYPACK.com](http://HYPACK.com)  
 [sales@hypack.com](mailto:sales@hypack.com)



## MALIN RENEWABLES MAKES WAVES WITH NEW £1M CONTRACT

Malin Renewables has secured a £1m contract to supply a fifty-tonne wave energy converter.

The company has been appointed by AWS Ocean Energy Ltd to build the half scale Archimedes Waveswing power generation device, designed for offshore wave energy production. The development of the Archimedes Waveswing is funded by Wave Energy Scotland through its Novel Wave Energy Converter program.

The Waveswing will be fabricated and assembled at Malin's Westway Park site in Renfrew. This latest wave energy award affirms Malin's place in the renewable market, having previously completed fabrication projects for offshore wind farm development and the design and build of an offshore microgrid buoy for a tidal energy project.

Ben Sharples, Director Malin Marine, said, "This particular project enables the team to utilize their expertise in hydraulics, electrical power, air systems, pressure vessels and mooring, delivering an integral piece of equipment for the wave energy sector."

Activity will commence immediately to create the first partial-scale converter, which will work to verify the concept to drive forward grid scale and micro grid scale variants. This developmental step is supported by a continued working relationship between AWS and the wider Malin Group, which is set to continue in the future through the development of the Scottish Marine Technology Park (SMTP).

The SMTP, the first of its kind in Europe, will be developed on the upper Clyde at Old Kilpatrick and will be a center of excellence for the marine industry, creating 1000 jobs. It will feature a large fabrication facility and a deep-water jetty with a 1,100 tonne ship hoist—the largest of its kind in Scotland—which will be required to support the commercialization of wave energy technology of this scale.

[WWW.MALINMARINEABERDEEN.COM](http://WWW.MALINMARINEABERDEEN.COM)

## ØRSTED AND EVERSOURCE SIGN MOU WITH THAYERMAHAN

Ørsted and Eversource have signed a memorandum of understanding with ThayerMahan, a Groton-based marine robotics and maritime surveillance company that will monitor wildlife and seabeds in connection with the Revolution Wind offshore wind project.

"When we started looking at growing the offshore wind industry in Connecticut, one of the most important factors was ensuring we are setting up in an area with some of the best innovators and most skilled workforce in the world," Thomas Brostrøm, chief executive officer of Ørsted U.S. Offshore Wind, said in a statement. "Offshore wind is part of the next generation of green energy and green technology, and we need partners who are the best in their industry. The people at ThayerMahan are remarkable inventors, and their technology will help us reduce any disruption offshore wind might have on North Atlantic marine life and the local fishing fleets."

"In addition to the hundreds of well-paying, local jobs that will be required to construct our Revolution Wind project, utilizing local partners like ThayerMahan will be critical to the overall success of our projects in Connecticut and beyond," said Mike Ausere, Eversource vice president of business development. "We look forward to working with ThayerMahan to bring our Revolution Wind project to life and advance Connecticut's clean energy economy and achieve its aggressive climate goals."

Revolution Wind is expected to be operational in 2023, delivering 304 megawatts of energy.

[WWW.THAYERMAHAN.COM](http://WWW.THAYERMAHAN.COM)



# VAN OORD AND SAARE WIND ENERGY TO DEVELOP ESTONIAN OFFSHORE WIND FARM



Van Oord and Saare Wind Energy have agreed to combine their forces and mutually develop the Saaremaa offshore wind farm, covering 154 square kilometers, south-west of the Estonian island Saaremaa.

## Development Estonian Offshore Wind

Saare Wind Energy started the development of the project in 2015 on basis of a thorough analysis and ample spatial planning experiences. The next phase in the development process includes the start of the Environmental Impact Assessment which will be initiated after receiving a positive decision from the Estonian authorities.

In addition to the construction of offshore wind farms, Van Oord has been involved in several early developments. The parties are convinced that their combined knowledge base will facilitate a successful development of the project. The discussions that lead to the agreement were supported by the Estonian Investment Agency, which demonstrates the commitment of the Estonian authorities.

## Saaremaa Site

The Saaremaa site offers an excellent opportunity for the construction of an offshore wind farm because of its location in the Baltic Sea in relation to the main wind direction. The offshore wind farm can act as a foothold for the development of an international Baltic Grid. The Saaremaa offshore wind farm is one of the parks under development in Estonia. Van Oord and Saare Wind Energy look forward to intensifying the cooperation with local and national Estonian stakeholders as this is a precondition for the upcoming permit process and the subsequent construction of the project.

 [WWW.VANOORD.COM](http://WWW.VANOORD.COM)

# SUBSEA CABLE PROTECTION SYSTEMS

PMI Industries Inc. offers standard termination and protection products for marine cable systems as well as custom adaptations based on customer needs to solve new challenges in offshore energy applications.

## CABLE PROTECTION



EVERFLEX



CABLE HANG-OFF



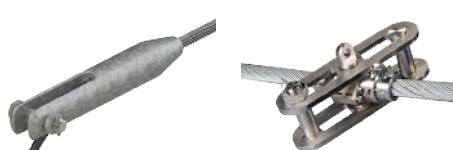
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## CABLE MANAGEMENT



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DYNA-HANGER II



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# SEATOOLS' UMBILICAL WINCH TO POWER VAN OORD'S NEW TRENCHER



On behalf of its client Van Oord, subsea technology company Seatoools completed the delivery of a CT umbilical winch. The winch will power Van Oord's new subsea trencher "Deep Dig It," which will be deployed during cable installation operations at an offshore wind farm later this year.

The plug-and-play umbilical winch stands out in its ability to transfer exceptionally large amounts of power and data: a total of 1800 kW of power at a voltage rating of 4100 VAC. To guarantee uninterrupted operations across a wide variety of environmental conditions, during the engineering phase much effort was invested in heat management. Moreover, the winch comes with a 20 feet container footprint and features integrated load measurement.

Charged with power and data transfer between the cable lay vessel and the subsea trencher, an umbilical winch plays

a crucial role in the availability of the subsea trenching spread as a whole. This inevitable single point of failure and the exceptionally high voltage and power needs beg industry-leading knowledge and capabilities in the development, realization, and test phases of this mission-critical CT winch.

Seatoools was found to be the most suitable partner for the successful execution of this project. Several decades of experience in the infrastructure of mission-critical subsea equipment alongside vast knowledge and field-proven competences in high-voltage electrical engineering, slip ring units, umbilicals, and control engineering—it all amounted to Van Oord's choice to award Seatoools with the contract.

During the engineering, realization, and test phases of the project, Van Oord and Seatoools closely collaborated—an expression of the high value that Seatoools

places on partnerships with its clients. Van Oord's strong involvement allowed for the incorporation of the company's specific domain knowledge and preferences. From it results the confidence that the end product will operate to the client's full satisfaction.



For more information, visit  
[WWW.SEATOOLS.COM/NEWS/  
CT-UMBILICAL-WINCH/](http://WWW.SEATOOLS.COM/NEWS/CT-UMBILICAL-WINCH/)

# KONGSBERG SELLING HYDROID, INC. TO HUNTINGTON INGALLS INDUSTRIES



Kongsberg Maritime AS has signed an agreement to sell its underwater technology company Hydroid, Inc. for USD 350 million to Huntington Ingalls Industries (HII), the largest supplier of vessels to the US Navy. The agreement provides that, as of closing, the parties will enter into a strategic alliance agreement concerning underwater technology and maritime solutions.

Kongsberg Maritime acquired Hydroid for USD 80 million in 2007 and is now selling this US subsidiary for USD 350 million on a debt-free and cash-free basis and as adjusted off an agreed upon working capital.

"Kongsberg Maritime has driven technology development and created considerable value during the 12 years it has owned Hydroid, and we are capitalizing on this now. We are proud to have positioned Hydroid as a leading supplier of small and medium-sized autonomous underwater vessels in the market. We now look forward to work together with HII on new, maritime solutions and, at the same time, strengthening our world-leading underwater environment in Horten," says Geir Håøy, President and CEO of the KONGSBERG Group.

Kongsberg Maritime delivers globally first-class products to customers, including sensor and sonar technology and hydro acoustics from Horten in Norway. According to the agreement, the parties will enter into a strategic alliance at closing. It will combine the two companies' complementary experience, expertise and technology. The aim of the agreement is to strengthen both parties' abilities to sell their products and solutions to both US and global customers in the underwater segments.

"Kongsberg Maritime will continue to aggressively develop technology, including that related to our underwater expertise. We are the global leader in civilian-sector maritime technology, while HII is the world's largest supplier of navy vessels. This alliance will allow a wider range of our maritime solutions for both naval and civilian usage in the United States and the rest of the world," says Egil Haugsdal, CEO of Kongsberg Maritime.

Hydroid, Inc. is a wholly-owned indirect subsidiary of Kongsberg Maritime AS and has its head office in Pocasset Massachusetts in the USA. Hydroid builds autonomous underwater vessels and sells them to military and commercial markets, with the US Navy as its biggest customer.

At the end of Q4 2019, Hydroid had an order backlog of MNOK 813. In 2019, Hydroid achieved revenue of MNOK 862 and an EBITDA of MNOK 133. Refer to the table below for key figures for the 2016-2019 period.

Profit and loss items (MNOK)*	2016	2017	2018	2019
Revenues	598	542	617	862
Operating profit before depreciation and amortization (EBITDA)	97	76	84	133
Earnings before interest and taxes (EBIT)	60	38	60	120

*\*Key figures are presented as reported in Kongsberg Gruppens consolidated financial statements.*

The transaction is expected to be completed in Q1 2020 and is subject to customary closing conditions, such as approval by the relevant authorities.

Upon repatriation, the net proceeds in Norway are expected to be about USD 248 million after tax. The final accounting gain will be known when the Q1 2020 results are presented on 10 May 2020.

KONGSBERG will announce how the proceeds are to be utilized on February 12, 2020, in connection with the presentation of its Q4 2019 results.

For more information, visit  
[WWW.HUNTINGONINGALLS.COM](http://WWW.HUNTINGONINGALLS.COM)  
[WWW.KONGSBERG.COM](http://WWW.KONGSBERG.COM)  
[WWW.HYDROID.COM](http://WWW.HYDROID.COM)

## CGG'S MOZAMBIQUE MULTI-CLIENT SURVEY DATA NOW AVAILABLE

CGG has announced the final 3D PSDM seismic dataset from its recent 15,400 sq km multi-client survey of the outer Zambezi Delta in the Mozambique Basin is now available for license. The ultramodern data was acquired over blocks Z5-C and Z5-D and surrounding open acreage as part of a multi-client program agreed between CGG and Mozambique's Instituto Nacional de Petroleo (INP).

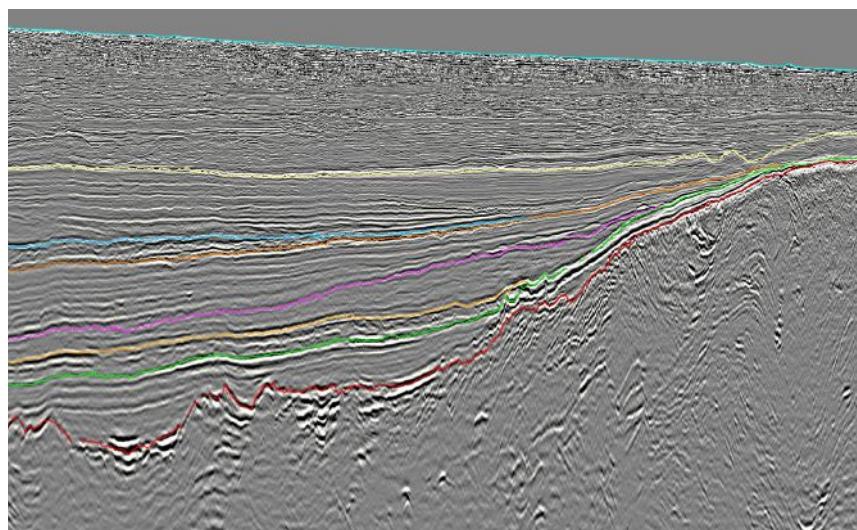
The final PSDM data identifies key stratigraphic intervals for a better understanding of the petroleum system and, in conjunction with the high-resolution gravity and magnetic data, brings new information on the basin morphology and its evolution. CGG's advanced imaging workflow, including full-waveform inversion (FWI), reveals a high level of detail in this complex geological setting, such as the complex deep marine turbiditic system and associated frontal splays, and the complex faulting pattern and internal architecture of the Beira High.

To enhance exploration decision-making, a complementary Mozambique JumpStart™ package is also now

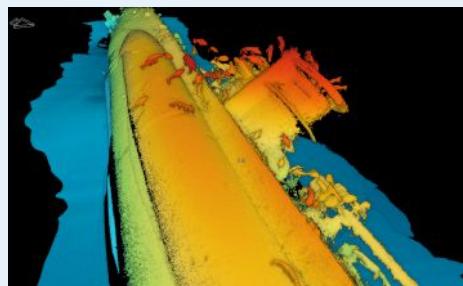
available to license with the PSDM seismic data. This package provides an integrated geoscience analysis of all the regional data available and frames it in its geological context in an easily accessible format. Data from 11 wells has been analyzed in detail alongside the new seismic interpretation which was supported by hydrocarbon seep identification, high-resolution potential fields data and the full suite of Robertson multi-client geological data sets.

Dechun Lin, Executive Vice President, Multi-Client, CGG, said: "These exceptional seismic images of the Zambezi Delta Basin and detailed JumpStart geoscience study of the region's geological context add to our extensive, high-quality African multi-client data library and will give the industry enhanced insight into this highly prospective region to accelerate and better inform their decision-making."

For more information, visit  
[WWW.CGG.COM](http://WWW.CGG.COM)



» 3D seismic interpretation of eight key horizons of the Zambezi Delta (image courtesy of CGG Multi-Client).



## SONARDYNE ACQUIRES 2G ROBOTICS

Leading marine technology provider Sonardyne International Ltd. has acquired underwater imaging and inspection specialist 2G Robotics Inc.

2G Robotics will join the Sonardyne group of companies, while remaining an independent business and brand, continuing to serve its customer base in unmanned and autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs). 2G Robotics' founder Jason Gillham will continue to lead the company as Chief Executive Officer.

The acquisition of 2G Robotics is the latest step in Sonardyne's long-term growth strategy and follows the acquisition of Danish survey software company EIVA last year.

John Ramsden, Sonardyne's managing director, says, "2G Robotics has a dedicated research team and well-developed product and service lines, with scope for growth. As an independent company, their offering is complementary to the growing range of products and services our wider group of companies provides to the marine sector."

Jason Gillham adds, "Sonardyne is a great fit for us, with their existing global reach. We look forward to growing with their support and working with our new partners."

2G Robotics is based in Ontario, Canada. The company was founded in 2007, and will continue to operate from its current location. The terms of the acquisition, which was for the business and assets of 2G Robotics Inc., were not disclosed.

For more information, visit  
[WWW.SONARDYNE.COM](http://WWW.SONARDYNE.COM)  
[WWW.2GROBOTICS.COM](http://WWW.2GROBOTICS.COM)



## UK UNDERWATER ENGINEERING INDUSTRY TO CREATE 9,000 JOBS BY 2022

The UK's underwater engineering industry is set to recruit 8,928 people in the next three years, according to the findings of a new report.

The industry's body, Subsea UK, unveiled the results of its Business Activity Review for the fiscal year 2018/19 in advance of Subsea Expo in Aberdeen, UK in February.

The total value of UK subsea output has increased to almost £7.8billion from £7.5billion in 2017. This represents around 37% of a global market, estimated to be worth around £21billion annually. While employment figures remain fairly static, rising from 45,033 in 2017 to 45,163, the forecasts for recruitment in the next 12 – 36 months are more promising. Almost 80% of companies anticipate ramping up recruitment, with forecasts suggesting employment in the industry could rise to over 54,000 by 2022. The majority of these jobs will be in North-east Scotland, where 63% of the industry is based. However, the North-east of England, where the subsea industry is worth around £1.5billion and supports 15,000 jobs, will also see a considerable increase in recruitment.

From 2003, when the first Subsea UK Business Activity Review was conducted, the industry grew year on year, reaching a peak output of just under £9billion in 2013 which supported 53,000 jobs. The sharp decline, reported in 2017, was a direct result of the collapse in oil price which led to the deferral or cancellation of major projects around the world by oil and gas exploration and production companies.

Neil Gordon, chief executive of Subsea UK, said, "The last five years have taken their toll on those subsea companies predominantly operating in oil and gas. But the findings in this business activity review reveal that the UK subsea industry has weathered the storm. The decline has been arrested with a clear upturn in activity,

largely due to an increase in output from subsea SMEs and more activity in renewables, particularly offshore wind. The growth projections provided by both the Tier 1 companies and SMEs reveal much greater optimism, due to both the recovery in oil and gas and the opportunities presented by the energy transition."

Total revenues from renewables have risen by over half a billion from £1.3billion in 2017 to £1.8billion. Around 80% of large subsea companies are predicting growth in their revenues from the renewable energy sector, with a fifth predicting to grow their revenues from renewables by 20% or more. Almost 70% of SMEs expect to grow their revenues in renewables with over a fifth anticipating growth in this sector or more than 20%.

Exports account for around 43% of the total 2019 output. This is down on the 55% reported in 2017. 80% of the large subsea companies are predicting growth in export revenues in the next three years, with a third expecting exports to grow by more than 20%. Meanwhile, 70% of subsea SMEs are forecasting growth in exports with 31% expecting to increase their export sales by more than 20%.

Download the Full Subsea Business Activity Review at  
[WWW.SUBSAUK.COM](http://WWW.SUBSAUK.COM)

An advertisement for Digital Edge Subsea featuring their EdgeDVR products. It shows a monitor displaying the 'DIGITAL VIDEO RECORDING &amp; INSPECTION SYSTEMS' interface, a 4U rack-mounted unit, and a laptop. The text highlights 'EDGEDVR IS MOBILE' and 'The EdgeDVR Laptop - an Industry First'. It lists applications: Diving, Workclass &amp; Inspection ROV, Platform &amp; Pipeline Inspections, and Construction &amp; Decommissioning. The bottom of the ad features the 'DIGITAL EDGE SUBSEA' logo and the website 'www.digitaledgesubsea.com'. There are also icons for EdgeDVR Lite, EdgeDVR, and EdgeDVR Pro.

**UXOcontrol**

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## UXOCONTROL UNVEILS INDUSTRY FIRST SOLUTION FOR RISK MITIGATION

N-Sea and BODAC, two of the subsea sector's most experienced subsea survey and UXO disposal companies, have announced the new identity of their existing joint venture (JV). Following a multi-million-euro investment in its specialist UXO provision, the JV will now trade as UXOcontrol, reflecting its unique, market-leading UXO risk mitigation solutions.



» Members of the UXOcontrol team.

Since its inception in 2016, it has built an enviable track record in Europe in UXO survey, identification and disposal, complemented by three years of SHEQ incident-free operations. UXOcontrol will continue to offer the global energy sector UXO risk solutions supported by expertise, assets and specialists from both N-Sea and BODAC. UXOcontrol is the only specialist contractor offering complete solutions from Desktop Studies and Survey to Identification and Disposal—and ultimately the ALARP certificate.

Building on its year-on-year commercial growth and increasing demand for specialised UXO risk mitigation solutions, UXOcontrol will strengthen its team with additional personnel and assets, operating from offices in the

UK (Scotland and East Anglia), The Netherlands, Poland, Germany and France.

UXOcontrol combines the expertise and experience of its two parent companies. N-Sea, a leading survey and IMR subsea solutions provider delivers effective and cost-efficient subsea support services to asset operators and tier 1 contractors within energy industry, whilst BODAC, a leading UXO risk mitigation company is certified in UXO surveying, identification and neutralising explosives in the marine environment.

For more information, visit

[WWW.N-SEA.COM](http://WWW.N-SEA.COM)

[WWW.BODAC.EU](http://WWW.BODAC.EU)

# TRENDSETTER ENGINEERING EXPAND SYSTEMS INVENTORY

As part of their continued focus on Subsea Well Intervention, Trendsetter announces that they have expanded their systems inventory in response to market demand to include a second Subsea Tree Injection Manifold (STIM).

The STIM-II has completed all testing and is now ready for deployment for subsea hydraulic intervention operations. With a pressure rating of 15,000psi, flow rates in excess of 12bpm and a water depth rating of 10,000 ft., the STIM systems are the premier solution for live well acid stimulation and abandonment as well as hydrate and flowline remediation operations.

"The addition of STIM-II to our fleet will allow us to respond to the aggressive timelines required by Operators to maintain well productivity and add value to their bottom line," said Mike Cargol, Vice President of Rentals & Services for Trendsetter Engineering. "Our teams' focus on reliable and simplistic designs has been the key to Trendsetter's intervention success with STIM and we will be building upon this success in 2020 with the impending introduction of our revolutionary new TRIDENT™ modular intervention systems."

[WWW.TRENDSETTERENGINEERING.COM](http://WWW.TRENDSETTERENGINEERING.COM)



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# OFFSHORE WIND POWER CABLES: GETTING IT RIGHT FROM THE START

By Ed Freeman, ON&T Features Writer



The winds of change have finally provided momentum for offshore renewables in the US, and 2020 promises to be a pivotal year for the offshore wind sector on the back of a burst of state procurement pledges in 2019. According to a whitepaper published in March 2019 by the Special Initiative on Offshore Wind (SIOW), offshore wind in the US is set to become a \$70 billion industry over the next ten years. With so much at stake, the immediate task is to action the key components required to build out the US's offshore energy capacity—in short, we need a domestic supply chain.

## **Out Of Sight, Not Mind**

Besides wind, there are a few other essential elements required to build a wind farm. At a minimum, you will need: 1. Offshore foundations for turbines and substations; 2. Wind turbines and towers; 3. Onshore/offshore substations;

4. Specialist support services, such as environmental consultancy, insurance and risk mitigation, and experienced project management. But even with this show of engineering might and expertise, your nacelles will be rendered useless without the right conduit: the subsea power cable.

Submarine transmission cables are often overshadowed by towering machinery, but this is set to change. Cables are now, quite rightly, being touted as the critical connection, which was the very theme of a first-of-its-kind cable conference organized by the Business Network for Off-shore Wind and SubCableWorld.com in Houston, TX, designed to highlight cable supply chain concerns in the US. And there are many, especially given the US's current manufacturing capacity: zero. (It should be noted, however, that two local cable plants are being modified to trigger domestic production.) The event

was far from your standard "show and tell" industry meet, this was a highly motivated network of decision-makers from cable manufacturers, wind farm developers, oil and gas majors, and ocean tech manufacturers, hellbent on defining how US-made subsea power cables will be the vital link to getting reaching 40GW by 2040.

The scale of the opportunity for the cable industry is mind-boggling. Equally overwhelming, the task of trying to quantify the likely demand over the coming decade. However, a recent white-paper published by SubCableWorld.com editor John Manock, outlines three possible scenarios, the most aggressive of which suggests that procurement pledges will require nearly 14,000 km of new cable by 2030. Suffice to say, this is a multi-billion-dollar prospect, and we need to get this right from the start.

## Mitigating The Risks

The risks associated with wind farm development are many, from the development phase (e.g. permitting delays, budgetary constraints, design issues) through to construction phase (e.g. scope gaps, adverse weather, political risks) and finally the operational phase (high O&M costs, lower power prices, equipment failure). However, according to the Lloyd Warwick International Claims Database (2002-2019), cable issues account for 83% of insurance claims. For further context, 57 of the last 60 offshore wind farm construction projects filed cable related claims, with the average carrying a cost of \$2.5 million.

Other variables of cable laying and maintenance, such as exorbitant vessel costs, create additional pressures and can jeopardize quality in the name of false efficiency; narrowing deadlines lead to shortcuts and misguided management decisions prioritize short-term results. Getting it right from the start means planning must accommodate for time buffers and contingencies, which puts increased emphasis on skilled project management, not just contractors. The right mindset is one that budgets a higher CAPEX in favor of a lower OPEX.

But identifying risks—and the root causes of outages—is only half the story; evaluating how the industry responds to them may prove equally beneficial. And perhaps there is something to be learned from the subsea fiber sector here with respect to industry cooperation. Fiber optic cable systems tend to operate under Cable Maintenance Agreements (CMAs), which include provisions for emergency and nonemergency repairs by geographical zone, as well as scheduled maintenance. Thus, the industry accepts that cable failure is a problem and cooperation is the solution. From the offset, the offshore wind cable industry needs to consider collective solutions to safeguard against the likely challenges that expansion will pose.

## Fit-For-Purpose Cable Design & Installation

Parallels with the fiber optic market only go so far, however; subsea power cables are distinct. While fiber optic cables are typically 2.5 mm in diameter, power cables

can vary substantially in diameter (70-210 mm typically) and come in AC (Alternating Current) and DC (Direct Current). Interturbine cables, also known as array cables, are usually installed in single lengths from the base of one turbine to another through a J-tube, forming a collection circuit that then feeds into a substation. Export cables are of similar design but are naturally rated for higher voltage. The specific cable selection criteria vary with each development, depending on route length, voltage, transmission capacity and grid format. In other words, there is no one-size-fits-all design.

With so many variables to consider and mounting concerns about the long-term reliability of subsea power cables, innovation continues to challenge material selection, manufacturing process, load management, installation methods, and ultimately the cost of goods sold. More than ever, wind farm developers recognize that cable design needs to be a front-end consideration in any project scope. This shift bodes well for OEMs as long-term collaborators: they need to be involved as early as possible, and no longer seen as a procurement and execution solution. This fit-for-purpose approach to cable design will become even more critical as the industry expands and ventures further offshore to capitalize on the ever abundant wind resources.

The same can be said for installation, which incorporates more than cable laying; it is planning (engineering and risk management), routing (seabed mapping and route design), onshore (cable pulling and grid connections), installation (laying, shore landing), protection (trenching, burial). Advances in ocean technology have synchronized the traditional three-step trench-lay-bury method and made way for ROVs, like Oceaneering's high-speed Work Class Isurus, to become the go-to tools for precision installation, while DP3 vessels have redefined what's possible in terms of dynamic positioning, especially in harsher environments. This ability to operate effectively in deeper waters strengthens the viability of floating turbines and extensive development along the Pacific coast and the islands of Hawaii.

Other advances in cable design and installation show how higher voltage inter-array cables allow wind farms to connect directly to the shore without the support

of an offshore substation, as is the case of the 2018 Blyth wind farm, in the UK. This, along with the tendency for less factory joints—exemplified by Hengtong High Voltage's 2018 record for the longest length of 500kV AC XLPE at 11.5 miles—has enormous implications for wind farm planning and configuration.

## 46,000 Jobs By 2030

Most talk of supply chain management tends to focus on tangible assets, but the creation of a qualified US workforce is a headline concern. Cable laying vessels are not restricted by the Jones Act, a federal decree that goods shipped between US ports may only be transported by ships built, owned and operated by US citizens or permanent residents. In other words, wind farm projects are not legally bound to a local pool of labor. Just as we could import a foreign supply chain, we could draft in foreign nationals with offshore wind experience. But this industry's underlying ambition is not to satisfy procurement pledges, but rather create a self-sufficient marketplace.

Put simply, the industry cannot cannibalize itself by relying on overseas competition. According to the US Department of Energy, offshore wind in the US will create up to 46,000 jobs by 2030 so the time for a grassroots campaign to invest in fresh talent is now. To that end, there is a growing number of US college degree courses and skills-based academies working to groom the next generation of offshore wind professionals.

The relationship between industry and academia will grow progressively important too, helped by bodies like the Business Network for Offshore Wind, which has just launched *CareerMatch*, its first national offshore wind job fair as part of the organization's 2020 International Partnering Forum (IPF) on April 21 in Providence, Rhode Island.

Given the recent ground swell of positive publicity and industry cooperation surrounding off-shore wind in the US, perhaps "getting it right from the start" is outdated: we have assessed how to build a robust supply chain, now we just need to make it happen.

## BIRNS INTRODUCES BREAKTHROUGH NEW SUBSEA CABLE ASSEMBLY

The BIRNS team has recently developed an exclusive deep submergence cable constructed for Cat 8.2 use, and deep submergence cable assemblies with data transfer rates of 9.4+/- 0.1 Gigabits per second. Performance testing proved that data consistently transmitted at this rate over the entire range of pressures from 0 to 8700 PSI/600 bar (6000m equivalent depth). The initial pin configuration in the 6km-rated BIRNS Millennium™ connector series tested for the capability is the BIRNS 3M-16, a configuration with twelve 22-AWG data contacts and four 16 AWG contacts for power. Additional high data-rate configurations in the series are expected to be introduced soon, using the exclusive BIRNS 52A-278 cable.

The team at BIRNS developed the revolutionary new ultrahighspeed cable assembly capability in answer to industry demands for true Gigabit data transfer for advanced subsea vehicles. "We were recently asked by a customer if it was possible to develop a system with transfer rates up to 10Gb/s,"



said Eric Birns, President and CEO of BIRNS. "After exhaustive testing, we believe our new cable assembly technology actually exceeds that rate—however, existing computer technology limits accurately testing anything above 9.4Gb/s. We are thrilled to be leading the industry with these new proven data transfer speeds, and look forward to expanding upon it."

For more information, visit  
[WWW.BIRNS.COM](http://WWW.BIRNS.COM)

## FIRST SUBSEA PROVIDE CABLE PROTECTION SYSTEMS FOR NNG

First Subsea, part of the First Tech Group, has been awarded a major contract by DEME Offshore for the Cable Protection System for the inter-array cables at the Neart na Gaoithe offshore wind farm. The windfarm has been developed by EDF Renewables and Irish electricity company ESB, which now has a 50% stake in the project.

Neart na Gaoithe will consist of 54 turbines and will be located in the North Sea approximately 15km off the coast of Fife in south-east Scotland. When fully operational, the NnG offshore wind farm will generate 450 MW the equivalent electricity to power over 375,000 households each year, which corresponds to 4% of Scotland's electricity consumption.

The cable protection system will be designed to protect the cable during installation and during the operating lifespan of the windfarm, significantly reducing cable fatigue at the point of entry into the wind turbine offshore structures. Engineering is in progress and offshore construction is due to start in June 2020, with full commissioning in 2023.

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# in-depth

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# DOWN TO THE SEA IN USVs

By Norman Polmar and Scott C. Turner, via CIMSEC



» Rear Adm. Robert Girrier, director, Unmanned Warfare Systems, offers remarks during a christening ceremony for Anti-Submarine Warfare Continuous Trail Unmanned Vessel (ACTUV) Sea Hunter, an entirely new class of unmanned ocean-going vessel during a ceremony held in Portland, Oregon. The Defense Advanced Research Projects Agency (DARPA) in conjunction with the Office of Naval Research (ONR) is working to fully test the capabilities of the vessel which is able to travel thousands of miles over the open seas for months at a time without a crew, and with a high degree of autonomy in operation. Photo credit: Lt. Amber Lynn Daniel, U.S. Navy.

"How often can you be at the christening of a robot warship?" Deputy Secretary of Defense Robert Work asked the crowd at the baptism of the Navy's *Sea Hunter* unmanned surface warship in April 2016.

"...You're going to look back at this day just like... when the *USS Nautilus* was christened, or when the *USS Enterprise* was commissioned," he said. "And you are going to look back on this and say, 'I was part of history.'

Also part of that history, President Trump and the Navy Department are in tenuous agreement that the U.S. Navy requires 355 manned and unmanned ships, a significant increase from the current force of some 290 ships. This requirement is in part based on great power competition with China and Russia, which involves a growing renaissance in naval and maritime activities. Further, the world situation continues to witness crises, terrorism, and civil wars raging across

Africa, the Middle East, and Asia. Yet even in "peacetime" naval ships are invaluable to represent U.S. political and economic interests in many areas of the world. Considering this global political-military environment, innovative concepts are essential to sustaining U.S. sea power.

A family of large, medium, and small USVs will take advantage of new technologies—some only dimly perceived in early 2020—to provide increased capabilities to the Fleet with reduced construction, maintenance, and manpower. Getting there from today's fiscal environment is critically important, and there is still much work to do to increase trust and develop CONOPs, but the potential for these unmanned vehicles to transform the future Navy is astounding.

"But I got to tell you," Vice Adm. Richard Brown, commander of Naval Surface Forces and Naval Surface Force Pacific, warned the Surface Navy Association, "the security environment isn't

getting any more secure, it's getting less secure, and it's a maritime security environment hands down. And when the United States Navy's not there, it creates a sucking vacuum and people fill it in. And it's usually not good people."

Significantly, in December 2019, during deliberations on the president's budget, the Navy proposed a 287-ship force by fiscal year 2025. "But that level," Bloomberg News explained, "which includes the decommissioning of 12 warships to save money, would be well below the long-term 308-ship target set by the Obama administration and even farther from President Trump's goal of 355 ships."

The Office of Management and Budget (OMB) has directed the Navy and the Department of Defense to review force level goals, and reiterated the need for a "resource-informed plan to achieve a 355-ship combined fleet, including manned and unmanned ships, by 2030." Acting Navy Secretary Thomas Modly issued a December 6, 2019 memo to his staff that was "in sync" with the White House/OMB directive. He called for a plan to achieve a fleet of 355 or more ships "for greater global naval power within ten years" that includes robust levels of unmanned systems.

U.S. shipyards could deliver the additional ships, even taking into account the accelerated retirement of outdated ships, but it would not be easy. Several yards are short of skilled workers, contributing to increasing ship construction and maintenance times. There are other constraints listed by Bloomberg: "Looming over the push to accelerate

shipbuilding is an inconvenient truth outlined on December 4 by the Government Accountability Office: "The Navy continues to face persistent and substantial maintenance delays that hinder its ability to stay ready for operations and training. Since fiscal year 2014, Navy ships have spent over 33,700 more days in maintenance than expected."

Another problem with a larger fleet is the requirement for even more personnel: The Navy currently is short some 7,000 sailors. More ships will demand more sailors, a problem in the current, highly favorable U.S. economy.

"I think the number we identified matches the ownership costs that we identified," said Rear Adm. Brian Luther, deputy assistant secretary of the Navy for budget, during congressional testimony. "So we grow in lead of some of the equipment because we have to train people ahead of when the ship arrives. It was a disciplined approach to ensure we didn't procure a ship without people, [and] we didn't procure a ship without armament. So, it's a very balanced and disciplined approach."

A practical and near-term Surface Force solution is unmanned surface vessels (USVs). Successful testing of the DARPA and Office of Naval Research prototype *Sea Hunter* underscores the feasibility of USVs. During her evaluation, the 132-foot-long trimaran *Sea Hunter* sailed—unmanned—from San Diego to Pearl Harbor, and back, and conducted a variety of demonstrations, showcasing the ability to host a variety of mission payloads. While important lessons were learned,



» Dr. Arati Prabhakar, director, Defense Advanced Research Projects Agency (DARPA), breaks a bottle over the bow of *Sea Hunter* during a christening ceremony for an entirely new class of unmanned ocean-going vessel during a ceremony held in Portland, Oregon. Prabhakar was joined by, from left, The Honorable Robert O. Work, deputy secretary of defense, Rear Adm. Robert Girrier, director, unmanned warfare systems, Rear Adm. Mat Winter, chief of naval research, Scott Littlefield, Anti-Submarine Warfare Continuous Trail Unmanned Vessel (ACTUV) program manager, DARPA, and Roger Krone, chairman and chief executive officer, Leidos. Photo credit: John F. Williams, U.S. Navy.



» Combatant Craft Division, a detachment of Naval Surface Warfare Center, Carderock Division, demonstrates the Unmanned Surface Vehicle Lab Afloat on July 17, 2019, during the Advanced Naval Technology Exercise (ANTX) East in Camp Lejeune, N.C. The USV Lab Afloat is a key component to the USV Autonomy Lab and Integration Center, and while at ANTX East, the boat docked itself autonomously. Photo credit: Kelley Stirling, U.S. Navy.

there were no significant problems during her 5,000-mile voyage. The Sea Hunter has since transitioned to the Navy's Surface Development Squadron ONE (SURFDEVRON-1), and the Navy is testing two other USVs as part of the Pentagon-sponsored Ghost Fleet program.

"Because it is big and it has a lot of payload capacity, and because it also has a lot of range and endurance, it can potentially carry out a range of different missions," Scott Littlefield, former DARPA program manager in the tactical technology office, predicted in 2016.

Follow-on USVs are now being developed and procured by the Naval Sea Systems Command to provide increased capabilities at reduced costs. The Navy is shaping multiple competitions for successors—a "family" of small, medium, and large USVs—that look to operationalize how a more advanced USV could be employed for a broad spectrum of missions and tasks. In December, the U.S. Fleet Forces Command (FFC) issued a notice asking the service's surface force to develop a concept of operations (CONOPS) for the large and medium USVs in development.

"The MUSV will initially focus on intelligence, surveillance and reconnaissance (ISR) payloads and electronic warfare (EW) systems, while the LUSV will focus on surface warfare (SUW) and strike missions," the FFC explained. "The fundamental capabilities of these platforms may necessitate changes in how Carrier Strike Groups, Expeditionary Strike Groups and Surface Action Groups conduct operations. The CONOPS will describe the capabilities at initial operating capability (IOC), the organization, manning, training, equipping, sustaining, and

the introduction and operational integration of the Medium Unmanned Surface Vehicle and Large Unmanned Surface Vessel with individual afloat units as well as with Carrier Strike Groups, Expeditionary Strike Groups, and Surface Action Groups."

"Knowing what's going on out there is extremely important," Admiral James Foggo, the commander of U.S. Naval Forces Europe and Africa and NATO's Allied Joint Force Command Naples, remarked in December. "So, for unmanned systems, [intelligence, surveillance and reconnaissance] is probably one of our limitations and we could use more of it. Indications and warnings are important. If you could put an unmanned system up, then there's less of a risk, less of a threat."

Speaking at the U.S. Naval Institute's defense forum in December 2019, the new Chief of Naval Operations Admiral Michael Gilday said that unmanned systems will be part of the Navy's Integrated Force Structure Assessment expected in early 2020. "I know the future force has to include a mix of unmanned systems. We can't wrap \$2 billion platforms around missiles."

There has been programmatic success that looks to invigorate the USV family. According to *Defense News*, the Navy will get two large unmanned surface vessels (LUSVs) in 2020.<sup>14</sup> The 2020 Defense appropriations bill funds the two LUSVs that the Navy requested, but prohibits funding for integrating/testing of vertical launch systems on those vessels, which is the heart of the LUSV mission. Congress also directed the service to prepare a comprehensive unmanned surface vessel plan before it charges ahead.

In that context, the White House and OMB told the Navy to develop a proposal for counting at least some of its unmanned surface vessels and underwater vehicles among its "Battle Force," the portion of its fleet that has historically included larger, manned warships, such as aircraft carriers and destroyers, and support ships, according to *The Drive*.

"This would be a major shift that would create a more realistic path for the service to meeting the ambitious congressionally mandated goal of a 355-ship Battle Force fleet and would help solidify the already growing importance of unmanned platforms in its future concepts of operation."

The U.S. Navy is on the threshold of a new era in maritime-naval operations.

"I think it's well within the possibility that we'll fight fleet on fleet with unmanned surface vessels deep into that fight," Vice Adm. Brown predicted, "calling it a fundamental change to how the fleet fights akin to the introduction of carrier-based aviation to a battleship-centric fleet ahead of World War II."

"In the United States Air Force, there are airplanes and drones," Deputy Defense Secretary Bob Work remarked. "The Navy cannot make that mistake. There have to be warships. And it doesn't matter whether they are manned or unmanned. They will take the fight to the enemy."

References for this story are available on the CIMSEC website at <http://cimsec.org/down-to-the-sea-in-usvs/42953>.

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## PHOENIX WINS MAJOR DIVING CONTRACT FROM US NAVY

Phoenix International Holdings Inc. (Phoenix) has been awarded a \$97 Million (maximum value) contract to provide diving and diving related services to the United States Navy. The primary purpose of this contract is to deliver operational, engineering and technical support to the Navy's air, mixed gas and saturation diving services program overseen by the Naval Sea Systems Command's Office of Director of Ocean Engineering, Supervisor of Salvage and Diving (SUPSALV).

Work will be performed worldwide based on each individual task orders.

Commenting on the award, Phoenix President Patrick Keenan stated, "Phoenix has a long history of providing diving related services to the U.S. Navy and we are honored by SUPSALV's selection of our company to continue performing this critical mission."

The Naval Sea Systems Command, Washington, District of Columbia, is the contracting activity.

For more information, visit  
[WWW.PHNX-INTERNATIONAL.COM](http://WWW.PHNX-INTERNATIONAL.COM)



» An Expeditionary Warfare Unmanned Surface Vessel (USV) autonomously navigates a predetermined course through the water during Advanced Naval Technology Exercise 2019 at Camp Lejeune, N.C. July 12, 2019. ANTX East 2019 is an event designed to test new technology with academic, industry and Navy participants. Photo credit: LCpl. Nicholas Guevara, U.S. Marine Corps.

# DAMEN TO SUPERVISE OVER 100 COMPANIES CONTRIBUTING TO COMBAT SUPPORT SHIP



With the contract signing for construction for the new supply ship HNLMS *Den Helder*, more than a hundred, mainly Dutch companies receive work. The contract was signed in Den Helder by the Director of the Netherlands Defence Material Organization (DMO), Vice Admiral Arie Jan de Waard and Arnout Damen, the new CEO of the family business Damen Shipyards Group.

Damen Schelde Naval Shipbuilding (DSNS) will supervise the project, together with DMO, as the main contractor. Damen will not do this alone; more than a hundred companies from the Dutch naval construction sector are involved in this ship. This means that a large part of the sector will be deployed to participate in this innovative new ship.

With HNLMS *Den Helder*, the maritime supply capacity of the Royal Netherlands Navy will be restored. The ship will operate alongside the Joint Support Ship HNLMS *Karel Doorman*. This vessel also forms the basis for the design of this Combat Support Ship. The new ship can be used worldwide and can operate under high threat, protected by frigates. In addition, she can be used in the fight against drug

trafficking, controlling refugee flows and providing emergency aid.

The supply ship, which is almost 200 meters long, will receive a 75-person crew and can also take 75 extra people on board. There is room for several helicopters and around 20 containers. The design explicitly looked at fuel consumption and exhaust emissions. The combination of diesel engines, hull shape, and propeller design reduces fuel consumption by around 6% compared to HNLMS *Karel Doorman*.

The building contract is not contracted out elsewhere in Europe. DMO wishes to keep the knowledge and skills of designing and building naval ships in the Netherlands. The armed forces thus invoked Article 346 of the Treaty on the Functioning of the European Union. It states that Member States may protect essential security interests. This also relates to the production of defense equipment. Completion is scheduled for the second quarter of 2024. A year later, in the second quarter of 2025, the Combat Support Ship must be operable. The size of the total project budget is 375 million euros.

## **Virtual Reality (VR) for Royal Netherlands Navy**

In related news, students from the Royal Netherlands Navy can now make virtual acquaintance with naval ships via a Virtual Reality (VR) program that Damen Schelde Naval Shipbuilding (DSNS), Thales Nederland and the maritime innovation cluster Extended Reality developed for them. The program was commissioned by the Royal Dutch Navy in mid-February.

The program allows students of the Royal Navy Technical Training to learn the functional design of the ship and the location of the systems on board. With this, the Royal Netherlands Navy tries to fascinate and attract talented personnel to the defense sector. The program was developed in close collaboration with the maritime innovation cluster Extended Reality. This cluster is largely run by naval personnel from the Simulation Center Maritime (SimCenMar). Here experiments are performed with all kinds of possibilities of extended reality.

# HYDROID DELIVERS REMUS 300 UUV TO US NAVY

Hydroid, Inc., a subsidiary of Kongsberg Maritime and a leading manufacturer of marine robotic systems, have delivered the first REMUS 300 Unmanned Underwater Vehicle (UUV) prototype to the U.S. Navy through the Defense Innovation Unit (DIU). The Naval Information Warfare Center (NIWC) has accepted and is characterizing the REMUS 300. This new, modular UUV will be assessed over the next year as a potential solution for the Next Generation Small-Class UUV (SUV) program for the Navy.

As part of the Prototype Project Agreement with DIU, Hydroid is working with the Navy on spiral upgrades to the commercial REMUS 300 to increase capabilities. REMUS 300 conforms to the Navy's Modular Open Systems Architecture (MOSA) and Unmanned Maritime Autonomy Architecture (UMAA) standards. This small-class UUV will provide increased modularity, allowing for rapid integration of new modules and software and decreasing risk with development, schedule and costs.

Duane Fotheringham, President of Hydroid, said. "The modularity and open architecture will make future developments easier than ever to integrate, ensuring REMUS will continue to be one of the most advanced UUVs on the market."

The REMUS 300 maintains the 7.5-inch diameter of the REMUS 100, increases the depth rating to 305 meters, and remains two-man portable. Built around the REMUS Technology Platform, the design also allows for reconfigurable payloads, sensors and energy modules to meet mission requirements. It was developed as a commercial product to complement the REMUS Family of Systems. It will be available for order commercially by the second quarter of 2020.



For more information, visit  
[WWW.HYDROID.COM/REMUS300](http://WWW.HYDROID.COM/REMUS300)

A composite image. The left portion shows two workers in hard hats and life jackets standing on the deck of a boat, looking out at the ocean under a sunset sky. The right portion shows a large, multi-tiered offshore oil or gas platform structure illuminated from within, standing in the ocean at sunset.

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# CRUDE & NATURAL GAS Spot Prices

PRICES IN US DOLLARS AS OF FEBRUARY 7, 2020

Oil prices fell significantly in the past month. After a two-month period of relative stability, prices dropped from just over \$58 per barrel mark in mid-January to just above \$50 a month later. CNBC and numerous other news organizations report that the dramatic drop is due to concerns over the Coronavirus's impact on China's economy. China is the world's second-largest consumer of oil, according to the International Energy Agency, and CNN reports that fears of the virus' impact on the already-slumping Chinese economy drove prices downward.



## KEY EQUITY Indexes

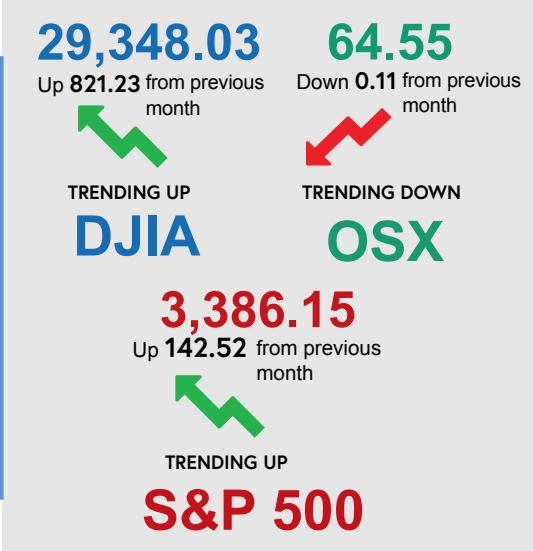
PRICES IN US DOLLARS AS OF FEBRUARY 17, 2020

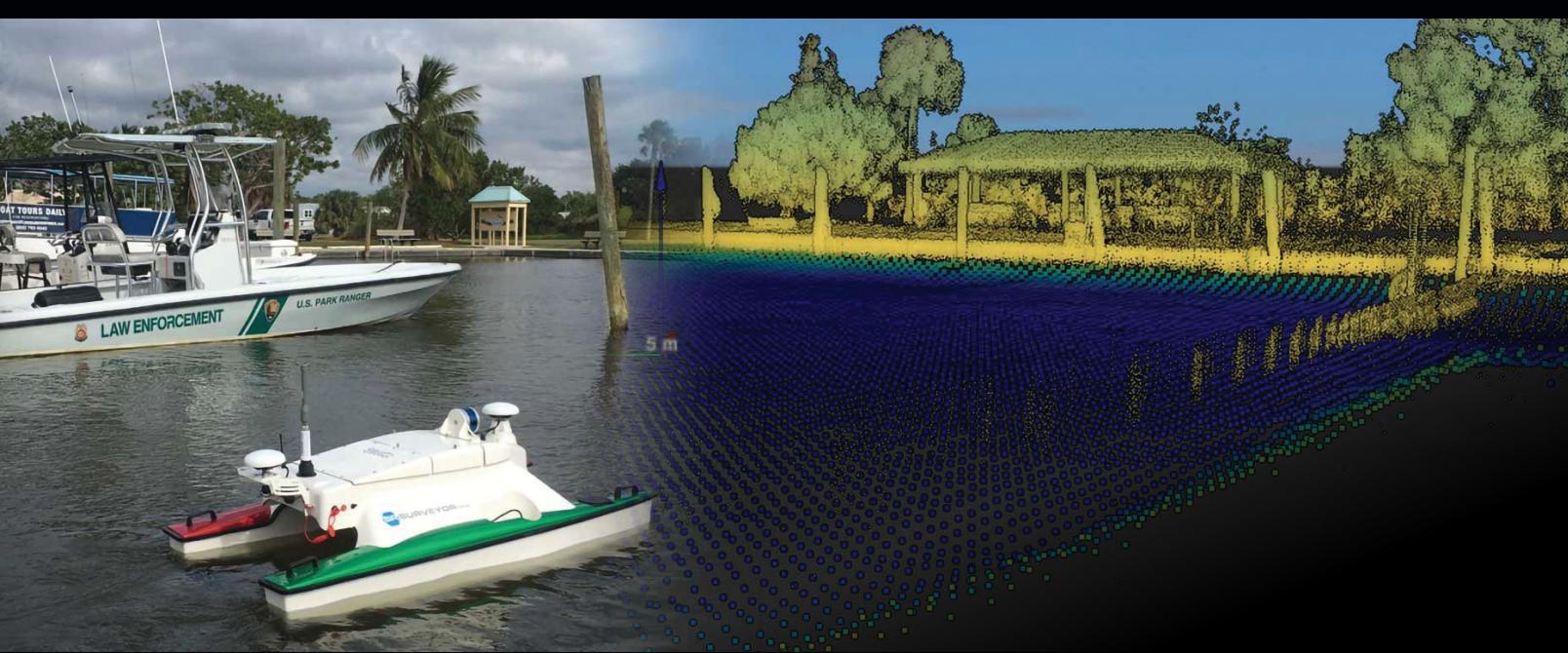
### EQUITY INDEXES CONTINUED to show volatility in the past month

The S&P500 saw a similar pattern, crossing the 3,300-point mark and remaining there throughout mid-February, closing above 3,380 points on February 17, thanks to strong corporate earnings. At press time, however, new fears about the impact of the Coronavirus and concerns over the health of the US economy threatened to negatively impact the indexes.

The Philadelphia Oil Services Index (OSX) remained mostly stable in the past month. In an unusually tranquil period for what has been a volatile index, the OSX saw a difference of only \$0.16 from the highest to the lowest weekly closes for the four-week period from mid-January to mid-February.

### SELECTED EQUITY INDEXES





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## WILDCARDS AT WORK IN THE COMMODITY MARKETS

BY G. ALLEN BROOKS | Author, *Musings From the Oil Patch* | [www.energymusings.com](http://www.energymusings.com)

### Crude Oil:

After a tumultuous few weeks, crude oil prices seem to be recovering, or at least stabilizing, as fears of a global pandemic due to the Covid-19 virus are easing. In early January, Chinese officials notified the World Health Organization of the illness and its rapid spread. The ease of viral transmission and with no known vaccine, fear about its impact on the global economy grew rapidly. By mid-January, as China headed into its Lunar New Year celebration—an event during which the country largely shuts down and people travel to visit family and friends and often use the week-long holiday for vacations outside of the country—neighboring foreign governments began instituting travel bans preventing Chinese people from coming to their countries. Airlines were forced to shut down travel routes, severely disrupting Asian travel markets and sharply reducing aviation fuel consumption.

Crude oil prices almost immediately reacted to the virus announcement. Prices were in a freefall by the time the Chinese government announced it was quarantining roughly 150 million people living in various regions of the country. People were forbidden to leave their homes, although officials permitted a single family-member to leave to shop for food and other necessities. Companies were shut down for the holiday but their closures were extended for an additional week to help limit the virus from spreading.

With health officials questioning the accuracy of Chinese statistics about the number of people infected and the total death toll, analysts attempting to quantify coronavirus' impact on economic activity and oil consumption started throwing out wild estimates. Would this virus be like SARS with minimal numbers of people dying, or like the 1918 Spanish flu that infected 500 million people, a third of the world's population, and killed 20-50 million? Covid-19 death tolls were estimated to range anywhere from a few tens of thousands up to a billion people.

As China's economy shut down, energy use plummeted and OPEC panicked. An emergency meeting of its technical staff recommended an immediate 600,000 barrel per day cut in exports on top of the 1.7 million b/d cut already in place. This latest recommended cut has yet to be agreed to. Forecasters have been revising near-term and full-year 2020 demand estimates, and possible oil price targets. Oil prices below \$40 were considered a high probability by some, especially when the IEA projected a 1Q 2020 oil demand decline of 450,000 b/d, the first such drop in over a decade.

As the spread of the virus appears to be slowing, oil prices are rebounding. This may yet prove to be the calm before the storm, but expectations suggest a less drastic impact on economic activity and oil demand than the scare scenarios put forward earlier. This wildcard is not finished impacting the oil market, as it will reduce total consumption and pricing from earlier expectations. Focus will now shift to the second half of 2020, and importantly, the outlook for 2021. Will we return to the more traditional 1-1.5 million b/d demand growth in 2021?

### Natural Gas:

Surprisingly, the coronavirus wildcard is impacting the U.S. natural gas market at a time when winter weather traditionally would be dominating the news. This winter has been warmer than usual, causing weekly gas storage withdrawals to trail those of last year, but stay aligned with the 5-year average withdrawals. At the same time, gas output continues growing, as associated gas from Permian shale oil wells has increased unabated. Oil drilling in the Permian is slowing due to lower virus-impacted oil prices, but declining oil volumes are being offset by expanding gas output from shale wells.

While some parts of the nation have experienced bouts of bitter cold and wintry weather reminiscent of past severe winters, these cold spells have been short-lived. The lack of extended serious winter weather contributed to Henry Hub gas prices falling well below \$2 per thousand cubic feet, marking the lowest February gas prices in decades.

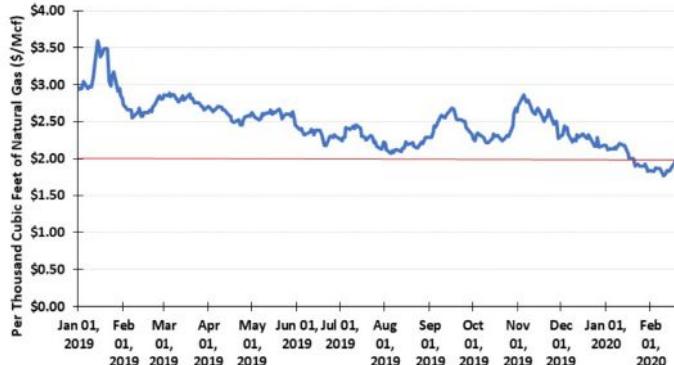
LNG exports and gas volumes being pipelined to Mexico have helped to support the gas market and prices. The latest market help came from an increase in the daily shutdowns of nuclear reactors, prompting increased natural gas consumption for powering gas-fired electricity generators to offset the lost nuclear output. Forecasts call for more nuclear plant maintenance this spring.

The gas market can use all the help it can get, as Covid-19 is impacting LNG markets in Asia and elsewhere. Last October, Asian LNG prices had fallen to \$6/Mcf from over \$10/Mcf in 2018. With Japan opting for cheap coal to fuel power plants, and significant portions of China's economy and territory shutdown, LNG consumption is falling and pressuring exporters. Asian LNG prices are currently under \$3/Mcf – prices never seen that low before.

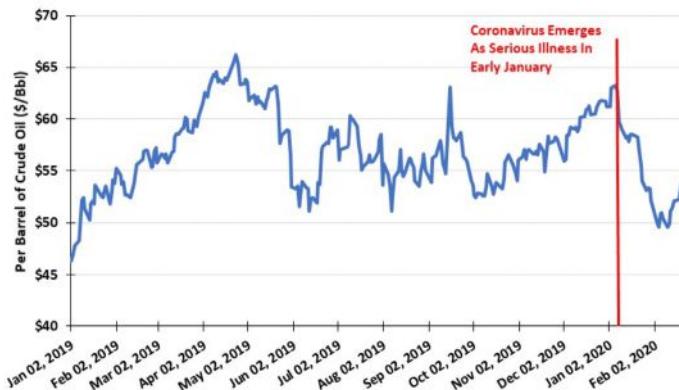
According to Bluegold Research, global LNG landed prices are down nearly 30 percent month-on-month, and down 56 percent year-on-year. The Gulf Coast LNG futures contract is currently averaging \$2.15 per million Btu, 25 percent below the landed price. At such low prices, many LNG exporters cannot make money on cargos shipping now. We fully expect to see extended repair and maintenance outages for LNG export terminals this summer, as gas producers look for global gas inventories to be drawn down and LNG prices to rebound.

Low U.S. gas prices, which have characterized our gas market for quite a while now, show no signs of improving in the foreseeable future. As new LNG exporters commence operations, the world appears to be grossly oversupplied with natural gas, depressing gas prices everywhere. While we would like to think this is a temporary condition, it seems the U.S. has exported its low natural gas price-environment worldwide, unfortunately eroding its competitive advantage in the global LNG market. Is this transitory, or is it the new reality of the global gas market?

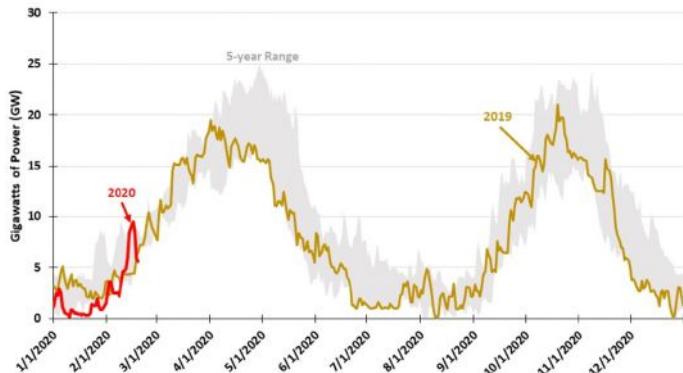
## Natural Gas Prices and Absence of Winter Weather



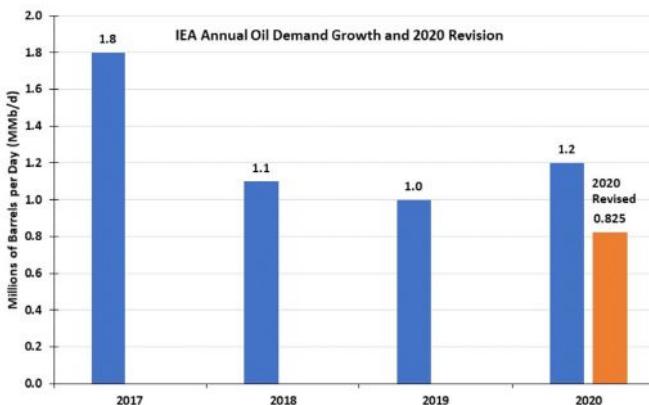
The Coronavirus Impact on Oil Price was Sharp and Deep



Daily U.S. Nuclear Capacity Outage Helping The Natural Gas Market



What Coronavirus Has Done to Oil Demand





## AMERICAS

### **MTS Florida TechSurge**

Fort Pierce, FL » April 1-2

[florida.mtsociety.org/mts-florida-techsurge-florida-estuary-and-coastal-monitoring](http://florida.mtsociety.org/mts-florida-techsurge-florida-estuary-and-coastal-monitoring)

### **MTS Buoy Workshop**

Wilmington, NC » April 13-16

[buoytech.mtsociety.org](http://buoytech.mtsociety.org)

### **IPF**

Providence, RI » April 21-24

[www.offshorewindus.org/2020ipf](http://www.offshorewindus.org/2020ipf)

### **Mari-Tech**

Halifax, Nova Scotia » April 28-30

[www.mari-techconference.ca](http://www.mari-techconference.ca)

### **AUVSI XPONENTIAL**

Boston, MA » May 4-7

[www.xponential.org/xponential2020](http://www.xponential.org/xponential2020)

### **OTC**

Houston, TX » May 4-7

[2020.otcnet.org](http://2020.otcnet.org)

### **Int'l Conference on Ocean Energy**

Washington D.C. » May 19-21

[www.icoe-conference.com](http://www.icoe-conference.com)

### **H2O Conference**

Halifax, Nova Scotia » June 15-17

[www.h2oconference.ca](http://www.h2oconference.ca)

### **US Offshore Wind**

Boston, MA » June 18-19

[events.newenergyupdate.com/offshore-wind](http://events.newenergyupdate.com/offshore-wind)

### **Int'l Conference on Ocean, Offshore, & Arctic Engineering (OMAE)**

Ft. Lauderdale, FL » June 28 – July 3

[event.asme.org/OMAE](http://event.asme.org/OMAE)



## EUROPE

### **Eastern Mediterranean Offshore**

Cyprus » April 7-9

[www.emc-cyprus.com](http://www.emc-cyprus.com)

### **Offshore Wind Decommissioning Summit**

Rotterdam, The Netherlands

» April 21

[energy.knect365.com/offshore-wind-decommissioning](http://energy.knect365.com/offshore-wind-decommissioning)

### **MCE Deepwater Development**

London, UK » April 21-23

[www.mcedd.com](http://www.mcedd.com)

### **All-Energy**

Glasgow, UK » May 13-14

[www.all-energy.co.uk](http://www.all-energy.co.uk)

### **Deep Sea Mining Summit**

London, UK » May 13-14

[www.deepsea-mining-summit.com](http://www.deepsea-mining-summit.com)

### **UDT**

Rotterdam Ahoy, NL » May 26-28

[www.udt-global.com](http://www.udt-global.com)

### **Seanergy**

Nantes, Saint-Nazaire, France

» June 9-12

[seanergy-forum.com/en/seanergyforum/Seanergy-2020](http://seanergy-forum.com/en/seanergyforum/Seanergy-2020)

### **UTC**

Bergen, Norway » June 16-18

[www.utc.no](http://www.utc.no)

### **Marine Tech Expo**

Plymouth, UK » July 1-2

[www.marinetechexpo.co.uk](http://www.marinetechexpo.co.uk)

### **Offshore Northern Seas**

Stavanger, Norway » Aug 31 – Sept 3

[www.ons.no](http://www.ons.no)



## OTHER REGIONS

### **OCEANS '20**

Singapore » April 6-9

[www.singapore20.oceansconference.org](http://www.singapore20.oceansconference.org)

### **Offshore Well Intervention APAC**

Kuala Lumpur, Malaysia » June 2-3

[www.interventionasiapac.offsnetsevents.com](http://www.interventionasiapac.offsnetsevents.com)

### **PHILMARINE**

Manila, Philippines » June 16-18

[www.philmarine.com](http://www.philmarine.com)

### **Vietnam Marine Offshore Expo**

Hanoi, Vietnam » July 29-31

[www.marine-vietnam.com](http://www.marine-vietnam.com)

### **Oceanology Int'l Middle East**

Abu Dhabi » September 7-9

[www.oceanologyinternationalmiddleeast.com](http://www.oceanologyinternationalmiddleeast.com)

### **Telecoms World Middle East**

Dubai » September 8-9

[www.terrapinn.com/conference/telecoms-world-middle-east](http://www.terrapinn.com/conference/telecoms-world-middle-east)

### **Submarine Networks World**

Singapore » September 23-24

[www.terrapinn.com/conference/submarine-networks-world](http://www.terrapinn.com/conference/submarine-networks-world)

### **Mediterranean Offshore Conference**

Alexandria, Egypt » October 13-15

[www.moc-egypt.com](http://www.moc-egypt.com)

### **MAST Asia**

Tokyo, Japan » November 2-4

[www.mastconfex.com/asia2020](http://www.mastconfex.com/asia2020)

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<b>JANUARY</b>		
» Mapping / Survey » Unmanned Vehicle Tooling	Manipulator Arms & Tools; Pumps, Hoses & Hose Connectors; Cam- eras, Lights; Bathymetric Mapping & Charting	Underwater Intervention » February 4-6 Subsea Expo » February 11-13 Canadian Hydrographic » February 24-27
<b>FEBRUARY</b>		
» Oceanology » Metocean	Data Acquisition & Processing; Metocean Buoys; Transducers; Hy- drophones, Altimeters, Profilers, Velocity Loggers, Telemetry, & Pressure Sensors	Oceanology International » March 17-19
<b>MARCH</b>		
» Offshore Technology » Subsea Cables	Simulators; Autopilots; Digital Twins; Cybersecurity Services; UAVs; Echosounders and ADCPs	IPF » April 21-24 AUVSI XPONENTIAL » May 4-7 Deep Sea Mining Summit » May 13-14
<b>APRIL</b>		
» Deepwater Inspection, Repair, and Maintenance » Defense & Security	Sonar Systems & Vessels; Imaging & GIS, Magnetometers, Open Ar- chitecture Robotics & Unmanned Defense Systems	OTC » May 4-7 UDT » May 26-28
<b>MAY</b>		
» Offshore Exploration	Mining Machines; Cloud-based Computing & Software	TBD
<b>JUNE</b>		
» Surface Vehicles	Mounting Systems & Gimbal; Small Survey Boats; Control Systems; USVs; Towed Vehicles & Gliders	Marine Tech Expo » July 1-2
<b>JULY</b>		
» Buyers' Guide: Unmanned Vehicles	ROV, AUV, USV, Gliders & Towed Vehicles	TBD
<b>AUGUST</b>		
» Submersibles	Cranes & Winches; LARS & Con- trol Systems; Sensors, Profilers & Measurement; Thrusters; Umbili- cal, Tether, Cables & Connectors	Offshore Northern Seas » Aug 31 - Sept 3
<b>SEPTEMBER</b>		
» Renewables	Energy Storage Devices; Inspec- tion Drones; Current Meters	Offshore Energy » October 26-28 Ocean Energy Europe » December 1-2
<b>OCTOBER</b>		
» Ocean Science & Technology	Acoustic Modems; Acoustic Re- leases, Transponders, Command & Control Systems; Technical Schools & Training Programs	OCEANS'20 » October 19-22
<b>NOVEMBER</b>		
» Maritime Transportation and Communication » Tracking and Positioning	Telecommunications Tech; Transponders / AIS; S/P Power Systems; Workboats & Supply Vessels	TBD
<b>DECEMBER</b>		
» Buyers' Guide: Upper Deck	LARS, Winches, Cranes, A-Frames, & Buoys	TBD



## TSC STRATEGIC KICKS OFF 2020 WITH SUCCESSFUL OCEAN INDUSTRY EVENTS

Technology Systems Corporation (TSC), has released details of two marine industry networking events that the ocean marketing and media agency recently hosted. The year kicked off with the Blue Innovation Symposium in Newport RI from January 14 – 15, while Subsea Cables: A Critical Connection was a one-day event in Houston, TX on January 23. Attendance at both events exceeded projections, hinting at a growing appetite among the ocean industries for events that cater to more networking opportunities than traditional conferences allow.

Both events presented specialized programs led by industry thought leaders, panel discussions, and technical presentations, but were critically important for different reasons. The Subsea Cable event, co-hosted by TSC's Subcableworld.com and the Business Network for Offshore Wind, gathered over 120 key stakeholders from the renewable energy sector to look at lessons from the past, challenges of the present, and the prospects for the US offshore wind supply chain, with cables cast in a leading

light. The one-day event was supported by many high-profile sponsors, including Nexans, Mott MacDonald, and Aker Solutions.

Meanwhile, the Blue Innovation Symposium, co-hosted by TSC, Salve Regina University and The Consulate-General of Canada in Boston, is as much an exhibition as it is a meeting of the minds. This year's event welcomed nearly 40 sponsors for a two-day agenda of keynote addresses, panel discussions,



and a unique series of five-minute flash talks. Other highlights from the Blue Innovation Symposium included a surprise announcement from Stefan Pryor, RI Secretary of Commerce who revealed that Rhode Island Governor Gina Raimondo, in partnership with offshore wind developer Ørsted, will bring its US Innovation Hub to Providence, RI in spring 2020.

New to the 2020 line-up, the inaugural Rising Tide Awards were presented to Dr.

Jim Bellingham, director of the Center for Marine Robotics (CMR) at the Woods Hole Oceanographic Institution (WHOI), Boston Engineering of Waltham, Massachusetts and GeoSpectrum Technologies of Dartmouth, Nova Scotia, all in recognition of their ongoing contributions to the industry.

TSC's decision to partner on such events is central to the agency's 2020 strategy of narrowing the focus on critically important issues and in doing so create ever-progressive forums for thought-leadership and networking.

"We identified a number of strategic partners that wanted to bring something new to the traditional conference circuit," said Jessie Lewis, TSC's Operations Director. "While established conferences will always be essential meeting points for our industry, smaller, more intimate events are often more conducive to genuine business networking opportunities in very specific sectors of the blue economy, such as sensor technology and subsea power cables."

Plans are already underway for follow-up events, as well as a number of projects yet to be announced. To find out more about future TSC events, marketing services and expanding portfolio of media channels, visit: [www.tscstrategic.com](http://www.tscstrategic.com).

## DEEPOCEAN MAKES MAJOR ANNOUNCEMENTS

### New President For Deepocean Americas

Tony Stokes has been appointed as President of Delta SubSea and for the DeepOcean Americas region. Tony was previously Senior VP in the region and before that held senior positions for DeepOcean in UK, Middle East, and Singapore.

This move also sees Delta Subsea rebranded to DeepOcean creating a single DeepOcean brand for all subsea services. The rebranding will occur over course of Q1 2020.

DeepOcean has also hired Mike Arnold as VP Commercial and Business Development, based in Houston. Mike joined DeepOcean at the start of 2020 and brings vast experience in the Subsea IRM market with previous experience in ROVOP, M2, Bibby, Hallin and Rovtech.



### New North East UK HQ

DeepOcean has reaffirmed its commitment to Darlington and North East England after it reached agreement with Darlington Borough Council to locate its UK headquarters in the new Feethams House development.

The global subsea services company will move from its existing premises in the town to the new development in the coming months, continuing the company's 27-year association with

Darlington. It has taken the entire top floor of Feethams House, covering over 7000 sq. ft.

Employing over 100 specialists in the town, DeepOcean also has a center of engineering expertise and offshore maintenance facility in Blyth, Northumberland. DeepOcean is active in offshore energy markets, particularly oil & gas, offshore wind as well as subsea internet cables.

DeepOcean undertakes complete Engineering & Marine works solutions for large subsea cable projects associated with offshore wind farms, as well as providing inter country links, such as the recently installed Nemo cable which provides two percent of the UK's electricity by connecting the UK & Belgium.

Feethams House will also provide a base for DeepOcean's subsea trenching and seabed intervention division, Enshore, with staff working between Darlington and its facility at the Port of Blyth in the development, maintenance and operation of the world's most advanced fleet of underwater trenching vehicles. Enshore is also pioneering the development of technology to harvest subsea minerals, which will play a vital role in sourcing clean metals for batteries in the latest generation of electric vehicles.

Pierre Boyde, Managing Director of Enshore, said: "We have always benefited from the excellent talent pool in Darlington and the wider North East and this new office will also further help us attract people to work at DeepOcean from beyond the region.

Our vision is to be the world's leading subsea services provider. We are excited by the tremendous opportunities in the offshore wind industry, both in the UK and further afield as well as rising to the challenge of sourcing metals from the ocean floor in an environmentally sustainable way that supports the transition away from fossil fuels to a low carbon economy."

[www.deepoceangroup.com](http://www.deepoceangroup.com)



» Back row left to right: Cllr Heather Scott, Tees Valley Mayor Ben Houchen, Peter Gibson MP. Front row left to right: Simon Hounsome (DeepOcean Subsea Cables) and Pierre Boyde (Enshore).

Looking deeper and seeing more.



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The range includes the Hunter system (AUV Imaging and Laser), the Scout system (Observation Class ROV Imaging and Laser Profiling), the Pathfinder system (Work Class ROV Imaging and Laser Profiling) and the Prowler I & II systems (Towed Vehicle Imaging Range and Scale Measurement).

**DEEPSSEA POWER & LIGHT**

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For over 30 years, DeepSea Power & Light has provided high-quality and innovative products to the oceanographic community. The company's expertise and product line has grown to include underwater video systems, lighting solutions, pressure relief valves, and lasers.

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E-mail: sales@birnsaquamate.com  
Website: www.birnsaquamate.com  
Contact: Michelle DeTerra



Birns Aquamate design and manufacture underwater electrical connectors, cable assemblies, and cable terminations. The company produces a wide range of standard industry products such as the 5500 Series, SC, MC, LP, FAWL/FAWM, NANO, TC, Rubber Molded, etc. Birns Aquamate is the only manufacturer to guarantee compatibility with other uw connectors. Birns Aquamate also specializes in fast turn-around for custom design of special connector solutions. All connectors are manufactured under DNV ISO 9001:2000 certification. Dealers in Canada, Brazil, UK, Belgium, Holland, Norway, Germany, South Africa, Holland, Italy, and China.

**SOURIAU - SUNBANK | CONNECTION TECHNOLOGIES**

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Website: www.souriau.com  
Contact: Vincent Mansour,  
North America Product Manager Marine/Space/Milaero



SOURIAU-SUNBANK Connection Technologies is a global leader in interconnect solutions engineered to withstand the harshest of environments as aeronautics, space, defense, transport, energy, industrial equipment, healthcare devices, and lighting. It invests in R&D and manufacturing facilities to produce solutions that comply with environmental requirements and international trade rules. SOURIAU-SUNBANK's wide range of products are designed using cutting-edge electrical and optical connection technologies. All are suitable for use in non-hazardous environments as well as those involving extreme temperatures, strong vibrations and corrosive liquids, and meet specific international market standards.

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The EdgeDVR is currently used worldwide by most of the major ROV and Diving contractors. With our present Version 4 software, we have 6 models. The EdgeDVR has become an essential part of any ROV and Diving system offshore, easy to use and reliable. The system is capable of recording simultaneous High Definition and Standard Definition video, together with auto creation of Dive, Video, Photo and Anomaly logs. Multi channel digital overlay is also available for all recorded channels, logos and realtime survey data can be displayed. With around 500 systems now offshore, we have a proven record of reliability.

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Ocean Specialists, Inc. (OSI) is a system development and advisory firm for undersea cable projects and technology with global capabilities. OSI works with clients during all project phases of subsea network development, from planning and design to procurement and implementation. Our customers, primarily representing Oil and Gas, Telecommunications and Ocean Observing, recognize the value of fiber optic networks to their field and services solutions, and look to OSI to deliver the skills and experience that developing these networks require.

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Kongsberg Seatex

Kongsberg Seatex is a leading international marine electronics manufacturer specializing in the development and production of precision positioning and motion sensing systems. Our commitment is to provide quality products and solutions for safe navigation and operations at sea in the commercial offshore, maritime, hydrographics and defence industries.

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ATL specializes in the design/manufacture of custom bladder-type fluid containment systems, including tanks, inflatables, pillows and bellows for surface and subsea. ATL's flexible fluid containers boast unparalleled chemical tolerance, abrasion resistance, and remarkable durability - used with methanol, diesel fuel, gases, ethyleneglycol, hydraulic fluids and chemical cleaning cocktails. Expedited deliveries are also available.

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E-mail: gstevens@conshelf.com  
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CSA Ocean Sciences Inc. (CSA) is a marine environmental consulting firm specializing in multidisciplinary projects concerning potential environmental impacts of activities throughout the world. With extensive experience in environmental sciences and technical field operations, CSA is staffed and equipped to offer a complete range of services for projects in offshore, nearshore, estuarine, wetland, and freshwater environments.able solutions.

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EvoLogics provides the world's most advanced spread-spectrum underwater communication systems (S2C) with multi-channel data management, networking capability, built-in tracking and positioning functions with USBL. Data loggers, acoustic wake-up module and releasers optionally included. Deployments in offshore platforms (FPSO, ABS), environmental monitoring, defense systems, ROV and AUV operations and more. Applications include simple positioning and sensor information to transmission of underwater photos.

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**RJE INTERNATIONAL, INC.**

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RJE International offers product design, development, evaluation and marketing for military divers, offshore and marine scientific communities, search and rescue teams, and more. RJE has become the industry leader in diver navigation and acoustic relocation. Our team has an extensive background in developing, manufacturing, and supplying underwater acoustic marking and relocation systems, diver navigation platforms, and other subsea equipment.

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- **Manufacturer's Representative:** Teledyne RD Instruments, Deep Water Buoyancy, WERA Northern Radar.

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RBR creates instruments to measure the blue planet. From the ocean abyss to the polar ice caps, our sensors track water parameters – temperature, depth, salinity, dissolved gases, pH, and many others. With design and manufacturing centrally located in Ottawa, Canada, our team works in a fast-paced, dynamic atmosphere to serve customers all over the globe.

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Contact: Darrin Verge, President & CEO



ROMOR Ocean Solutions provides instrumentation solutions for the geophysical, oceanographic, defense, security, oil & gas, and renewable energy industries. By partnering with world renowned manufacturers, ROMOR is able to offer technical knowledge, value added services, logistics expertise, and the most reliable instrumentation on the market.

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Sea-Bird Scientific provides best-of-class sensors and systems for oceanographic research and environmental water quality monitoring of physical and biogeochemical properties. Sea-Bird Scientific is the leader in accurate, stable ocean instruments for measuring conductivity (salinity), temperature, pressure, oxygen, pH, chlorophyll, CDOM, turbidity, beam attenuation, irradiance, radiance, PAR, nitrate, and phosphate. Our CTD profilers, water samplers, moored CT recorders, wave/tide recorders, DO sensors, and optical sensors are used by research institutes, ocean observing programs, government agencies, and navies globally.

### STAR-ODDI

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Website: [www.star-oddi.com](http://www.star-oddi.com)  
Contact: Baldur Sigurgeirsson

A manufacturer of miniature data loggers with sensors as temperature, depth/pressure, salinity, tilt/acceleration, compass direction/magnetometer, light levels, acoustic receiving/transmitting. The loggers are used for various researches, including oceanography, fishing gear studies, equipment behavioral monitoring and fish tagging.

## STAR:ODDI

### SONAR SYSTEMS



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Contact: Doowon Choi

Echologger represents the best quality sonar products in the market. We are a leading developer/manufacturer of high-end ultracompact echosounders and high resolution scanning sonar that are equipped with state-of-the-art features and essential functionalities to match customers' needs in affordable price.

Founded in 2009 and a company located in South Korea, and with a brand name Echologger, EofE Ultrasonics Ltd. is a knowledge-based company that continuously designs, develops and manufactures high technology sonar devices and solutions to meet the changing needs of the customers. Having been in the industry for years, the company understands how the industry operates and what works best for the benefit of our valued customers.



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Website: [www.edgetech.com](http://www.edgetech.com)  
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EdgeTech designs, manufactures and sells industry-leading side scan sonars, sub-bottom profilers, bathymetry systems and combined sonar systems. Additionally, the company produces world class underwater actuated and transponding solutions including deep sea acoustic releases, shallow water and long life acoustic releases, transponders, reliable USBL acoustic tracking and positioning systems, and custom-engineered acoustic products.

### KLEIN MARINE SYSTEMS, INC.



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Website: [www.kleinmarinesystems.com](http://www.kleinmarinesystems.com)

Celebrating over 50 years in the marine technology industry, Klein Marine Systems continues to be a world leading sensor technology manufacturer of high-resolution side scan sonar equipment and radar-based security and surveillance systems. Klein Marine Systems has developed a worldwide reputation of excellence in the industry by providing quality products and excellent customer service. Klein sonar systems are deployed by government agencies, navies, port authorities, surveyors, oil companies and universities worldwide. Visit our web site at [www.KleinMarineSystems.com](http://www.KleinMarineSystems.com) and discover how Klein is Making the Oceans Transparent!

**MARINE SONIC TECHNOLOGY**  
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 E-mail: Regan.Lipinski@na-atlas.com  
 Website: [www.marinesonic.com](http://www.marinesonic.com)



Marine Sonic Technology builds high quality, high resolution side scan sonar systems. Located in Yorktown, Virginia, Marine Sonic has been in business for more than 25 years. Our towed systems are rugged, easy to deploy and simple to operate. We also offer highly efficient AUV/ROV embedded systems, which occupy minimal space and low power consumption.

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 Website: [www.saivas.no](http://www.saivas.no)  
 Contact: Gunnar Sagstad



- STD/CTD, Sound Velocity probes/recorder with optional multi-parameter facilities; Turbidity, Fluorescence, Oxygen etc. The new CTD/STD model SD208 with wireless communication and high accuracy: 0.002 mS/cm, 0.002 °C.
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New Industries provides quality fabrication services to the offshore oil & gas and marine industries focusing on large diameter pressure vessels, suction piles, DNV buildings and deepwater subsea production equipment such as jumpers, PLETs, PLEMs and manifolds.

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**KONGSBERG**

Kongsberg Maritime is a marine technology company providing innovative solutions for all marine industry sectors including merchant, offshore, subsea, naval and fisheries. The company delivers systems that cover diverse maritime applications. Within subsea, Kongsberg Maritime's sonars, Sub-bottom profilers, multibeam and single beam echo sounders, cameras, positioning and underwater communication & monitoring systems, instruments, software and Marine Robotics are used in survey and inspection operations worldwide. Working closely with customers to develop technology that pushes the limits in subsea applications, Kongsberg Maritime is also dedicated to developing innovative environmental monitoring solutions such as the K-Lander system in addition to cutting-edge Marine Robotic platforms such as the futuristic Elumee vehicle.

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**GENERAL DYNAMICS**  
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General Dynamics Mission Systems' Bluefin Robotics products provide undersea capabilities for defense, scientific and maritime customers worldwide. Bluefin Robotics products offer a range of systems and configurations that can operate in the open ocean and in constrained waterways. Our core autonomous product line includes Bluefin SandShark, Bluefin-9, Bluefin-12, and Bluefin-21, Hovering Autonomous Underwater Vehicle (HAUV), and Subsea Power technologies.

The Bluefin Robotics AUV family shares a free-flooded, modular, and open architecture backbone that has enabled the integration of 70+ sensors. We have developed and delivered AUVs worldwide to research institutes and industry and have provided AUVs to the United States' and International Navies.

**INTERNATIONAL SUBMARINE ENGINEERING LTD. (ISE)**

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 Website: <https://ise.bc.ca/>



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International Submarine Engineering Ltd. (ISE) is a world leader in the design and integration of autonomous and remotely operated robotic vehicles and terrestrial robotics. Over our 40+ years in business, we have accumulated a great deal of expertise in the design, manufacture, and maintenance of:

- Autonomous Underwater Vehicles (AUVs)
- Remotely Operated Vehicles (ROVs) for subsea operation
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- Customized systems for the Military-Naval sector
- Hydraulic, pneumatic, and electric robotic manipulators
- Teleoperated and autonomous robotic systems
- Robotic systems for nuclear Industry applications
- Communications and real-time control system

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E-mail: IVER.Sales@L3Harris.com  
Website: www.L3Harris.com  
Contact: Jim Kirk



L3Harris Technologies is an agile global aerospace and defense technology innovator, delivering end-to-end solutions that meet customers' mission-critical needs. The company provides advanced defense and commercial technologies across air, land, sea, space and cyber domains.

L3Harris OceanServer develops autonomous, lightweight Unmanned Undersea Vehicles. L3Harris OceanServer has established itself as the leader in man portable UUVs, providing highly capable vehicles to a wide array of military, commercial and research customers. With over 15 years experience in the underwater field, our engineers have developed a reliable and easy to use platform that is trusted to complete marine missions all around the world.

**OUTLAND TECHNOLOGY**  
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Contact: Jeff Mayfield



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We design, research and manufacture SEAMOR ROVs and related accessories. The SEAMOR ROVs are at the forefront of the expansion of marine industries and research, providing safe and cost-effective eyes underwater to help guide industrial activity and monitor the health of underwater ecosystems. Our ROVs are very unique because of their modular design and their wide range of capabilities. Our engineers have developed system components (vehicle, controller, tether and power source) to be interchangeable across our product line; Mako, Chinook, and Steelhead. SEAMOR vehicles are quality machines and are built to last. Our vehicles can be easily upgraded and repaired.

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Contact: Ted Brockett



SOSI and DT Marine brand winches, handling systems, and engineered solutions are now available exclusively from Okeanus Science & Technology. Proven, reliable, and cost-effective standard and custom designed winches range from small all-electric instrumentation winches to high horsepower all-electric or hydraulic umbilical and multi-purpose oceanographic systems. SOSI brand winches can be packaged and supplied with skids, A-frames, over-boarding sheaves, HPUs, and other auxiliary equipment. Okeanus has offices in Houston, TX, Redmond, WA and Houma, LA. Call, email or visit [www.oceanus.com](http://www.oceanus.com) for more information.

# INSIDER NEWS

## FOR THE OCEAN INDUSTRY

A collage of three magazine covers for "ON&amp;T Ocean News &amp; Technology". The top right cover shows an offshore oil rig with wind turbines in the background. The middle left cover shows a close-up of an ROV underwater. The bottom left cover shows another ROV with the text "ESSENTIAL INTELLIGENCE" and "ON&amp;T". To the right of the covers is a large image of an offshore oil platform at sunset.

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