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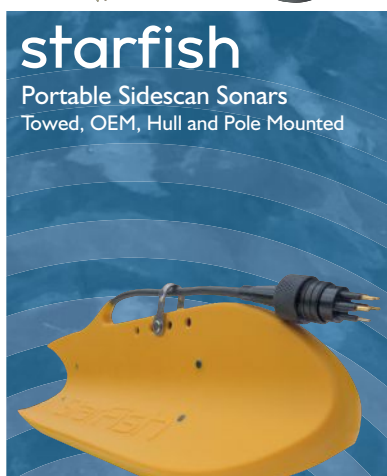
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COVER IMAGE

The ESPS *Méndez Núñez* berthed at Port of Suva September 28, 2019. The Spanish Navy frigate paid its first visit to Fiji, a historic stop to mark the first circumnavigation of the Earth 500 years ago by Ferdinand Magellan and Juan Sebastián Elcano, the sailors who discovered the link between the Atlantic Ocean and Pacific Ocean. (Credit: Aileen Torres-Bennett)

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Bringing Home a Hero

On November 1, 2019, Coast Guardsman and World War II hero Lieutenant Thomas James Eugene "Jimmy" Crotty returned home to Buffalo. He is one of the thousands of Coast Guard members who have made the ultimate sacrifice, and his life and career embody the Service's core values of "honor, respect and devotion to duty."

Crotty represents the more than 600 Coast Guard MIAs lost at sea who never returned home alive. His life also exemplifies the proud legacy of the Long Blue Line of Coast Guard men and women who place themselves in harm's way every day in service to their country and all Americans.

Crotty was born in 1912, in Buffalo, New York. He graduated from the United States Coast Guard Academy in 1934 after serving as company commander, class president and captain of the academy's football team. For the next seven years after graduation, he saw distinguished service on board cutters in New York City, Seattle, Sault Ste. Marie and San Diego.

In the days leading up to the attack on Pearl Harbor in December 1941, he served with the U.S. Navy as an officer at the 16th Naval District located at Cavite Navy Yard near Manila. During the Japanese invasion of the Philippines, he supervised the destruction of ammunition and facilities at the Navy Yard and destroyed the disabled fleet submarine USS *Sea Lion* to prevent its use by the Japanese. In the defense of the Philippines, he served as the executive officer of the Navy minesweeper USS *Quail*, and, as the Japanese advanced on the island fortress of Corregidor, he took charge of an artillery unit on Malinta Hill, defending the island's Allied headquarters.

On May 6, 1942, Japanese aerial bombardment and the landing of overwhelming enemy forces led to the capitulation of Allied forces on Corregidor. After the surrender, Crotty was taken prisoner by the Japanese and held at the Cabanatuan Prison Camp. On July 19, 1942, he died of diphtheria and was buried with other POWs in a common grave outside the prison walls.

After World War II, the U.S. government moved the remains from the common graves at Cabanatuan to the American Cemetery and Memorial in Manila. In early 2018, Crotty's remains were exhumed from the cemetery as part of an effort led by the Department of Defense to bring military service members home. In September 2019, his remains were positively identified from DNA samples provided by the Crotty family.

Because Crotty was the only Coast Guardsman to serve in defense of the Philippines, his combat service there authorized the Coast Guard to display the Philippine Defense Battle Streamer on its Coast Guard Ensign. He was posthumously awarded the Bronze Star Medal, Purple Heart Medal, Filipino Veterans of World War II Congressional Gold Medal, Prisoner of War Medal and many other honors.

Crotty is one of hundreds of thousands of Coast Guard men and women who have served their country over the past 230 years. To honor him, every Coast Guard unit and member observed a moment of silence when he began his journey home to Buffalo on October 31, 2019.

On November 1, 2019, arrival honors were held at Joint Reserve Base, Niagara, New York, and funeral services were held on November 2 at St. Thomas Aquinas Roman Catholic Church in Buffalo. That same day, interment took place with full military honors at Holy Cross Cemetery in Lackawanna, New York.

The half-masting of the national ensign of all Coast Guard units will take place when Crotty is honored once again at the U.S. Coast Guard Academy in the spring of 2020. **ST**

TOTAL OCEAN MARKET COVERAGE

JANUARY

Annual Review & Forecast/Buyers Guide/Directory

**Canadian Hydrographic Conference, February 24-27, Quebec, Canada

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

**Oceanology International 2020, March 17-19, ExCel London, U.K.

**OCEANS 2020 Singapore, April 6-9, Singapore

MARCH - digital only

Electronic Charting/Vessel Management/

Ports & Harbors/Dredging/Homeland Security

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

**AUVSI XPONENTIAL 2020, May 4-7, Boston, MA

**Offshore Technology Conference, May 4-7, Houston, TX

**UDT 2020, May 26-28, Rotterdam, The Netherlands

MAY

Communications, Telemetry, Data Processing

**BlueTech Expo, June 10-11, Washington, DC

**CLEAN PACIFIC 2020, June 9-11, Seattle, WA

JUNE

Seafloor Mapping/Sonar Systems/Vessels

JULY - digital only

Deck Gear, Cable, Connectors, Power Systems & Salvage

AUGUST

Geophysical Exploration/Seafloor Engineering

**SEG 2020, October 11-16, Houston, TX

SEPTEMBER

Ocean Resources Development & Coastal Zone Management

**OCEANS 2020 Gulf Coast, October 19-22, Biloxi, MS

**CLEAN GULF 2020, October 20-22, San Antonio, TX

**Euronaval, October 20-23, Paris Le Bourget, France

**Offshore Energy 2020, October 26-28, Amsterdam, The Netherlands

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

**International Water Conference, November 8-12, San Antonio, TX

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DECEMBER

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2020

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)) Another Step Toward Decarbonized Shipping. MISC Berhad, Samsung Heavy Industries (SHI), Lloyd's Register (LR) and MAN Energy Solutions will work together on a joint development project (JDP) for an ammonia-fueled tanker to support shipping's drive toward a decarbonized future. The creation of the alliance has been motivated by the partners' shared belief that the maritime industry needs leadership and greater collaboration if shipping is to meet the International Maritime Organization's 2050 greenhouse gas (GHG) emission target, an ambition that requires commercially viable deep-sea zero-emission vessels (ZEVs) are in operation by 2030. Ammonia is just one of the pathways toward zero-carbon-emitting vessels. The partners recognize that the shipping industry will need to explore multiple decarbonization pathways and hope their collaboration will spur others in the maritime industry to join forces on addressing this global challenge.

)) IMUs Chosen for Autonomous Voyage to Commemorate *Mayflower* Journey. Two Silicon Sensing Systems AMU30 inertial measurement units (IMUs) will provide critical navigation data to the autopilot capability for the *Mayflower Autonomous Ship* (MAS) throughout its milestone trans-Atlantic voyage this September, when the 15-m-long, 5-ton MAS400 will repeat the *Mayflower's* original epic voyage 400 years ago. Led by marine research organization Pro-Mare and powered by IBM, it will sail from Plymouth, England, to Plymouth, Massachusetts, using computer vision, machine learning, edge technologies and sensors to navigate and detect hazards. Silicon Sensing's AMU30 devices will form two vital units within the MAS navigation suite, constantly delivering precise three-axis data on angular rate and acceleration; roll, pitch and heading angles; altitude and pressure; and temperature to the ship's autopilot. Traveling at a maximum speed of 12 kt., MAS is expected to take just 12 days to reach the coast of Massachusetts, instead of the 66 days of the voyage four centuries ago. Throughout the voyage, the ship will also function as a scientific laboratory with onboard sensors that will transmit data for research in maritime cybersecurity, marine mammal monitoring, ocean microplastic analysis and sea level mapping.

)) Anniversary of First Humans to Reach Deepest Part of Ocean. Sixty years ago, plunging into the deep, dark abyss of the Pacific Ocean's Mariana Trench, U.S. Navy Lt. Don Walsh and Swiss engineer Jacques Piccard heard a loud cracking sound in their vessel, the bathyscaphe Trieste, which the Office of Naval Research (ONR) purchased for scientific observations. At 30,000 ft. below sea level, Walsh and Piccard faced the ultimate decision: risk their lives to become the first people to travel to the deepest part of the ocean, the Challenger Deep, or return to safety. The crack had scarred one of Trieste's outer plexiglass panels, but Walsh and Piccard (whose father designed Trieste) decided to push on. After a nearly 5-hr. descent, the Trieste reached the Challenger Deep, approximately 36,000 ft. below sea level, on January 23, 1960. Exactly 60 years later, on January 23, 2020, the National Museum of the U.S. Navy in Washington, D.C., celebrated the anniversary of Trieste's journey with a program featuring Walsh, the lone remaining pilot of the trip. Trieste's descent to the Challenger Deep was a remarkable achievement for the Navy, ONR and oceanography as a scientific discipline. Bought by ONR in 1958, Trieste was designed to go deeper than any craft before it. The ship boasted a small, spherical crew space slung underneath a large float resembling a balloon in both shape and function. The historic feat of reaching the deepest part of the ocean ushered in a "golden age" of manned underwater exploration in the 1960s and 1970s, when submersibles helped make extraordinary discoveries in biology, geology, chemistry, oceanography and other fields.

)) Two Major Industry Acquisitions. Sonardyne International Ltd. has acquired underwater imaging and inspection specialist 2G Robotics Inc. 2G Robotics will remain an independent business and brand, continuing to serve its customer base in unmanned and autonomous underwater vehicles and ROVs. 2G Robotics' founder Jason Gillham will continue as CEO. This acquisition follows the acquisition of Danish survey software company EIVA last year. In other acquisition news, Huntington Ingalls Industries (HII) has entered into an agreement to acquire Hydroid Inc., a provider of advanced marine robotics to the defense and maritime markets and a U.S.-based indirect subsidiary wholly owned by Kongsberg Maritime. HII and Kongsberg Maritime are also establishing a strategic alliance to jointly market naval and maritime products and services to the U.S. government and, potentially, to global markets.

)) Interdisciplinary Efforts on Sustainable Blue Economy. The Centre for Blue Governance (CBG) at the University of Portsmouth, U.K., launched in February with over 45 researchers from different disciplines collaborating to meet the global challenge of advancing the sustainable blue economy. World Ocean Council CEO Paul Holthus was the keynote speaker on "Blue Finance" at the launch seminar. The objective of CBG is to contribute to the design, setup and implementation of blue governance in countries, regions and political entities, and to develop and provide actionable research at sectoral (various economic branches) and overall levels (coordination, planning) while addressing the coherence challenge among nature conservation, economic development and social interests. CBG's four central themes are: blue policies, planning and security; blue energy, technologies and transport solutions; biodiversity, blue carbon and climate change; and aquatic resources management. **ST**

Safeguarding Harbors

USVs Increase Coverage for Port Security

By George Galdorisi

As readers of *Sea Technology* are well aware, the critical nodes that support globalization and world trade that has lifted hundreds of millions out of poverty are the world's harbors. From Singapore to Antwerp to Shanghai to other megaports and hundreds of other smaller ports, these harbors are essential. A disaster like a fire, explosion or a major oil spill could close one of these ports for an indefinite time. The secondary effects of such a catastrophe could include releasing a huge amount of pollution into rivers and oceans.

Port authorities must ensure security around the clock and in all weather conditions. Those monitoring the port must be alert for multiple threats along all waterways and especially in the vicinity of the ships berthed there. They must ensure adequate revisit times—an enormous task unto itself, considering the size of megaports. They must also be prepared for on-demand inspections, such as when an oil or other spill is detected, or after a storm. Port authorities must accomplish these myriad tasks while monitoring port activities' impact on the environment.

The challenge of providing comprehensive security for an average-size port—let alone some of the world's megaports—is daunting. Port authorities may also be lulled into apathy if the port has operated securely for years or even decades. This can result in giving a simple nod to security and setting up an inspection program that is inadequate to deal with even a modest threat. This is a dangerous approach. The risk—for example, a terrorist group or other disaffected person or persons can attack a port using something as simple as a RHIB and a small amount of explosives to blow a hole in an oil tanker—is just too great.

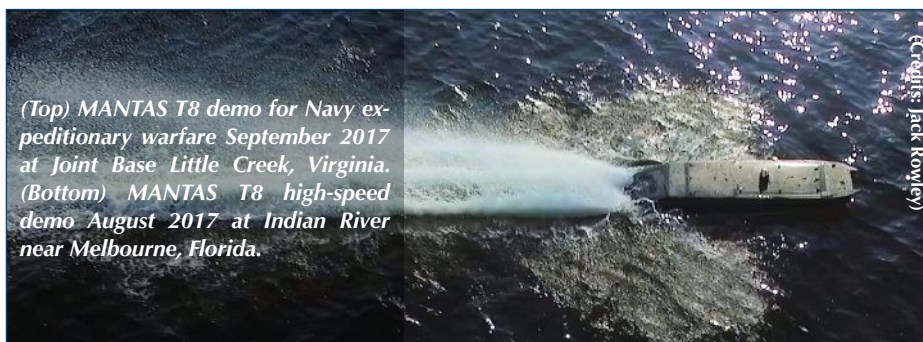
Current State of the Art for Port Security

The state of the art of providing security for ports has not advanced substantially. There are two primary methods of monitoring a port. First, most ports have dozens, scores or even hundreds of cameras placed at strategic locations and monitored by watchstanders. Second, ports provide security with a variety of manned surface vessels (and occasionally air vehicles) that patrol on a regular schedule. This traditional approach is good, but it can lead to gaps in coverage that make the port less secure than it could be.

Cameras would appear to offer an affordable solution for port security. They are relatively inexpensive and can be installed throughout the harbor. However, there



(Top) MANTAS T8 demo for Navy expeditionary warfare September 2017 at Joint Base Little Creek, Virginia. (Bottom) MANTAS T8 high-speed demo August 2017 at Indian River near Melbourne, Florida.



(Credits: Jack Rowley)



(Top) MANTAS T12 patrolling ammo loading dock October 2018 at Naval Weapons Station, Concord, California. (Bottom) MANTAS conducting ISR patrol demo February 2019 at Cape Canaveral Harbor.



(Credits: Jack Rowley)

are second-order effects that come with the use of cameras. The video that cameras collect must be piped somewhere, typically to a command center. There, enough people must be posted to monitor all of the cameras in real time. For ports that have hundreds of cameras, the number of screens in this command center, and the number of watch personnel viewing them, can be quite large. This is an enormous expense, especially when one considers the fact that the command center must be manned around the clock to provide adequate—let alone comprehensive—security. Furthermore, if a camera malfunctions or otherwise goes out of service, this leaves a gap in coverage, and a repair crew must be available to fix the device.

Patrolling a harbor with manned vessels is the second primary method of providing port security. The typical harbor requires several manned vessels to provide effective coverage, and a megaport must be patrolled by multiples of that number. While these craft are relatively affordable, that cost represents only the tip of the iceberg.

These craft must be manned—typically by at least two people at a time—and due consideration must be given to just how long people can bounce along in a small vessel. Add bad weather or choppy seas, and the limits of human endurance lead to either not using the craft at all or switching crews more frequently. And in order to provide sufficient coverage, these crews must take to the water around the clock. It is easy to see how this cost can present a burden that few port officials are willing to bear.

Another issue involved with using manned vessels to patrol ports is the fact that manned vessels drawing any kind of water simply can't reach all areas of the port. Shallow areas must be avoided by manned craft lest they run aground. The larger the craft and the more people and gear carried, the more severe the problem. Add adverse weather like heavy rain or fog and the effectiveness of manned craft decreases even more.

Given the ongoing need to provide 24/7/365 port security and the concomitant inadequate nature of today's systems, some forward-thinking port officials recognize

that they must find a more cost-effective and better way to safeguard their harbors. They are looking for technology solutions that can offer a way to provide enhanced security that is also more affordable. The Port of Los Angeles is one such facility, and it can serve as a leading example for other ports.

The Port of Los Angeles Challenge

The Port of Los Angeles (POLA) is one of the world's largest megaports. POLA contains over 40 sq. mi. of water and 43 mi. of waterfront. A total of 26 passenger and cargo terminals are contained in the port. POLA is, by far, the busiest port in the United States based on volume of cargo handled. In the last year statistics were available, the port handled almost 10 million 20-ft. equivalent units (TEUs) of cargo.

As with most ports, the Port of Los Angeles uses cameras—a total of over 500—to monitor the waters of the port. Also, as with many other ports, POLA employs a fleet of manned vessels to traverse the more than 40 mi. of waterfront, especially in the vicinity of berthed ships. Port officials have watched the costs of providing security continue to climb and were in search of a technology solution to both drive down costs and provide more effective security around the clock.

POLA officials are also acutely aware that the port is an inviting target because it is the most active harbor in the United States, which makes protecting the port all the more important. They also realized that since people make up, by far, the most expensive part of the security equation, costs under the current security structure will only go up year over year.

POLA Technology Demonstration

Due to the fact that it is the busiest port in the United States and is located in the nation's second largest city

“Port authorities must ensure security around the clock and in all weather conditions.”

and third largest airport, there are a large number of government agencies and other organizations that are focused on the security of the Port of Los Angeles. While officials in these entities recognized the desire of POLA officials to contain security costs by seeking a technology solution, they also insisted on a “try-before-buy” approach before replacing current systems with new technology. Therefore, a technology demo was required as a first step before making any wholesale changes in the port’s security protocols.

Port of Los Angeles officials did their due diligence and searched for another port or harbor that had experimented with emerging technology to provide enhanced security. POLA’s search led them to a port security demonstration conducted by the U.S. Army. In September 2017, the Army evaluated three unmanned vessels as part of a Mobile Ocean Terminal Concept Demonstration (MOT-CD) in Concord, California. The demonstration was coordinated by the Army Physical Security Enterprise & Analysis Group. The primary objective was to assess the ability of a small USV to patrol and protect the harbor and ammunition-loading container ships berthed there.

In order to perform a comprehensive evaluation, the Army used three small USVs (6-, 8- and 12-ft.) for varying missions. The family of small USVs provided superior coverage of the expanse of terminal, as well as quicker threat detection and identification than the manned vessels currently in use.

Leveraging what was learned during this successful Army demonstration, Port of Los Angeles officials invited Maritime Tactical Systems Inc. (MARTAC), which provided the USVs for the MOT-CD, to visit in 2019 to demonstrate its MANTAS USV.

MANTAS is a high-performance USV built on a catamaran-style hull and comes in a number of variants ranging in size from 6 to 50 ft. A POLA demonstration was conducted with a 12-ft. MANTAS, as it was deemed that this size USV was the most viable for the wide variety of POLA missions.

The 12-ft. MANTAS (T12) has a length of 12 ft. and a width of 3 ft. and draws just 7 in. of water. Its twin-screw electric propulsion prime mover enables the T12 to cruise at 20 kt. in sea state four. The T12 has a carrying capacity of 140 lb., enabling it to be outfitted with a variety of sensors. It has a cruising range of up to 60 nautical mi. That distance can increase with adaptable solar panels.

The family of MANTAS vessels can be controlled via a remote operator or maneuvered autonomously. The MANTAS can be equipped with a wide variety of above-surface sensors to monitor the water surface or surrounding land areas day and night, as well as state-of-the-art below-surface sensors such as sonars and echosounders. Additionally—and more importantly—the MANTAS can carry a number of sensors that monitor the environment and test for hazardous materials in the air or water. The carrying capacity of the vessel enables it to host various communications packages, facilitating monitoring by watchstanders in real time.

For the POLA demonstration, officials were focused on the Port of Los Angeles’s unique requirements. During the visit to POLA, MARTAC representatives provided a briefing on MANTAS capabilities. They then took a 3-hr. boat tour to observe the entirety of POLA authorities’ span of operations and were able to pinpoint areas where MANTAS could provide enhanced coverage.

The most important part of this demonstration and evaluation occurred when POLA officials were given control of a T12 MANTAS operating off the eastern coast of Florida near MARTAC headquarters. Officials observed how the MANTAS linked its video to what it observed on a Mobile Command Center laptop, as well as how easy it was to control the USV using the same laptop. The demonstration showed how employing a thoroughly tested and proven USV is a viable solution to POLA’s unique security challenges.

One of the MANTAS features especially valued by POLA officials is its open architecture and modular design, which allows for the rapid changing of payload and sensor components to provide day-to-day port security, as well as on-demand inspections. POLA officials were able to “virtually” package different sensor arrangements to meet their particular needs.

This demonstration certified that commercial off-the-shelf (COTS) USVs can be harnessed to conduct a comprehensive harbor security inspection of a megaport. POLA has a longstanding need to augment its manned vessel patrol activities with emergent technology in the form of USVs. The Port of Los Angeles demonstration provided a best practices example of an affordable, readily available means of enhancing port security.

Future Prospects

The technology to provide reliable, adaptable and affordable USV support to augment manned capabilities

and expand the reach of port police at facilities such as the Port of Los Angeles simply did not exist just a few years ago.

Now, this technology is available with commercial off-the-shelf USVs that can increase the effectiveness of port protection. Given the enormous personnel costs associated with monitoring cameras and patrolling with manned vehicles, this new solution will drive down costs. This is not to suggest that ports completely abandon current means of patrol and inspection, but rather that they supplement these means with COTS USVs.

While this article has focused on using commercial-off-the-shelf unmanned surface vehicles for day-to-day, 24/7/365 port and harbor security, COTS USVs are also ideal for use in disaster relief and mitigation. Examples include responding to a catastrophe at a port or power plant, an air crash or ship disaster, or flooding in low-lying areas, when response involves locations too dangerous for humans.

One need only look to events such as the Fukushima Daiichi nuclear disaster in March 2011 to understand the challenges of dealing with these sorts of catastrophes. Rapid location of injured personnel becomes a critical and time-sensitive mission in such cases, and unmanned surface vehicles are suited to the task, especially in shoreline areas not accessible by larger harbor boats or rigid-hulled inflatable boats, or not safely accessible due to potential personnel hazards such as biological, chemical or radiological agents.

“Given the enormous personnel costs associated with monitoring cameras and patrolling with manned vehicles, this new solution will drive down costs.”

Given the way that commercial off-the-shelf unmanned surface vehicles have performed in an increasing number of military and civilian exercises, experiments and demonstrations, one has to ask why they are not being leveraged more fully—and more quickly—for a variety of missions. Like any new technology, COTS USVs take a while to gain traction. But there is danger in waiting too long to put them to use. The possibilities are likely limited only by our imagination. **ST**

Captain George Galdorisi (U.S. Navy, retired) is a career naval aviator whose 30 years of active-duty service included four command tours and five years as a carrier strike group chief of staff. He has a graduate degree in oceanography and has worked with unmanned systems throughout his Navy career.

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Dredging Edge

3D Tech Enables Accurate Visualization for Nearshore Construction

By Jonathan White

Nearshore operations have always been a complex challenge, largely due to limited visibility beneath the surface. In the past, subsurface construction and dredging workflows had to rely on crude tools to monitor progress and positioning. In 2020, technology is enabling as-constructed visibility, safer processes and accuracy to less than 5 cm.

Dynamic marine construction projects are often dependent on underwater surveyors to confirm that work has met design specifications, and these projects can result in expensive rework. It's an industry that has relied on experience and expertise to drive productivity improvements.

However, skilled staff shortages and an aging workforce are forcing many companies to look beyond conventional practice. Technology such as advanced underwater 3D guidance and visualization systems provide

operators, surveyors and contractors the tools to significantly increase productivity, situational awareness and personnel safety.

Eyes Underwater

Borrowing from land-based machine control and 3D visualization advancements, underwater marine construction companies are able to improve productivity and efficiency of underwater tasks such as dredging, crane operations, piling and hydrographic survey.

The key components of machine control/3D visualization technology for nearshore construction are: precision GNSS receivers for heading and positioning; on-vessel sonar scanning to provide real-time updates on material removal; object positioning; and accurate, real-time 3D visualization software to assist the operator with underwater construction tasks.



Cutter suction dredge installed with Trimble TMC precise dredge navigation system.

Operators can use dredging support for pre-/post-dredge surveys in order to identify high and low spots, calculate progress volumes and send grid model updates to both the office and the dredge vessel.

In 2017, Teledyne and Trimble set the groundwork for a first of its kind end-to-end machine control solution for performing dredging and marine construction activities. The solution combines Trimble's equipment-based machine control elements, giving the operator knowledge about the movement of buckets and other machine components, with Teledyne sensors such as multibeam and single-beam sonars and cameras to provide 3D visuals of subsurface activity, even in turbid water. This information is displayed graphically with the Trimble Marine Construction software as a highly accurate, easy-to-read, real-time 3D visualization of the bucket/dredge head relative to design specifications. The software supports multiple sensors, such as laser scanners for wire cranes for more efficient and precise block placement. Scanning sonars can provide fast, accurate updates of placed material before the operator leaves the area, thus reducing rework.

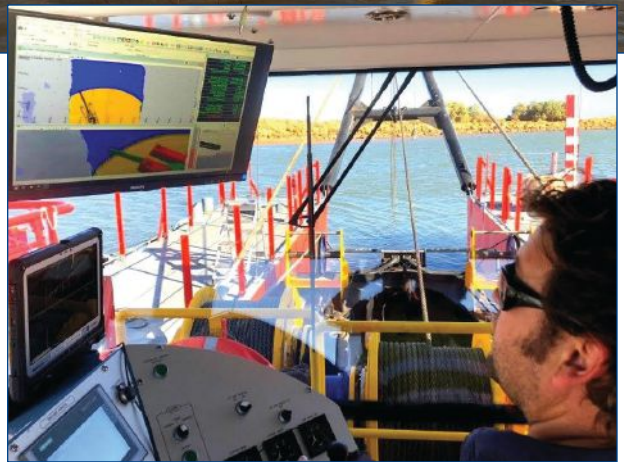
There are myriad benefits of 3D visualization for dredging. It facilitates working to design specs, with color-coded progress view putting an end to overdredging, high spots and/or the need to go back for additional cleanups. Even new operators can quickly and easily understand and adapt to the highly intuitive software interface, while more experienced operators can work faster with greater control. Real-time updates are done via sonar scans to identify progress and help audit dredge blocks before moving the vessel, reducing rework and keeping work to spec. The guidance and inspection system ensures full situational awareness to locate and identify submerged/partially buried unknown objects, cables or other hazards under the waterline before digging. Full reporting capabilities allow managers to monitor job progress, validate project completion and compare project efficiency. Real-time remote access to the operator's screen allows for project training, troubleshooting, support and status updates from anywhere in the world.

In short, 3D dredging tech visualizes the underwater environment, thus expediting dredge and construction operations and increasing profitability.

Precision Guided

The Trimble/Teledyne 3D solution has been invaluable to construction teams charged with underwater projects around the world, such as the demolition of the old Tappan Zee Bridge in New York, a project that began in July 2017.

Working with Trimble and Teledyne, Tappan Zee Constructors implemented a turnkey marine machine control



(Top) Trimble Marine Construction software makes it easy for operators to “see” above and below the surface of the water during this project removing debris from the deconstruction of New York’s iconic Tappan Zee Bridge. (Bottom) Trimble Marine Construction systems show an accurate seabed surface and real-time updates from dredge depth to design surface.

solution to help equipment operators remove the old Tappan Zee Bridge that spanned the Hudson River between Tarrytown and Nyack, New York. The specific solution included Trimble Marine Construction software for visualization; Trimble precision GNSS receivers and antennas for positioning, guidance and tracking of machines; and the Teledyne SeaBat T20 high-resolution multibeam echosounder for marine imaging for subsurface applications.

The Trimble Marine Construction system and Teledyne SeaBat T20 high-resolution multibeam echosounder were used to create a plan for breaking the old bridge structures, which could then be safely removed from the bottom of the Hudson River. Surface data were then provided to the various machine types for guidance in deconstructing the submerged structures. The software was also used to monitor and visualize deconstruction prog-



Tappan Zee Constructors has effectively used the system to break up difficult components and material underwater—without relying solely on divers. When needed, divers have a predictable and well-documented plan before they go underwater to work, thereby improving diver safety.

Blake Yaffee, area manager for the demolition portion of the Tappan Zee Bridge Project, believes his team worked safer and faster with greater accuracy due to 3D visualization tech.

Global Advantage

In Kuwait City, Kuwait, Gulf Dredging & General Contracting relied on machine control and 3D visualization and positioning technology to construct a new armor rock sea wall for the expansion of its scientific center in July 2019.

The conventional method of constructing the sea wall would have required dropping buoys along the wall to guide the crane operator, as well as a diver to help maintain accurate positioning of rocks and pipe alignment with existing construction. Accuracy of rock and pipe placement had to be subcentimeter, and the project had to be completed in just six months. All work had to be performed in daylight for safety and visual referencing.

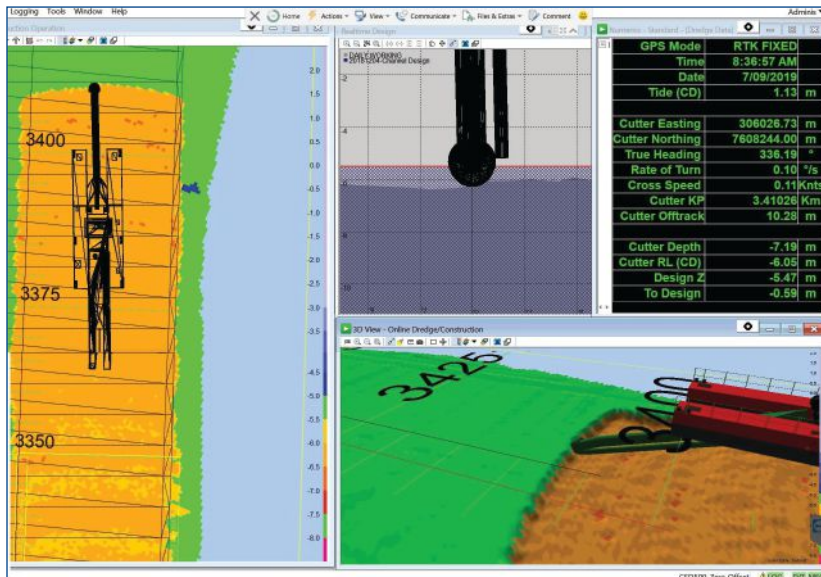
Gulf Dredging sought a machine-guidance system to help manage the process and provide visual and documented verification. Specifically, the team used the

Trimble Marine Construction system on a wire crane to deliver accurate 3D visualization of the bucket relative to the design in 3D to assist the operator with underwater construction work.

Similarly, in Onslow, Western Australia, Maritime Constructions Pty Ltd. used a modular Damen Cutter Suction Dredger 500 “Pilbara Sawfish” (CSD 500) equipped with a Trimble Marine Construction system as part of the Onslow Marine Support Base (OMSB) Channel Dredging Project, a multimillion-dollar effort to expand the wharf and harbor in and around Beedon Creek. The project ran from September 2018 to September 2019. The software-enabled system was used to position and guide dredge operations as part of the reclamation of nearly 1 million cubic meters of seafloor sediment.

Dene Oehme, current sales and technical consultant with Trimble Distributor UPG, explained, “The Trimble TMC-enabled solution allowed crews to dredge to the engineering design with little or no rework. It also provides the team the necessary data for daily progress reports and volumes dredged.”

Oehme trained the dredge crew in the operation of the TMC software and their new surveyor on basic hydrographic surveying techniques for dredge support. “Having worked in this exact role at Maritime Constructions for eight years, I knew exactly what they expected,



(Top) Operators on the Tappan Zee Bridge deconstruction project used TMC software on a jackhammer for precise machine guidance and real-time visualization capabilities. (Bottom) Dredge coverage and depth-to-dredge are displayed in the operator's choice of 3D or plan view.

ress of submerged structures and bridge components. As deconstruction progressed to the removal phase, the survey vessel continually collected data and updated the existing 3D surface model, which was transferred in near real time to the machine fleet to provide the operators with updated views. As part of the demolition, excavators use hydraulic jack hammers and shears to demolish underwater concrete bridge components. With the software, operators are able to visualize the location of their hammers relative to the structures, as well as see which portions have already been demolished.

Andrew Teese, machine operator with the International Union of Operating Engineers 825 in New York working on the Tappan Zee deconstruction, saw instant value in seeing real-time data from inside his cab. “I also have depth, and I have the bucket position in two different views, which aided me in locating debris to be removed. I can position my boom point wherever I want on the image and find whatever was previously scanned,” he said.

“Skilled staff shortages and an aging workforce are forcing many companies to look beyond conventional practice.”

and this allowed me to give specific instructions to their surveyor on the ‘Maritime Constructions way’ of doing things and what they would expect of him,” he said.

The on-site training gave the crews the knowledge to do their system checks and calibrations when required and to extract the daily log and volume data to satisfy the client’s reporting requirements. Besides the dredging work, the precision 3D guidance data are also used for daily progress reports.

For Sikko Krol, manager of dredging and port development at Maritime Constructions, the value is clearly evident. For the OMSB project, he recently reported: “Under dredge was zero, and over dredge was 300 mm.”

Demonstrating DQM Compatibility

The U.S. Army Corps of Engineers (USACE) is also seeing the advantages of 3D visualization. The USACE National Dredging Quality Management (DQM) Program is a nationally standardized low-cost remote monitoring

and documentation system. This system provides USACE with timely data access; multiple reporting formats; full technical support, including dredge certifications, data quality control and database management; and support for the DQM operating system.

On board the dredger, sensors continually monitor dredge activities, operations and efficiency. Information from these sensors is routed to the National DQM Support Center for data processing, storage and publishing. USACE Districts utilize Corps-provided software to prepare summary reports, plots or spreadsheet compilations of dredge operations.

In the DQM Program, responsibility for dredge-monitoring sensor data was with the system provider or dredging contractor. However, legacy systems lacked ruggedness and were prone to failures.

As part of a pilot project with USACE to demonstrate DQM-compatibility in July 2019, Trimble, with Kruse Integration and Measutronics Corp., installed the Trimble

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***“A single application to manage data acquisition and editing
saves time and increases a contractor’s efficiency.”***

cutter suction dredge system on a dredge owned and operated by the Port of Portland, Oregon.

In this test, Kruse Integration bundled dredge positioning data from Trimble hardware and Trimble Marine Construction software with onboard system data and outputted the combined data string per the requirements of USACE. The test verified that data originating from the software are successfully transmitted to the DQM database.

This pilot project opens the door for operators to use DQM-compatible Trimble Marine Construction software for USACE dredge positioning, heading and data collection.

Moving Forward

The Trimble Marine Construction technology has continued to advance in terms of capabilities and applications over the last three years. In 2019, Trimble introduced the Trimble Marine Construction Software for

Positioning, which gives construction contractors the ability to perform pre-/post-construction hydrographic surveys. The software includes single-beam echosounder (SBES) acquisition, data editing and dredge volume calculations. A single application to manage data acquisition and editing saves time and increases a contractor’s efficiency.

Trimble Marine Construction Software for Positioning also supports subscription electronic charts, open-source charts and automatic identification systems (AIS) for improved safety and navigation in congested waterways. It can be used to accurately and efficiently place aid to navigation (ATON) buoys and anchors.

To download the Trimble Marine Construction system buyer’s guide and watch a video, visit trimble.com/marine. **ST**

Jonathan White is the marine product manager at Trimble.



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Harbor Cable Project

Submarine Cable in Busy Boston Harbor Installed in Just 24 Months

By Jenn Said

With more than 65 years of experience installing submarine utilities, Caldwell Marine International has set the bar high by working around obstacles that would cause most contractors to walk away. The marine construction contractor has had to think outside of the box to overcome challenges while installing hundreds of submarine power and telecommunications cables worldwide. So when the U.S. Army Corps of Engineers asked the contractor to remove an existing power cable in Boston Harbor and replace it with a deeper cable on an extremely aggressive time line, Caldwell Marine was up for the challenge.

Background

Originally installed in 1990, the underwater cable provides power to a wastewater treatment plant on Deer Island, a peninsula in Boston. The cable, which runs for 3 mi. between Boston Harbor and the peninsula, was intended to be installed at least 25 ft. below the bottom of

the two shipping channels it crosses. However, during its original construction, crews encountered bedrock, and, instead of 25 ft. below, they placed the cable just 12 ft. below the harbor floor in some areas.

That cable quickly became a roadblock to the Army Corps of Engineers' recent plans to dredge Boston Harbor. Dredging would allow the Port of Boston to accommodate more traffic and large container ships, but because of its shallow depth, the existing cable could sustain damage during dredging and put the crews and their equipment at risk. It would have to be removed before the dredging could start, which put immense pressure on the project's time line. The Army Corp of Engineers wanted the project complete in 24 months—a tall order.

Obstacles to Overcome

The project, which began with cable procurement in May 2018, challenged Caldwell Marine in more ways

Technology played an important role in helping Caldwell Marine replace more than 15,000 ft. of submarine cable under the main shipping channel and across the busy Boston Harbor.





Caldwell Marine's construction ERP system, Viewpoint Vista, helped keep the project on schedule by centralizing and providing complete visibility into the project's financial data, giving both on-site and out-of-state team members easy access to project data.

than one. Along the cable route was Boston blue clay, a stiff marine clay that complicated laying the new cable. Typically, submarine cable is buried using a jet plow to sink it to an appropriate depth, but this method is ineffective in clay because of its density. "Other contractors didn't want the risk of laying the cable, but we were confident we could come up with a solution," said a spokesperson for the Caldwell Marine management team.

The new cable system includes 8,700 ft. of land cable installed through duct banks and vaults in South Boston, transitioning to 15,400 ft. of submarine cable under the main shipping channel and across Boston Harbor, and, finally, back to 1,350 ft. of land cable on Deer Island, where it will be connected to the peninsula's power system.

The location alone required a tremendous amount of perseverance and coordination. The weather conditions put a strain on crews and required provisions to ensure the project stayed on schedule, even at temperatures below zero with the wind chill. "Icy conditions were a safety factor so the crew had to take time to heat the pipelines, clear snow, de-ice and salt," said the Caldwell Marine management team.

The cable route was among congested existing infrastructure in a location with almost 400 years of historic harbor structures and utilities to consider. In addition, the route begins in the busy Boston Harbor and is situated among multiple airways. Not only did the operations teams coordinate project logistics with ship traffic into the harbor, they also coordinated with the Federal Aviation Authority.

"Coordinating the work around water and air traffic required emails and phone conferences twice a day, in addition to constant radio communication," said the Caldwell Marine management team. "It was common to have as many as 40 parties on the calls, working together to sort out logistics."

Around-the-Clock Innovation, Dedication

Caldwell Marine had to mobilize equipment and materials from multiple locations before drilling could start. A horizontal directional drilling conduit with a diameter large enough to accommodate the cable was shipped from Texas, and the cable itself was fabricated and shipped from Europe. "This all took place within six months," said a spokesperson for the Caldwell Marine management team.

At the same time, marine assets, such as barges, tugboats, crew boats for employee transport and cable-handling equipment were provisioned from New York and towed to Boston. Because the new cable system is essentially three cables in one and too stiff for coiling, Caldwell Marine also had to design a cable installation trough and barge setup with special rollers to support the movement of the rigid cable. The rollers mechanically turned the drum as an alternative to coiling the cable.

With the project's equipment and staff provisioned, Caldwell Marine and its sister company, ECI Drilling International, began work with a nearly 3,600-ft. horizontal foot drill operation through bedrock. At 170-ft. depth and 36-in. diameter, the bedrock drill ploughed the remaining distance to reach Deer Island. Three teams worked simultaneously, totaling 72 workers on the job site at all times. The drill crew, marine crew and fusing operation worked 24 hr. a day, seven days a week, through the holidays and winter weather to complete the job.

Success Factors

Caldwell Marine completed the cable installation on schedule in April 2019. As with every project, real-time insight into financial data was critical. Caldwell Marine's integrated construction enterprise resource planning (ERP) system, Viewpoint Vista, kept everything on schedule by centralizing and providing complete visibility into the project's financial data from start to finish.



Caldwell Marine will use the Boston Harbor project data in Viewpoint Vista to improve workflows and increase the quality and profitability of future projects.

Vista played a key role in successfully completing the project on time. "With Vista, project data were automatically synchronized, so teams in the office and in the field were working from the same source of truth and in tune with tracking costs, so nothing fell through the cracks," said a spokesperson for the Caldwell Marine management team. "They spent less time re-entering data, and managers didn't have to wait for field data to be entered before making important project decisions."

Throughout the Boston Harbor project, Vista provided Caldwell Marine's office and field teams with easy access to accounts payable, accounts receivable, general ledger, payroll and cash management data. "Our on-site crew members communicated with out-of-state

offices using Vista," said the Caldwell Marine management team spokesperson. "Without it, approval process for invoices would have been delayed. Vista helped ensure timely payments to subcontractors and vendors and, most importantly, provided accurate financial information on how the project was progressing so managers could identify potential financial implications that could have derailed the project."

Like many contractors, Caldwell Marine used paper to track financial data before moving to Vista. "The ef-

iciency gains and ease of use are the greatest benefits with Vista," said the Caldwell Marine management team. "Data are always accurate, and the team can access it from anywhere, at any time."

With the project complete, Caldwell Marine plans to use Vista to review historical cost data. "Our management team will run reports on this project and others to learn what works and what doesn't," said the Caldwell Marine management team. "This insight helps improve workflows to increase the quality and profitability of future projects." **ST**

Jenn Said is a freelance writer covering construction technology.

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Digital Engine Monitoring

Connectivity Enables Continuous Cylinder Oil Tracking, Analysis

By Joris van Brussel • Marcus Schaerer • Peter Decock

Managing lubricating oils—lubeoils—on board ships operating remotely has always presented a challenge for engineers at sea. There are the practical issues, such as ensuring that the right products are available in the right quantities at ports on a schedule, or holding enough reserves on board if a ship's schedule changes.

More recently, with far more sophisticated marine engines in service under changing operating parameters, the need to monitor the condition of shipboard components has become pressing, with the analysis of lubeoil samples a key indicator of machinery condition. The case for lubricant monitoring on board ship and analysis in laboratories ashore has become increasingly convincing.

A wider mix of marine fuels, including new blends with no track record, and specific requirements by OEMs that the latest engines run on strict guidelines specified by them is making lubeoil monitoring and analysis more important than ever. Shell Marine has certainly noted a recent upturn in customer interest and expects that to increase significantly as new challenges emerge in the field.

Until recently, there was limited technology available for monitoring the condition of shipboard components by taking lubeoil samples. Now, though, with new connectivity, it is possible for samples taken on board ship in the middle of the ocean to be assessed and subsequently compared with tests undertaken ashore. These ensure that main engines and other components

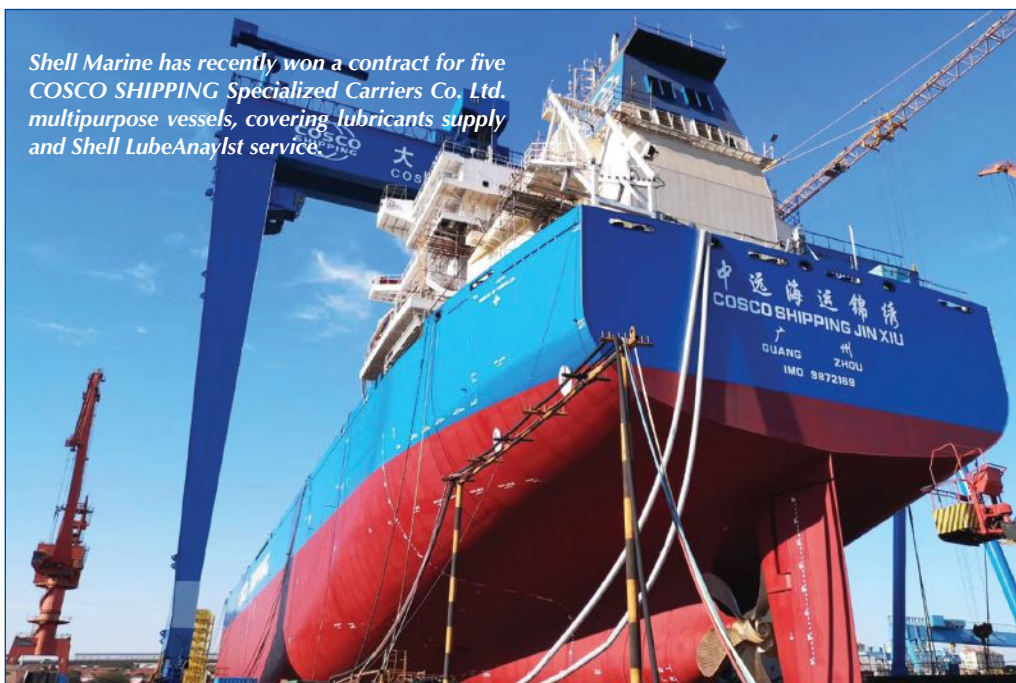
are not suffering undue wear and are operating within their design parameters.

Yet many shipowners and managers have not yet adopted new systems. Lubeoils figure prominently in a ship's daily operating expenditure and amount to a major cost center. With a range of new relatively untested fuels now a part of the bunker mix after the implementation of the International Maritime Organization's 2020 sulphur cap (IMO 2020), effective lubeoil management is more important than ever.

Effective Risk Management

Today, the technology is available to facilitate a whole new approach: Ship operators now have scope to control and potentially reduce lubeoil bills, as well as reinforce

Shell Marine has recently won a contract for five COSCO SHIPPING Specialized Carriers Co., Ltd. multipurpose vessels, covering lubricants supply and Shell LubeAnalyst service.





Shell Marine is completing alpha trials for AccuPort, a real-time information system designed to bring complete transparency to the procurement of the complex range of luboils required by ship operators today.

their risk management systems. Luboils are important for so many aspects of a ship's operation that it is sometimes easy to overlook the critical part they play in ensuring the vessel runs according to plan. They are required to lubricate and protect main engine and auxiliary components; they are needed to ensure the smooth-running of deck machinery and other cargo-handling equipment; and they are also necessary to protect machinery that operates at oil-to-sea interfaces such as propellers, stern tubes and thrusters.

Shell Marine is overseeing the introduction of a growing digital portfolio of "smart" software systems that provide ship operators with new scope to manage luboils and the machinery for which they are required.

This includes day-to-day monitoring of feed rates and usage, but also the deeper analysis that is now possible and can reveal information that has not previously been available to engineers at sea; variables such as component wear rates and the impact of new bunker blends.

Enhanced Connectivity

Until recently, seagoing staff could only carry out a limited number of tests at sea, but new connectivity means that a digital approach is possible. This can reveal the potentially harmful effects of substandard fuel and the impact of specific dangers, including cat fines and other contaminants that can potentially wreck the internals of a marine engine.

There has always been a compelling case for luboil monitoring, and, while many ship operators have avoided it, that case has become more pressing recently. Over the last few years, the pace of new engine development has moved very quickly as OEMs have optimized designs for improved fuel economy: after new engines have been introduced, and new challenges have emerged.

More than ever, OEMs themselves have been recommending that customers monitor what is going on in their engines properly in order to identify issues as early as

possible. With IMO 2020 adding a change in fuel types in use, even more variables have been introduced, bringing greater uncertainty. Closer engine monitoring allows customers to identify and respond to technical issues before they become catastrophic failures.

Shell Marine's LubeMonitor condition monitoring program addresses this need for two-stroke marine engines. It offers access to tools and advice to help strike and maintain an acceptable balance between cylinder oil costs and wear-related maintenance expenses.

However, the fact is that some owners see lack of failure as an opportunity to do less sampling and testing, on the basis of running assets as cheaply as possible. Among Shell Marine's own two-stroke engine oil clients, fewer than one-third have monitoring at all; not simply Shell LubeMonitor, but any standard used-oil analysis. Shell Marine's view is that, to be truly effective, luboil management needs to be continuous.

The good news is that the company believes more ship operators are likely to adopt luboil monitoring strategies in the months ahead, particularly if issues arise from the introduction of new 0.5 percent sulphur fuel blends. Furthermore, improved connectivity between ship and shore will shift attitudes by underpinning new luboil monitoring technology and greater functionality. Real-time, sensor-based monitoring is an important goal for luboil management and may soon be a reality.

Monitoring, Analysis and Risk Management

Shell Marine clients have the option of two possible services for monitoring and analyzing luboil samples. Shell LubeMonitor, a new version of which is about to be released, is a cylinder condition monitoring system in which the data from samples taken on board ship are sent ashore via the company's Marine Connect system.

Samples are then uploaded into a database ashore, analyzed by diagnosticians and compared with shipboard readings. Luboil issues are addressed with recommendations made to shipboard staff, and any anomalous sample readings from ships are notified as possibly requiring a recalibration of shipboard equipment.

Shipboard staff are sometimes reluctant to make any changes to engine operating parameters as a result of feedback from luboil sampling. But the Shell LubeMonitor service has inspired more confidence among engineering personnel at sea, partly because today's more critical engines have strict operating parameters laid down by engine manufacturers. There has been a definite upturn in interest from new customers who are implementing new engine-related risk management procedures.

Complementary to Shell LubeMonitor, Shell LubeAnalyst was launched in April 2019 as a new technical service that replaces Shell Marine's earlier Rapid Lubricant Analysis (RLA). Customers can log in to a portal and

dashboard that provides insights into the analytical results of samples that have been sent. For example, the samples are categorized as “Normal,” “Action” or “Attention,” and then comparisons can be made with similar machinery on other ships in the fleet, for example, so that users can get better insights from the data.

Customers who previously used the RLA service have been migrated to the new setup, which is now used by about 90 percent of clients, although this might not necessarily be on the main engine; it might be used on the stern tube product and other supplementary equipment, for example.

Annual Growth

These customers are now logging in to the new Shell LubeAnalyst portal more frequently, and year-on-year growth in traffic is an encouraging sign. A greater number of luboil samples are now going through the system.

Currently, the setup is not developed for real-time analysis, given that samples need to be sent to laboratories for testing. However, the dashboard includes a tracking function so that customers can see the position of a sample across the system. If a sample is found to be normal, it gets a green light and the next time the customer logs in to the portal, this information is available.

If, on the other hand, there is an issue with the sample, then it will be sent on to a diagnostician for further analysis. Recommendations are then posted on the portal, which, once again, are available to the customer at the next log-in.

Digital Co-Creation Strategy: a Win-Win

Complementary to luboil analysis, Shell Marine has initiated a unique project that promises to transform luboil management through a smart digital setup called AccuPort. The system, currently completing its alpha trials, is designed to provide real-time information and complete transparency on the procurement of an increasingly complex range of luboils required by ship operators today.

Primary products for main engines and auxiliaries to secondary oils for gears, hydraulic applications and oil-to-sea interfaces, sometimes requiring environmentally acceptable products, are essential for safe ship operation. Through AccuPort, the right products will be made available in the right quantities and at the right time across a global distribution network that extends to more than 700 ports in 61 countries.

The beta-stage pilot trials are engaging more Shell Marine luboil customers, with between 500 and 800 ships involved. Already the software has been enthusiastically received, and some third-party ship operators have asked to join the project.

Luboils are an important indicator on the longevity of main engines, auxiliaries and other shipboard plants, as well as being a cost: Shortcomings in luboil management are rarely due to human error; rather, issues tend to arise due to poor information.

Until recently, limited connectivity between ships and shore meant that office-based managers had no clue

about luboil volumes remaining on board, or whether the right products from their chosen supplier would be available at the next port of call. Meanwhile, shipboard personnel might not even know where they were heading next.

If the right products are not available, there can be far-reaching implications. These sometimes involve extra time in port while last-minute luboil supplies are procured before a ship sails, or possibly require an extra port call if hydraulic oil is not available at a destination port, for example, putting ships' cranes at risk.

Enthusiastic Reception

Large companies facing equivalent scenarios usually commission third parties to design systems that are then adopted in-house or leave independent operators to build standalone software systems and then adopt them. Shell Marine believes that neither approach is as effective as AccuPort, with the software so far meeting an encouraging response. Working together with customers during the alpha and beta pilot stages has also led to a range of additional user-centric features being included in the software.

Some customers asked whether it would be possible for products other than those supplied by Shell Marine to be managed using the AccuPort platform, for example. While no decision has been taken on this yet, AccuPort's open setup could become an appealing feature for other ship suppliers while potentially enhancing Shell Marine's customer base. **ST**

Joris van Brussel is Shell Marine's global general manager. Originally from the Netherlands, he is based in Singapore and joined Shell 17 years ago straight out of university. He has worked across various businesses (renewables, fuels, operational excellence and brand licensing) all over the world, with a special focus on customer innovation, setting up new businesses and new market entries. Shell Marine has a presence in 61 countries and 710 ports, serving more than 10,000 vessels per year.



Marcus Schaerer is Shell Marine's global technical and operations manager. With almost 25 years of tenure in marine businesses, he has developed enterprise-to-enterprise knowledge in sales, operations, marketing and business development that help him to contribute effectively to Shell Marine's bottom line. He has held several key roles in Shell Marine since he joined the team, including sales manager and global roles in technical, marketing and business development.



Peter Decock is Shell's marine digital commercial manager. With more than 16 years' experience working at large multinationals in the business-to-business commercial environment, he is a specialist in customer relationships, co-creating products and setting up contracts. He joined Shell more than six years ago, working in the commercial area for fuels and new energies. Decock was appointed as the commercial manager for the AccuPort project, a predictive buying solution that has been deployed on 500 vessels to date.



Safety at Sea

Navigation Evolves in the Era of Smartphone Apps

By Laurence T. Bussey

Safety at sea is foremost in every mariner's mind, like when the first Polynesian pushed his dugout canoe into the surf. Would he find his destination and reach it without incident? Would he be cast away upon some hidden reef? Would a sudden tsunami consume him? Would he ever see his family again? These questions persist for the modern mariner.

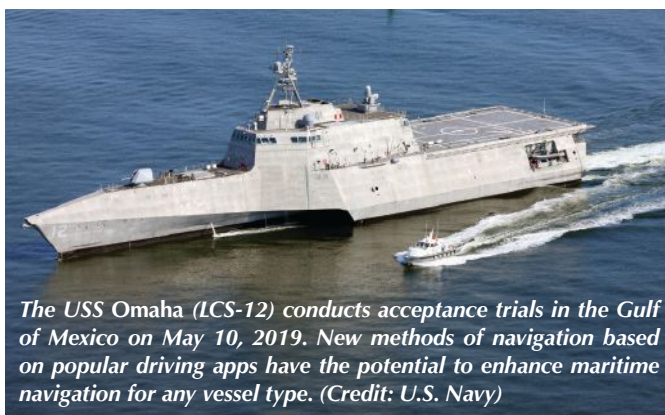
Accurate navigation is essential to safety at sea. In the 3rd century B.C., Eratosthenes first proposed a system of latitude and longitude for a map of the world. In the 2nd century B.C., Hipparchus was the first to use such a system to specify locations on Earth. Around 2,000 B.C., the Phoenicians developed the art of sea navigation by composing charts and observing celestial bodies to determine direction. Now, yachtsmen and ocean navigators still utilize identical locational baselines.

For centuries, ocean navigation was calculated along the lines of latitude, so a ship knew its distance north or south of the equator and could remain on that line sailing either east or west.

Longitude, the distance east or west of a given line we know as the prime meridian, had been impossible to compute. It wasn't until the Englishman John Harrison's invention of a stabilized chronometer in the mid-18th century that distance at sea could be accurately calculated.

Both the chronometer and sextant became the essential tools for commercial, military and pleasure-boat navigators.

Near the end of the 20th century, all that changed with the advent of GPS.



The USS Omaha (LCS-12) conducts acceptance trials in the Gulf of Mexico on May 10, 2019. New methods of navigation based on popular driving apps have the potential to enhance maritime navigation for any vessel type. (Credit: U.S. Navy)

Sat-Based Positioning

The Global Positioning System (GPS), originally Navstar GPS, is a satellite-based radio navigation system owned by the United States government and operated by the United States Air Force. It's a global navigation satellite system that provides geo-location and time information to a GPS receiver

anywhere on or near the Earth, where an unobstructed line of sight to four or more GPS satellites exists.

The Russian Global Navigation Satellite System (GLONASS) was developed contemporaneously with GPS, but suffered from incomplete coverage of the globe until the mid-2000s. China's BeiDou Navigation Satellite System is due to achieve global reach in 2020. In addition, there are the European Union's Galileo positioning system and India's NAVIC. Japan's new Quasi-Zenith Satellite is a GPS satellite-based augmentation system to enhance GPS's accuracy.

Since 2015, high-quality Federal Aviation Administration-grade, Standard Positioning Service (SPS) GPS receivers have provided horizontal positioning that exceeds 3.5 m, although many factors such as receiver quality and atmospheric issues can affect this accuracy.

Collisions at Sea

With the advent of the international Global Positioning System, the safety of vessels at sea worldwide has been enormously enhanced. However, that innovative technology has not gone far enough to prevent collisions at sea.

Incorporating the most accurate maritime computing systems, the Arleigh Burke-class destroyers USS John S.

McCain and *USS Fitzgerald* still resulted in the loss of 17 American lives after collisions with merchant vessels. After months of investigating the circumstances of the collisions in the Pacific Ocean, the U.S. Navy concluded that both incidents were “preventable and avoidable,” with the responsibility settling on numerous officers and enlisted personnel for causing the incidents. The nature of these accidents had initially seemed so bizarre, they quickly prompted a raft of conspiracy theories, but the official investigations reinforced subsequent reports that pointed instead to specific personnel error.

In an associated press release, the Navy described the mishap involving *Fitzgerald* and the container ship *MV ACX Crystal* on June 17, 2017 as the result of “an accumulation of smaller errors over time, ultimately resulting in a lack of adherence to sound navigational practices.”

When the *John McCain* collided with the chemical tanker *MV Alnic MC* on August 21, 2017, “complacency, overconfidence and lack of procedural compliance” were major factors in that accident, the Navy concluded.

In another collision example, the loss of the *SS El Faro* was the deadliest shipping disaster involving a U.S.-flagged vessel in more than 30 years. Its demise was caused by “the captain’s failure to avoid sailing directly into a hurricane despite numerous opportunities to route a course away from hazardous weather,” the National Transportation Safety Board announced. The 790-ft. cargo vessel, on a voyage from Jacksonville, Florida, to San Juan, Puerto Rico, sank October 1, 2015, during Hurricane Joaquin, taking the lives of all 33 aboard.

As for the *HMS Bounty*, a captain’s “reckless decision to sail into the well-forecasted path of Hurricane Sandy was the probable cause of *Bounty*’s sinking off the North Carolina coast in October 2012,” according to the National Transportation Safety Board. The captain and one crewmember died in the accident. Three other crewmembers were seriously injured.

Bulk Carrier Segment

The International Association of Dry Cargo Shipowners (INTERCARGO) released a report on bulk carrier casualties from 2008 to 2017 that states that 53 bulk carriers over 10,000 dwt were identified as total losses, with cargo shift and liquefaction contributing to the greatest loss of life among seafarers in the bulk shipping trade.

In total, cargo failure was blamed for nine vessel casualties from 2012 to 2015, resulting in the loss 101 lives. The nine casualties consisted of six bulk carriers carrying nickel ore from Indonesia, two vessels with laterite (clay) iron ore from India, and one with bauxite from Malaysia.

The number of fatalities from cargo failure accounts for exactly half of 202 total lives lost among the 53 total losses recorded from 2008 to 2017, according to INTERCARGO.

As of 2008, the most common reported cause of ship losses has been grounding, totaling 22 losses among the 53 incidents noted. A total of six ships were lost to unknown causes that claimed the lives of 61 seafarers. Meanwhile, flooding led to losses of eight ships and 14 lives.

In 2017, the INTERCARGO database recorded a total of 337 bulk carrier incidents.

Situational-Awareness Assistant

With today’s technology, there is a greater ability to prevent accidents. Do we need two decision makers continuously on the bridge checking each other? That’s neither practical nor realistic in the commercial or military world.

But what if the captain has a “situational-awareness assistant” continuously informing him or her of any ship/object that may pose a potential hazard within a variable set radius (5-mi. zone, for instance)? Such a “zone report” would consist of: vessels operating within the zone, specifying their courses, speeds, CPA and risk of collision; recommended evasive action should the risk of collision exist; course information such as SOG, distance, bearing, ID of next navigation aid, time to turn to new course, time to reach destination, arrival time to destination; proximate weather conditions, including wind speed and direction, visibility, temperature, rainfall, fog; sea conditions, including wave height, current, direction/speed, surface temperature; surface hazards, including sea life, icebergs, cargo containers and other flotsam/jetsam reported by other vessels; and ancillary information, including fuel range, propulsion/auxiliary machinery online, height of bilge water, freshwater levels, watch time remaining, cargo hold temperatures, inclinometer patterns, etc.

Safety of a ship and its crew is of paramount importance aboard every vessel, regardless of size. Currently, on the bridge of a naval vessel, information to the officer on deck is conveyed verbally from a number of sources, including wing lookouts, helmsman, engine order telegraph operator, navigator, signalman, combat information center and the radio operator. These reports may come at different times during the watch, so a consolidated situational report is difficult to conceive. Even with all the information necessary to make safe operational decisions, the sources of information are often so disparate that lapses in computation time may lead to a dangerous situation for the vessel.

Yachtsmen generally have a less complex set of circumstances to deal with, and today’s multipurpose/multi-focal screens convey situational awareness continuously. However, diverting the skipper’s attention from his surroundings to view a visual information screen would be unnecessary with a system that transmits continuous audible safety messages.

Enter SeaWaze and VNav. SeaWaze, invented by French company eOdyn, is a community-based maritime navigation service using measured sea conditions. It operates akin to Waze, the crowdsourced traffic and navigation app owned by Google. Waze is joining the Smart-DeviceLink Consortium and working with automakers and developers on open-source protocols for connecting smartphones to cars. That means that everything you do in Waze, you’ll soon do from the driver’s seat with a few taps and swipes on the infotainment screen. Why not have a similar system working on your ship’s bridge?

VNav stands for voice navigation, and it is a system that is currently in the concept stage. Visualize this: The ship driver coming on watch inserts a pair of wireless ear buds and checks the Bluetooth connection on the VNav unit. A test tone indicates connection, and the range covers 1,000 ft. A handheld unit triggers any of the selectable real-time voice channels, which announces the requested information. An emergency override channel immediately warns of vessels that pose a risk of collision, or any other hazard, and recommends the proper evasive action.

The amalgam of information from various sources (AIS, weather databases, GIS, ECDIS, etc.) provides safety input to the VNav system. Consider the GPS apps available to you in your car, e.g., Waze and Google Maps. Initially, they give identical location information based upon GPS signals. When you select your destination, you receive time and direction guidance. These apps work seamlessly for the most part and provide the data you need to traverse from point A to point B over the road. Simple. Some apps go even further, and utilize crowdsourcing to allow users to input safety information in real time that may be useful to others in the same vicinity. Police, accidents, stranded cars, road and traffic slowdowns are commonly reported by travelers. From a safety aspect, that information is very useful because it's transmitted in real time.

The algorithms incorporated into the VNav system are designed to be operationally selective, and voice reports

are based upon the ranking of each parameter within the sampled base. While the yachtsman or ship operator can manually or verbally select the information desired, the system continuously samples all bases, and if any exceed their pre-programmed safety threshold, that information is immediately communicated to the ship driver.

When the skipper receives audible information in real time, in addition to other selected source material, the result will be a knowledge-based situational-awareness scenario whereby every harm factor will be clearly identified for instant evaluation.

The VNav system will directly apply to current navigation products produced by Furuno, Garmin, Raytheon, Simrad, etc. It will also be produced as an app and widely distributed in the yachting and commercial vessel world. At this stage, developers for the app are being chosen. For more information, contact skipper@neyachts.com. **ST**

Laurence T. Bussey is a resident of York, Maine. He has a bachelor's degree from the University of Maine and a master's degree in maritime history from the University of New Hampshire. He served a 20-year career as a U.S. naval officer and was an aquanaut in the Navy's Sealab program. He commanded the experimental MK I Deep Dive System, establishing a world-record 850-ft. open-sea dive in 1970 off the California coast. He later became CEO of Aledo Marine USA, founded YachtVantage Inc. and now owns a yacht brokerage company in New England. He developed and patented the VNav concept.



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Guidelines for Autonomous Ships

ClassNK has released its "Guidelines for Automated/Autonomous Operation of Ships: Design Development, Installation and Operation of Automated Operation Systems/Remote Operation Systems." The guidelines are available at www.classnk.com.

In the field of ships, research and development of technology related to maritime autonomous surface ships (MASS) has been actively carried out to improve safety by preventing human error and improve working conditions by reducing the work load on crew members. Demonstration experiments are being carried out on a global scale.

Sustainability Award for Hybrid Conversion

Subsea 7 and Eidesvik Offshore won the International Marine Contractors Association (IMCA) Environmental Sustainability Award for 2019 in recognition of efforts to reduce vessel emissions and improve energy efficiency.

In January 2019, *Seven Viking* was successfully converted from a conventional to a hybrid vessel as part of a long-term inspection, repair and maintenance services contract with Equinor in Norway. The conversion delivers fuel savings, emission reductions and reduced maintenance costs.

Washwater Monitor in Compliance

Following exhaustive system testing and review, Rivertrace Ltd. has received a statement of compliance from DNV GL for its Exhaust Scrubber Washwater Monitor - SMART ESM.

Any washwater used by wet scrubber systems to remove pollutants from exhaust gas must be monitored to ensure it meets IMO regulations for water quality parameters prior to discharge to the ocean.

AEGIR-Marine Now in Dubai

AEGIR-Marine is expanding its global services network by opening a new office in Dubai, United Arab Emirates (UAE). The maritime stern tube seal and propulsion system service provider will now operate out of offices in the Netherlands, Singapore, Shanghai, Namibia, U.S. and UAE. The Dubai service team will focus its activities on the strong Middle East oil and gas industry in addition to the company's core business of commercial vessels.

JFD Acquires Testing Business

JFD has announced the acquisition of the business, including all intellectual property rights and assets, of Ansti Test Systems Ltd., an independent global designer and manufacturer of test facilities for performance measurement of underwater breathing apparatus. The acquisition is part of the company's long-term ambition to provide underwater diving equipment with unparalleled safety and performance, protecting and preserving life in the harshest marine environments.

New Member for Decarbonizing Coalition

Alfa Laval has joined the Getting to Zero Coalition, a coordinated effort to fight climate change by introducing zero-emission vessels by the year 2030.

Alfa Laval is committed to reaching this vital goal, which is key to decarbonizing the global shipping industry and reaching the International Maritime Organization (IMO) target of cutting vessel-related greenhouse gas emissions by at least 50 percent by 2050.

Expanding Connectivity Options

Inmarsat and ITC Global have announced a five-year strategic collaboration. They will combine their services to offer broadband connectivity, paired with connectivity solutions to customers in the maritime, yachting and off-shore energy sectors.

ITC Global will offer Inmarsat's Fleet Xpress service, incorporating the Ka-band solution into its existing comprehensive range of Ku-band connectivity services. Fleet Xpress for Offshore is powered by the Global Xpress Ka-band network, combined with the proven reliability of Inmarsat's flagship, FleetBroadband L-band service.

New AYOP Member

Engineering firm Pentacon has joined Amsterdam IJmuiden Offshore Ports (AYOP). The company from Haarlem specializes in the design, manufacturing and supply of special tooling for various sectors, including the offshore, heavy and space industries.

Milestone for US-Canada Cooperation

The U.S. Coast Guard and the Canadian Coast Guard celebrated the 40th anniversary of the Cooperative Vessel Traffic Services (CVTS) in Seattle.

The CVTS provides a system of shipping traffic management in the waters from Puget Sound to as far north as Prince Rupert, British Columbia. This cooperative allows for safe and expeditious movement of vessel traffic while minimizing the risk of pollution.

Phoenix Chosen for Mandatory Hull Cleaning

Phoenix sent a dive team to international waters 12 mi. from Auckland, New Zealand, to attend to a vessel denied entry into New Zealand due to fouling evident on the hull's niche areas.

The Phoenix dive team performed niche-area cleaning and subsequent underwater video inspection. They submitted the evidence to the New Zealand Environmental Protection Authorities so that the vessel was able to be cleared in time to fulfill its obligated charter in Auckland.

USCG, ABS Approval for SM200

Sea Machines Robotics announced that the U.S. Coast Guard (USCG) and American Bureau of Shipping (ABS) have approved the company's SM200 commercial wireless helm for installation aboard a class of U.S.-flag tugboats that support articulated tug-barge (ATB) sets. An industry first in wireless vessel control, the two bodies granted their approvals after an exhaustive review of the technology and applications aboard these tugs, deeming

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the system satisfactory for shipboard installation and trials. The SM200 enables wireless helm and propulsion control, as well as remote control of auxiliaries and payload equipment, freeing mariners from the wheelhouse to conduct operations from any location that offers the greatest visibility and safety.

Greensea Opens Second Location

Greensea Systems, headquartered in Richmond, Vermont, plans to open an office on the waterfront in Plymouth, Massachusetts. The new location, at Cordage Park Circle, will be the company's first office outside of Vermont and will house a growing team of software developers and robotics engineers.

Iridium Formally Approved to Offer GMDSS

Iridium Communications Inc. announced that a letter of compliance was signed by the International Mobile Satellite Organization (IMSO) stating it has positively verified the operational and technical requirements as requested by the Maritime Safety Committee (MSC) of the International Maritime Organization (IMO) for Iridium to provide Global Maritime Distress and Safety System (GMDSS) service. The letter formally authorizes Iridium to provide satellite GMDSS service, bringing global coverage and a choice of both network and equipment to this critical emergency service for the first time.

NOIA Adds Focus on ESG

The National Ocean Industries Association (NOIA) board of directors has approved the establishment of the NOIA Environmental, Social & Governance (ESG) Principles and Program. NOIA's ESG Committee establishes a programmatic effort through the NOIA ESG network to share, develop and promote best practices across the industry.

NOIA member companies operate in coastal and ocean environments with safety, health, environmental protection and sustainability as core values. They recognize the risks of climate change and strive to contribute solutions and best practices to optimally balance societal and environmental needs.

TerraSond Wins NOAA Contract

TerraSond, an Acteon company, has been awarded a five-year IDIQ contract by the Hydrographic Surveys Division of NOAA's National Ocean Service, Office of Coast Survey, to provide hydrographic surveying services. Under previous contracts with NOAA, TerraSond has surveyed more than 7,120 square nautical miles of U.S. waters in Alaska and the Gulf of Mexico since 1998, providing data for NOAA nautical charts.

Another Patent for FarSounder

FarSounder has expanded its IP portfolio with the issuance of its fifth U.S. patent, number 20150369908. The company manufactures 3D forward-looking sonar systems that provide valuable information for reliable navigation and clear understanding of the seafloor beneath a vessel. **ST**

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Rapid DNA Identifies *Conception* Victims

Thirty-four people died in a tragic boat fire on September 2, 2019 off the coast of Santa Cruz Island, California. Five crew members escaped with injuries after calling for help, but the intense fire aboard the *Conception* dive boat left the other victims unrecognizable.

Thanks to a technology funded by the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) and developed by Massachusetts- and Colorado-based ANDE Corp., the 33 passengers and one crew member who died were quickly identified.

The Santa Barbara Sheriff-Coroner relied heavily on a Rapid DNA instrument to identify the victims in 10 days, which had not been previously possible.

House Legislation for Coastal Protection

The U.S. House has passed the Coastal and Great Lakes Communities Enhancement Act (H.R. 729). The legislation includes provisions from two of Rep. Suzanne Bonamici's (D-Ore.) bipartisan bills, the BLUE GLOBE Act and the ICOOS Act, to help coastal communities better address rising sea levels, coastal flooding, harmful algal blooms, hypoxia and other effects of climate change by strengthening ocean data collection and monitoring.

Bonomici, co-chair of the House Oceans Caucus, offered several amendments to the bill, which were adopted. With her amendments, the bill allows coastal communities to seek funding to study coastal acidification, hypoxia and harmful algal blooms through an existing grant program. The bill also paves the way for high-risk, high-reward ocean research by directing NOAA to join the National Academy of Sciences to assess the need for and feasibility of an Advanced Research Projects Agency–Oceans (ARPA–O).

The Coastal and Great Lakes Communities Enhancement Act is a package of 10 bills to protect the ocean and Great Lakes and help coastal and lakeside communities. The bill includes: the Integrated Coastal Ocean Observing System Act, Tribal Coastal Resiliency Act, Living Shorelines Act, Keep America's Waterfronts Working Act, District of Columbia Flood Prevention Act, Coastal State Climate Preparedness Act, National Fish Habitat Conservation Through Partnerships Act, Great Lakes Fishery Research Authorization Act, Digital Coast Act, and National Sea Grant College Program Amendments Act.

Fugro to Survey for NOAA

Fugro has been awarded a five-year indefinite delivery indefinite quantity (IDIQ) contract by NOAA to provide hydrographic surveying services. The contract was issued by NOAA's National Ocean Service, Office of Coast Survey, to support the creation and maintenance of highly accurate nautical charts. Fugro has worked continuously with the agency on similar IDIQ contracts since 1998.

Fugro will manage all work from its Houston-based Hydrography Centre of Excellence in the Americas. Two new technologies available to NOAA for upcoming task

orders include RAMMS, a next-generation airborne LiDAR bathymetry system already used by the United Kingdom Hydrographic Office and the Canadian Hydrographic Service, and a USV designed for coastal surveys in challenging areas of shallow water, uncharted shoals and/or water clarity issues.

The new IDIQ contract will run from January 2020 to December 2024. Fugro is one of seven contractors who will receive task orders under the new IDIQ contracting program.

ABB Testifies on Carbon-Free Maritime Industry

ABB Marine & Ports has delivered testimony in the U.S. House of Representatives Committee on Transportation and Infrastructure about the future of marine technologies. Underpinning ABB's commitment to tackling the ever-increasing consequences of climate change, ABB Marine & Ports presented a comprehensive approach to reducing marine emissions at a hearing in front of the Subcommittee on Coast Guard and Maritime Transportation. The hearing on "The Path to a Carbon-Free Maritime Industry: Investments and Innovation" assessed current and future technologies for zero-emission vessel operations.

As the sole original equipment manufacturer (OEM) to testify at the hearing, ABB Marine & Ports presented an extensive overview of proven technologies that are commercially available today to reduce marine emissions, as well as shared recommendations for driving the shift to sustainable shipping and further developing solutions for enabling this transition.

ABB aims to reduce its greenhouse gas emissions by 40 percent by 2020 from a 2013 baseline.

New Coastal Watersheds Grant Program

Restore America's Estuaries' (RAE) has established its newest partnership with the U.S. Environmental Protection Agency (EPA). RAE, in close coordination with EPA, will be administering the National Estuary Program Coastal Watersheds Grant Program.

This newly established program is designed to support projects that address urgent and challenging issues threatening the well-being of coastal and estuarine areas within determined estuaries of national significance.

The grant program supports the following priorities: loss of key habitats; recurring harmful algae blooms; unusual or unexplained marine mammal mortalities; proliferation or invasion of species; flooding and coastal erosion; impacts of nutrients and warmer water temperatures on aquatic life; and contaminants of emerging concern found in coastal and estuarine waters.

MARAD Finances Marine Highways

The U.S. Department of Transportation's Maritime Administration (MARAD) has announced more than \$7.5 million in grants to nine marine highway projects.

The funding, provided by MARAD's America's Marine Highway Program, will go toward enhancing existing services in Florida, South Carolina, Kentucky, Louisiana, Michigan, Oregon, Texas, Virginia and Washington. **ST**

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All-Electric LARS



eLARS can be delivered as a complete system or as a standalone A-frame and will support inspection-, observation- and work-class ROVs. It is eco-friendly and includes zero-pressurized oil over water, significantly reducing the risk of harmful oil spills. eLARS requires less vessel power, enabling vessels with smaller generator sets to operate the system. MacArthey A/S.

Combo VHF/AIS+AM/FM

Available in 4- and 8-ft. lengths, this antenna delivers superior broadcast and reception performance in a space-saving package. It has a VHF frequency of 156 to 157 MHz, AIS 162 MHz, FM band 88 to 108 Mhz and AM 540 to 1,600 MHz. Air-Wave Marine.

Weather Info

Designed for real-time, site-specific weather information, the 110WXS and 150WXS WeatherStation Multisensor instruments can operate as standalone or integrated into systems designed for weather monitoring over larger geographic areas. AIRMAR Technology Corp.

High-Torque Access Plate

Traditional threaded deck or access plates can be extremely difficult to remove when used in high-pressure or near-vacuum conditions. The DP60 watertight 6-in. plate has a clear center for easy visual inspection of controls or gauges mounted behind panels or in engine rooms. A round handle and deep finger holes facilitate opening and closing by hand. Beckson Marine Inc.

Dark Vessel Detection

The use of space-based synthetic aperture radar (SAR) technology to scan the oceans can assist governments, NGOs and private customers in curbing drug and human trafficking, illegal fishing and illegal transshipments of goods. ICEYE.

Marine Connectors

These wet-mate connectors feature a special method of ejecting water from the connection interface, and this reduces the possibility of short-circuits or contact corrosion. Connectors are available for shallow and deep waters. SOURIAU - SUNBANK Connection Technologies.

Industrial Air Grinders



ATP Cyclone Grinders feature some of the highest power-to-weight ratios available today in power ranges from 0.5- to 4-HP tools. They are ideal for fabricated metals, shipbuilding, refinery, power generation and structural steel. The series comprises 44 standard models. Hy-Tech Engineered Solutions Inc.

Rope-Holding Tech

As the successor to the popular XTS0814 Powerclutch, the XTR0812 provides consistent and responsive control, further boosting its performance across the full-diameter rope range and significantly improving holding on the latest small-diameter rope types. Spin-lock LTD.

Multi-Use Mobile App

Sea Tow enables boaters to call for assistance, ask questions, share GPS coordinates, find local deals,

and purchase/renew memberships at the click of a button. It is available at the Apple App Store and Google Play. Sea Tow Services International Inc.

Ethernet Deep Cable



With data transfer rates of 9.4+/- 0.1 gigabits per second, the deep-submergence cable is constructed for Cat 8.2 use over pressures from 0 to 8,700 psi/600 bar (6,000-m equivalent depth). The initial pin configuration in the 6-km-rated Millennium connector series tested for the capability is the 3M-16, with 12 22-AWG data contacts and four 16 AWG contacts for power. BIRNS Inc.

Masthead Anemometer

Designed for boats of all sizes, the wireless, solar-powered Wind Instrument RB has the Air Link accessory for NMEA wiring and works with many phone/tablet apps. It has a built-in digital compass and can be accessed with a low monthly subscription fee. SailTimer Inc.

Universal Terminator

The TER-U acts as an intelligent diagnostic terminator that provides instant feedback on the state of the NMEA 2000 bus on board. It is also a universal terminator that can be used as an in-line terminator, or as a male or female terminator. Actisense.

Two-Color SOS Light

The C-1002 distress light is now U.S. Coast Guard approved for carriage. It eliminates the need to carry marine pyrotechnic flares and can function at the level of an alert and notification system. Sirius Signal LLC.

Enhanced Wave Sensor

SVS-603 now has ship strike detection capabilities, which can trigger an alert based on buoy motion pa-

rameters that indicate a ship strike (or other anomalous conditions). The alert allows prompt response to assess potential damage. The date and time of the alert can be matched to nearby ships at the time of a strike, based on AIS data. SeaView Systems Inc.

Surveillance Camera Update

New capabilities for the iSea-50HD include a new HD thermal camera and a SWIR channel for clear observation in the harsh environmental conditions typical of the Indian maritime climate. It provides maximum-range surveillance using highly sensitive sensors. CONTROP Precision Technologies Ltd.

Geographic Charting

Version five of WMS ChartServer offers greater interoperability to support spatial queries using GeoJSON-formatted coordinates. Bounding boxes cover more than 360° of latitude, allowing for compatibility with third-party geographic data sources. SevenCs GmbH.

Fuel Tracking

Verifavia Shipping has certified FUELTRAX against the EU's Monitoring Reporting and Verification (MRV) regulation requirements and IMO Data Collection System (DCS). FUELTRAX now offers MRV and DCS reporting for verification of meeting EU regulatory needs. Nautical Control Solutions LP.

Carrier Board Solution

STEVIE utilizes the NVIDIA Jetson AGX Xavier embedded computer module for AI, machine learning, image processing and other compute-intensive tasks. It is ideal for applications in typical commercial/industrial environments requiring low cost and compact size. Diamond Systems Corp.

Air-Pressure Alarm

Compliant with international safety guidelines for the supply of breathing air, the alarm applies to commercial diving and confined-space operations. It can assist up to three divers. Link Instruments Ltd. **ST**

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offshore oil & ocean engineering

Wireless Solution for Pipe-Laying off Taiwan

Singapore-based Gas Oil Services (GasOil) has delivered a wireless 80-t capacity Straightpoint (SP) running-line dynamometer to a pipe-laying project offshore Taiwan.

The dynamometer, part of SP's tension in motion range, was purchased by a Japanese company that employed it on wire rope as the cable was deployed from a vessel.

GasOil supplied the long-range 2.4-GHz version of the product, providing a wireless range of 700 m to SP's SW-MWLC software. Bluetooth output is an option that can be connected to any smartphone.

Subsea Inspection by Divers and ROV

Aqueos Corp. has completed a major diving and ROV project that included the subsea inspection of three large conventional jacket structures off the coast of California. The inspections are part of an ongoing structural integrity review of the jackets and included detailed inspection of welds.

Both close visual inspection (CVI) and magnetic particle inspection (MPI) methods were used throughout the jackets, with depth ranges up to 1,200 ft. of seawater.

Also included were detailed cathodic potential (CP) surveys to help determine the effectiveness of the current cathodic protection systems. A portion of the CP surveys included the cleaning of select anodes throughout the jackets, both by divers and the ROV, and the taking of measurements, both manually by divers and by scaling lasers via ROV.

3D Printing Certification

Keppel Offshore & Marine (Keppel O&M), in partnership with Nanyang Technological University, Singapore (NTU Singapore) and the A*STAR (Agency for Science, Technology and Research) Singapore Institute of Manufacturing Technology (SIMTech), has been awarded the Lloyd's Register (LR) Certification for its Laser-Aided Additive Manu-

facturing (LAAM) system to produce offshore-grade steel. This certification conforms to the American Society of Testing and Materials (ASTM) A131 requirements following an audit and successful mechanical testing.

Besides reducing project lead times, 3D printing can alleviate resource constraints, reduce the carbon footprint associated with manufacturing and provide long-term cost savings.

LARS for Fugro ASVs

RC Dock Europe, part of RC Dock USA Inc., has delivered two fully automated launch and recovery systems (LARS) for Fugro's new ASVs.

Designed to be used in rough offshore conditions and operated from a moving support vessel, both LARS are fully automated and feature an "open" design, making it suitable to receive ASVs with different types of keel-mounted payloads up to a weight of 6 tons.

A patented lock and release system consists of a series of special designed magnets activated by sensors and controlled by RC Dock's software.

Oil and Gas Industry Report

Optimism for growth in the oil and gas industry has weakened amid uncertainty around the oil price and global economic conditions, according to a new report by DNV GL. According to its survey of more than 1,000 senior oil and gas professionals, two-thirds (66 percent) are confident for industry growth in 2020, down 10 percentage points from 2019.

Despite volatile market conditions, and the need to draw on hard-earned cost efficiencies to make margin, oil and gas companies are making bold decisions this year. Industry leaders are boosting investment in areas that will allow them to forge a long-term position in the energy transition. Some 71 percent expect to increase or maintain investment in decarbonization, rising

sharply from 54 percent in 2019. Companies are pursuing multiple routes to achieve this, including diversifying into renewable energy, decarbonizing oil and gas production, and increasing investment in decarbonized gas, such as hydrogen produced from electrolysis and renewables, or from natural gas combined with carbon capture and storage. The industry's intentions to increase investment in the hydrogen economy has more than doubled in a year.

New OSV Concept

Following calls for greater vessel versatility offshore, Damen has developed a new concept: the Offshore Support Vessel (OSV) 9020.

The vessel features a stable platform with lots of accommodation, good station-keeping capability, low carbon emissions and lots of flexibility to add mission-specific tools. The vessel has been designed to perform a variety of offshore tasks at surface level and subsea.

GSI Expands in US

Gulfstream Services Inc. (GSI), an offshore and onshore equipment rental and engineered solutions provider, has grown in the U.S. with a new location in Midland, Texas, an expanded facility in Houma, Louisiana, and new office space in Houston.

Formed in 1978, GSI has seven locations in the U.S. and one in Aberdeen, Scotland, with a global team of 210.

New recruits Stanley Gardner and Keith Foley have also joined the company in west Texas and Houston, respectively.

GSI's new 60,000-sq.-ft. facility in Houma, Louisiana, supports company growth in the Gulf of Mexico and enables all offshore products and services to be based in one location.

In west Texas, the new Midland facility supports GSI's operator and service company customers working in the busiest basin in North America.

The U.S. expansion follows GSI's recent move to a new 8,000-sq.-ft. workshop in Aberdeen. **ST**

Electric Propulsion for ASV

SeaRobotics selected an electric propulsion system from Torqeedo for its Endurance 7.0 ASV.

The vessel requires extended endurance on station and a quiet operating mode while performing acoustic research operations.

The powertrain for the 7-m aluminum boat consists of a Torqeedo Deep Blue 50i electric motor; a 360-VDC, 30.5-kW lithium propulsion battery; a water-cooled DC-DC converter; a 24-VDC lithium battery for DC-DC backup; and a 25-kW diesel generator. The fully integrated computer-controlled propulsion system is designed for long-range unmanned hydrography and subsea mapping missions.

Supercomputing Cluster Powers Research

Research activities are accelerating at the University of Massachusetts Dartmouth since the installation of a new supercomputing cluster, funded by an Office of Naval Research DURIP grant award.

The powerful new cluster from Microway affords the university five times the computing performance its researchers enjoyed previously, with over 85 percent more total memory and over four times the aggregate memory bandwidth. It includes a heterogeneous system architecture featuring a wide array of computational engines.

Some of the main high-performance computing research activities on campus include: deep learning, astrophysical simulation, computational quantum chemistry, molecular dynamics simulation, solids analysis, computational fluid dynamics, systems security research, and the development and application of novel numerical methods.

Also in focus are wave energy converters in ocean buoys. As buoys bob up and down, that motion can generate electricity and can be modeled into the computation of the environment to optimize the parameters needed for the most ef-

ficient buoy design. Ocean weather systems are another research area. Large models are being built to predict regional currents, weather patterns and weather changes.

FPT, Yanmar Collaboration

FPT Industrial has signed a memorandum of understanding with Yanmar Marine International, foreseeing a commercial cooperation to develop and supply marine engines.

FPT Industrial will manufacture and provide two types of diesel marine engines based on its existing N67 EVO and C90 engine families to be customized by Yanmar and marketed under its brand.

Singapore Approves Softship

Software solutions provider Softship has been selected as a pre-approved vendor under the Maritime and Port Authority of Singapore's (MPA) Sea Transport Industry Digital Plan (IDP), a 3.7 million SGD fund to support ship agency and harbor craft businesses in Singapore to build stronger digital capabilities.

Softship is one of only two companies to be listed by the MPA as a pre-approved vendor and provider of a maritime-specific digital solution for small and medium-size (SME) ship agency businesses seeking to upgrade their digital capabilities.

The Sea Transport IDP and @ SMEGoDigital Programme were established to provide SMEs with step-by-step guidance to support them in the adoption of new digital solutions and provide a list of vetted and approved maritime-specific digital solutions.

More Ships 'Cyber Managed'

Bureau Veritas Marine & Offshore (BV) is seeing a rapid growth in the number of ships applying for its Cyber Managed notation, which ensures compliance with the main existing cybersecurity standards (IMO MSC-Fal 1-Circ3, NIST, BIMCO, etc.) and will enable shipowners to meet the requirements of the International Maritime Organiza-

tion's (IMO) guidance to administrations that maritime cybersecurity risk should be reflected in ship security practice under the ISM Code by January 1, 2021.

BV expected more than 100 ships to be operating under the notation by the end of January 2020.

Cyber Managed focuses on ensuring that cybersecurity is managed on board as per industry best practice for change management and traceability of IS/IT systems on-board, emergency procedures and basic security protection measures.

JW Fishers' Agenda for 2020

JW Fishers predicts 2020 will be a big year, with all its video systems now coming standard with 1920 x 1080 (1080 p) full-HD picture. The TOV-2 HD towed video system, the DV-2 HD dropped video system, the DHC-2 HD diver-held camera system and the MC-2 HD mini-camera system will come standard with the new camera.

The VRM-2 video recording monitor has also been redesigned for HD capability.

In the spring, JW Fishers will introduce the 450/900-kHz CHIRP side scan sonar system.

St. Kitts and Nevis Launches E-Certificates for Registration

The St. Kitts and Nevis International Ship Registry has created efficiencies by launching a range of electronic certificates that will not only speed up the registration process but help in the industry's efforts to reduce its carbon footprint.

The E-Certification process is now live. It follows the lodging of a notification of the initiative with the IMO.

Certificates that will be digitized include: provisional certificate of registry, provisional ship station license, permanent certificate of registry, ship radio station license, minimum safe manning certificate, continuous synopsis records, bunker CLCs, oil CLCs, wreck certificates, letter of consent to bareboat charter out, transcript of registry, declaration of Maritime Labour Convention Part 1, exemption certificate, and deletion certificate. **ST**

Textron Landing Craft Passes Acceptance Trials

Textron Systems, a Textron Inc. business, has successfully completed its first next-generation landing craft, Ship to Shore Connector (SSC), Craft 100 of the U.S. Navy's acceptance trials with a series of in-port and underway demonstrations. The Craft 100 demonstrated the capability of the fly-by-wire steering, electrical and propulsion systems to meet basic requirements as a test asset for Program Executive Office (PEO) Ships.

L3Harris Comms for Battle Force Tactical Network

The U.S. Naval Information Warfare Systems Command has selected L3Harris Technologies to provide advanced communications and network solutions for the Battle Force Tactical Network (BFTN) program. L3Harris will provide systems-of-network hardware and engineering and technical services for future enhancements in support of the BFTN system. BFTN provides secure connectivity to the maritime operational environment for Navy and coalition forces with a persistent internet protocol over radio-frequency networking capability to counter satellite communications-denied environments. The system also delivers line-of-sight and beyond-line-of-sight secure wireless network connectivity for ships, submarines, aircraft and naval shore facilities.

Aircraft Carrier Named After African-American WWII Hero

During a ceremony in Pearl Harbor, Acting Navy Secretary Thomas Modly honored the legacy of World War II hero Doris Miller by bestowing his name on a future aircraft carrier, *Navy Times* reported.

This marks the first time a flattop has paid homage to an African American, a Navy Cross recipient and an enlisted service member.

On December 7, 1941, Miller carried wounded shipmates from the blazing battleship *West Virginia* after it was hit by enemy fire. He fought the flames as they erupted on the vessel and then manned a .50 caliber machine gun—a weapon he never operated previously—to swat away Japanese planes during the ongoing surprise attack that launched the United States into World War II.

Miller was later killed when a Japanese submarine sank the escort carrier *Liscome Bay* off Makin Atoll during the invasion of the Gilbert Islands.

New Tech Chief for NUWC Newport

Dr. Jason Gomez, a U.S. Naval Undersea Warfare Center (NUWC) Division Newport employee since 1992, has been selected as Division Newport's chief technology officer. Gomez will drive innovation and development of new technologies through strategic partnerships with academia, industry, international partners and innovation cells. The office uses its influence to speed technology solutions to the fleet; to enhance information flow among the Office of Naval Research, other Science and Technology customers and the warfare centers; and to transfer technologies developed at NUWC Division Newport to industry.

Most recently, Gomez served as chief scientist in the Undersea Warfare Weapons, Vehicles, and Defensive Systems Department.

Teledyne Explores Business Opps In Philippines, Indonesia

Mike Read, president of Teledyne Marine, paid recent visits to Manila, Philippines, and Jakarta, Indonesia.

At the Philippine Navy Headquarters at Cavite, he met with the Fleet Operational Commander Admiral Carlo Bacordo to discuss ongoing and future requirements of the Philippine Navy, particularly with respect to port security.

Accompanied by the Managing Director Sea & Land Technologies (SALT), Singapore Zach Thomas during the visit to Jakarta, Read met with the Chairman of Lembaga Ilmu Pengetahuan Indonesia (LIPI) L.T. Handoko to discuss future deepwater sonar opportunities.

Diver Management Solution

Coda Octopus Group Inc.'s Gen 1 Diver Augmented Vision Display (DAVD) system has successfully transitioned to a first-generation operational system in production for the U.S. Navy.

The system will continue to evolve with the next-generation R&D development now underway, supported by the Office of Naval Research. **ST**

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Low Bering Ice Levels Affect Alaska Communities

Sea ice in the Bering Sea shrank to its lowest levels in recorded history in 2018, profoundly affecting northwest Alaska residents who depend on marine resources for food, cash and culture, according to a new study.

"This is an extreme event with immediate and long-lasting repercussions. It's indicative of very rapid change in the entire northern Bering Sea ecosystem," said lead author Rick Thoman, a climate specialist at the Alaska Center for Climate Assessment and Policy at the University of Alaska Fairbanks.

The interdisciplinary paper is part of a collection of 21 studies analyzing extreme weather across five continents and one sea.

Thoman and the researchers used remote sensing, climate modeling, government and academic studies, local observations, and media and public reports to reach their conclusions. They examined Arctic sea ice extent dating back to 1850 and compared it to their study period, January to April 2018.

They found that the maximum daily Bering Sea ice was the lowest on record, and the impacts included unprecedented weather events, marine wildlife die-offs and sightings of animals outside of their normal ranges. The ecological changes included the first documented mass strandings of ice-associated seals, a redistribution of thermally sensitive fish, and a multispecies die-off of seabirds due to starvation.

Persistently warm winter weather contributed to poor ice conditions that resulted in a fatal accident on the Kuskokwim River ice road. Retreating and fractured sea ice during a late February storm led to ice-laden flooding that caused a power outage and infrastructure damage on Little Diomed Island.

More than 50 reports of unusual events related to weather and marine wildlife were collected by the Local Environmental Observer Network. The researchers at-

tribute the record-low sea ice to human-caused climate change, entailing a warmer ocean, later arrival of sea ice and more frequent storms than in the pre-industrial era. These conditions could be typical in less than 20 years, Thoman said.

Wave Glider to Study Antarctic Waters

The University of Washington (UW) used a Liquid Robotics Wave Glider to investigate the summer conditions near Palmer Station on the Antarctic Peninsula to better understand how the warming ocean interacts with ice shelves that protrude from the shore.

Then, in February, the Wave Glider was scheduled to head north into Drake Passage.

The device uses wave power to propel itself, so the monster waves common in the Antarctic Circumpolar Current can help it move forward.

The goal is to learn more about the connections between the ocean, atmosphere and sea ice in this dynamic environment.

The Wave Glider will measure turbulence in the upper part of the Southern Ocean, which helps to measure how heat and other properties move between the water and the air. The board sends information back via satellite, and researchers will retrieve it once the mission is complete.

The UW team's previous project in late 2016 sent the same autonomous platform across the 500-mi. channel between Antarctica and Argentina. This time, the platform has more capabilities, including a winch that can lower an instrument to measure water temperature, salinity and pressure down to a depth of 150 m.

The revamped system also uses sonar to measure turbulence in the ocean and in the atmosphere, as well as a motion sensor to measure the waves. These measurements quantify the strength of the mixing occurring in the notoriously stormy region.

The coastal monitoring is part of the Long-Term Ecological Research Network at Palmer Station, a U.S. research station on an island off the Antarctic Peninsula. The research is funded by the National Science Foundation.

EU Plays Leading Role in Global Earth Observation

Earth observation plays a crucial role when it comes to driving productivity and sustainable economic growth around the world. Ministers, representatives and member countries came together recently during the Group on Earth Observation (GEO) week in Canberra to review and further plan the implementation of the Global Earth Observation System of Systems (GEOSS), a system that provides open and unrestricted access to millions of observation data.

The European Union is a driving force within GEO and contributes actively to the international effort, which has resulted in a stronger transnational collaboration in Earth observation activities all around the world. The EU Research and Innovation programs have been essential in building the GEOSS; they have invested more than €200 million between 2007 and 2013 and continue with support through Horizon 2020 activities.

Climate Change Will Cause Permanent Airport Flooding

Even if global emissions get under control and temperature rise is limited to 2° C, about half a meter of sea level rise is likely by 2100. This would put 44 airports around the world underwater, according to new analysis of sea level rise data from Resource Watch. This poses serious economic, public health and security threats.

Airports are typically located near large bodies of water, which are especially susceptible to sea level rise and storm surge.

Airports at risk for flooding include: LaGuardia, JFK, Newark, Key West International Airport, China's Yancheng Airport, and airports in small island nations such as the Solomon Islands, Fiji and Kiribati. **ST**

contracts

exactEarth Ltd., Cambridge, Canada, and Hisdesat, Madrid, Spain, have been selected to provide satellite-AIS data services for a four-year period. Hisdesat, as prime contractor, will provide exactView RT, exactEarth's second-generation real-time satellite-AIS data service. European Maritime Safety Agency.

KVH Industries Inc., Middletown, Rhode Island, has signed a new contract to continue KVH VSAT services for at least five years and is upgrading 102 vessels to utilize KVH's mini-VSAT BroadbandSM HTS network for advanced satellite communications. Vessel migration is expected to be completed by the third quarter of 2020. BW Group.

Naval Dome, Ra'anana, Israel, has signed an agreement to defend critical OT systems from cybersecurity hacks. Pilot trials of the Port-Dome cyberprotection will start on several systems in early 2020, followed by full network installation. Port of Ashdod.

Gentium, Singapore, and Damen Shipyards Group, Gorinchem, Netherlands, signed a memorandum of understanding to establish and develop a shipbuilding and ship-repair industry in Bangladesh. Ministry of Industry of Bangladesh.

Oceaneering, Houston, Texas, has been selected to supply two C-Nav5000 Global Navigation Satellite System (GNSS) receivers per vessel for a select number of oil and gas support vessels worldwide. SEA-COR Marine.

The World Ocean Council (WOC), Honolulu, Hawaii, has signed a partnership agreement to develop India's sustainable blue economy. The Federation of Indian Chambers of Commerce and Industry.

Rederij Wanmar, Barendrecht, Netherlands, will comply with IMO2020 regulations by signing a

contract for a 3.0-MW scrubber to be installed on the multipurpose cargo vessel MV *Donau*. Value Maritime.

Kraken Robotics Inc.'s, Mount Pearl, Canada, wholly owned subsidiary, Kraken Robotic Systems Inc., has finalized the contract for the OceanVision project, a three-year project to develop new marine technologies and products to enable an underwater robotics data acquisition and data analytics as a service business. Ocean Supercluster, Petroleum Research Newfoundland and Labrador, Ocean Choice International, and Nunavut Fisheries Association.

Fugro, Leidschendam, Netherlands, has been awarded a geotechnical contract for Apsara oil field in Block A offshore Cambodia as part of the nation's first hydrocarbon development. KrisEnergy.

The Myklebust shipyard, Gursken, Norway, has signed its fourth well-boat contract. The vessel is based on Kongsberg NVC 389. Delivery is set for October 2021. Sølvtrans Rederi.

EDF, Nantes, France, signed an agreement for the issue of energy-saving certificates that confirm and enhance the high environmental performance of its future commercial sailing vessels. NEOLINE.

WE Tech Solutions, Vaasa, Finland, has signed an agreement to deliver an integrated solution to two new-build product and chemical tankers. The 22,000-dwt vessels will benefit from a solution built around the WE Drive variable-frequency drive and Yaskawa Environmental Energy/The Switch's permanent magnet (PM) shaft generators. Rederi AB Donsötank.

Kongsberg Digital (KDI), Asker, Norway, will deliver a K-Sim Safety Advanced Fire Fighting Simulator for installation in a Horten-based training center in Norway. It will join other Kongsberg simulators already in use to train personnel. Norwegian Society for Sea Rescue. **ST**

meetings

APRIL

April 3—South West Marine Ecosystems Conference, Plymouth, England. ruth.williams@cornwallwildlifeturst.org.uk or tinyurl.com/wuv93en.

April 6-8—Sea-Air Space, National Harbor, Maryland. 703-312-1580, dlucey@navyleague.org or www.seaairspace.org.

April 6-9—OCEANS 2020 Singapore, Singapore. info@oceans2020singapore.org or https://singapore20.oceansconference.org.

April 13-16—MTS Buoy Workshop, Wilmington, North Carolina. rick-cole@rdsea.com.

April 21-24—International Partnering Forum on Offshore Wind, Providence, Rhode Island. www.offshorewindus.org/2020ipf.

MAY

May 4-7—AUVSI XPONENTIAL, Boston, Massachusetts. meetings@auvsi.org or www.xponential.org.

May 4-7—Offshore Technology Conference, Houston, Texas. 972-952-9494, meetings@otcnet.org or http://2020.otcnet.org.

May 6-7—Remote Hydrography Conference, Southampton, England. helen@ths.org.uk or www.ths.org.uk/content.asp?page=99.

May 18-19—Maritime Transport Efficiency Conference, Geneva, Switzerland. bernard.schopfer@maxcomm.ch.

May 19-21—International Conference on Ocean Energy (ICOE), Washington, D.C. www.icoe2020.org.

May 19-21—MegaRust, San Diego, California. 703-836-6727, asnehq@navalengineers.org or www.navalengineers.org/Symposia/MegaRust-2020.

May 19-21—OceanTech Program, Zhoushan, China. +852 2881 5889 or katherinelee@together-expo.com.

May 26-28—UDT, Rotterdam, Netherlands. www.udt-global.com.

JUNE

June 3-4—LNG Latin America 2020 International Congress, Buenos Aires, Argentina. <http://lnlatinamerica.com>.

June 9-11—CLEAN PACIFIC, Seattle, Washington. <https://2020.cleanpacific.org>.

June 9-11—Seawork, Southampton, England. www.seawork.com.

June 10-11—BlueTech Expo, Washington, D.C. rich.lawson@iostia.org or www.BlueTechExpo.org.

June 16-18—Technology, Systems & Ships, Washington, D.C. www.navalengineers.org/Symposia/Technology-Systems-and-Ships-2020.

June 17-19—International Workshop of Marine Technology - MARTECH, Vigo, Spain. www.mar-tech-workshop.org.

June 29-30—Navy Contracting Summit, Norfolk, Virginia. tinyurl.com/su69spo.

JULY

July 1-2—Scottish Fishing Conference 2020: From Innovation to Action, St. Andrews, Scotland. paul@mindfullywired.org or tinyurl.com/thlwnkx.

July 15-16—American Society of Naval Engineers Multi-Agency Craft Conference, Baltimore, Maryland. 703-836-6727, asnehq@navalengineers.org or www.navalengineers.org/Symposia/MACC-2020.

SEPTEMBER

September 7-9—Oceanology International Middle East, Abu Dhabi, United Arab Emirates. +971 2 491 7615, firmas.abultaif@reedexpo.ae or www.oceanologyinternationalmiddleeast.com/en-gb.html.

September 8-11—SMM (Shipbuilding, Machinery & Marine Technology), Hamburg, Germany. +49 40 3569 2445, nora.hirschfeld@hamburg-messe.de or www.smm-hamburg.com.

September 14-17—Fleet Maintenance and Modernization Symposium, Virginia Beach, Virginia. www.navalengineers.org/Symposia/Fleet-Maintenance-and-Mod

ernization-Symposium-2020.

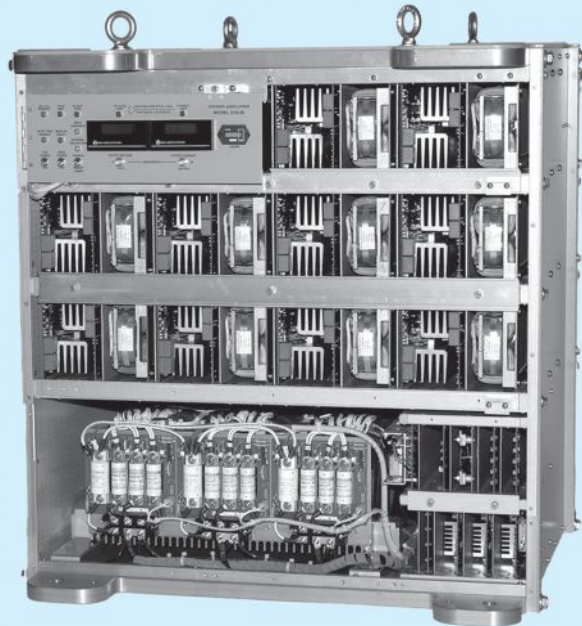
September 21-25—NMEA/RTCM Conference & Expo, Orlando, Florida. www.nmea.org.

September 28-October 2—SNAME Maritime Convention, Houston, Texas. 703-997-6701 or www.sname.org.

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

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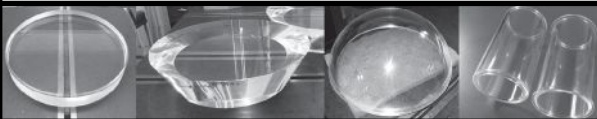
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Progress on Global Ocean Commitments—Kirsten Grorud-Colvert and Katherine Dziedzic

Kirsten Grorud-Colvert is an assistant professor in the Integrative Biology Department at Oregon State University. She is a marine ecologist who studies the dynamics of marine protected areas around the world and aims to communicate research beyond scientists. Katherine Dziedzic is a postdoctoral scholar at Oregon State University who studies coral reef adaptation to increasing sea surface temperatures.



It's clear that the ocean is changing at an unprecedented rate. The impacts of this are more evident than ever—not only on ocean biodiversity and marine resources, but also on the more than 3 billion people who depend on the ocean for their livelihoods and sustenance.

In the midst of real threats to these ocean systems, how do we move forward toward lasting solutions? One of the places that international leaders—from government, industry, NGOs, philanthropies, academia and other groups—have been gathering to address these challenges is the annual Our Ocean Conference (OOC).

When the OOC was first held in Washington, D.C., in 2014, the goal was to bring together those who had the opportunity and the means to put funding and resources toward meeting ocean challenges. Those invited were expected to make commitments and report on their progress at following meetings. This expectation continued as the meeting was held in Chile in 2015, again in Washington, D.C., in 2016, Malta in 2017, Indonesia in 2018, and Norway in October 2019.

As the commitments increased and more actions were promised, we wondered: What were the commitments? Who made them? Were the commitments empty promises, or were they followed by real progress? Was that progress meaningful?

Over the first five years of the OOC, a total of 1,021 announcements were made across six different themes, one of which was marine protected areas (MPAs) and other area-based conservation measures (ABMs). (The others were: climate change, sustainable fisheries, marine pollution, sustainable blue economy, and maritime security.)

We did a deep dive into the 206 MPA- and ABM-related announcements, which were 20 percent of all the OOC announcements from 2014 to 2018. Our strategy was to independently evaluate the progress made on each announcement. Some announcements committed to multiple actions, so we evaluated all the 288 actions that were committed.

Taking a close look at these actions took time and significant effort. We used our university setting to hold a seminar class where 10 graduate students and two professors gathered all the available information on each MPA/ABM action made at the OOCs from 2014 to 2018. We spent hours combing through online sources. We contacted the announcers or others who knew about the action to ask for evidence of progress. All this research allowed us to determine whether the action had been completed or was on the way to completion.

What we found was encouraging. In the midst of the splashy headlines from these high-profile meetings, real progress was taking place. The MPA and ABM actions from the first five years were made by 62 countries and 69 other organizations. The number of actions, the sectors that make commitments and the types of actions have been growing. Actions include creating or expanding existing MPAs, as well as committing funding to support MPA-relevant activities, such as capacity building in resource-limited countries, or educational programs

on ocean protection. Some actions were to hold scientific meetings or develop new technology for ocean monitoring. While governments have been the dominant sector, industry joined the commitment making in 2017 and is a quickly growing group making commitments at the OOCs.

But had all those promises led to real progress? We found that over half (57 percent) of MPA/ABM actions had been completed by October 2019; most of the rest (40 percent) show at least some evidence of progress. We could find no evidence of progress for the remaining 3 percent, but their expected dates for completion are in the future.

The OOC actions pledged 189 new or expanded MPAs or ABMs, and 43 of these have been implemented—meaning, protection is occurring at these sites. These alone total over 6 million km², or 1.7 percent of the ocean. MPAs and ABMs that were pledged at the OOCs and have been implemented as of 2019 account for one-third of all the implemented MPAs globally.

Yet the remaining 146 MPAs/ABMs that were pledged are still in progress—these still need to be implemented. The pending MPAs total over 7 million km², or 1.9 percent of the ocean. If all 189 MPAs/ABMs that were promised at OOCs were implemented, the area would total 3.6 percent of the ocean (over 13 million km²) and would more than double the amount of protected area worldwide. Of that 3.6 percent, 1.2 percent would be “fully” or “highly” protected and bring the greatest conservation and climate benefit. Other actions that are not area-based also need completion.

Progress is happening, but more is needed. Keeping track of progress requires an online reporting tool that is clear, verifiable and accessible. This will support continued action to improve the state of our ocean. **ST**

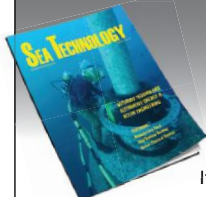
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