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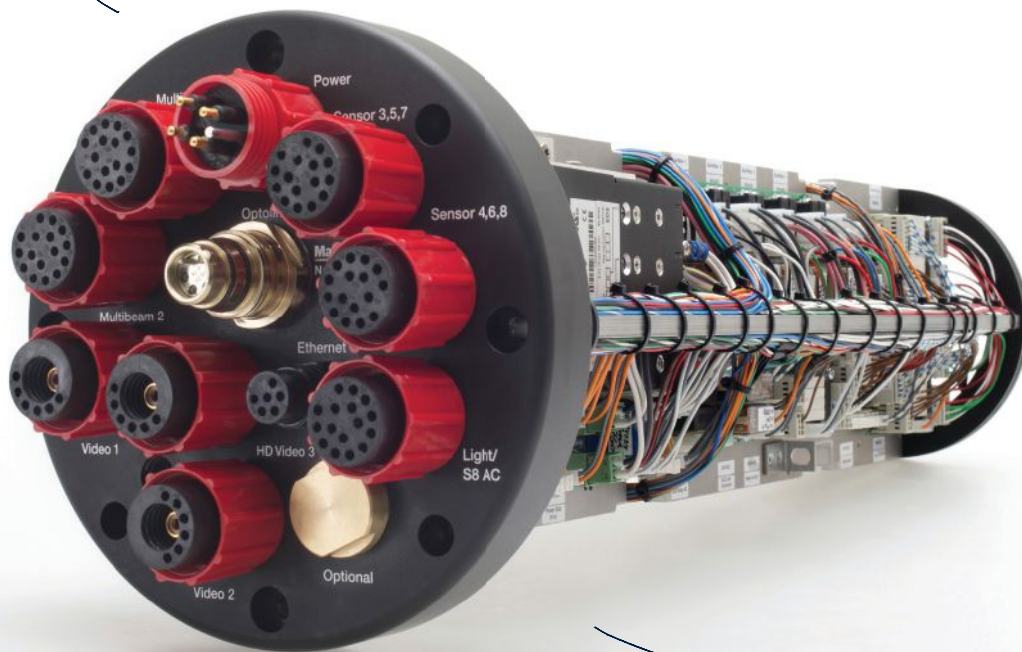


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Develogic seafloor lander beind deployed with satellite on the coast of Lofoten in north Norway for the LoVe Ocean Observatory, August 2019. Develogic GmbH has developed subsea landers, satellites and moorings customized with sensor and communication systems for LoVe. (Credit: develogic)

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Dark Vessel Detection satellite technology improves global security ... New standards set for long-endurance underwater navigation, automated subsea positioning ... Sesam software increases ship design-to-engineering efficiency ... ICESat-2 green laser data for shallow-water bathymetric applications ... Sonar, seafloor mapping for tactical undersea missions.

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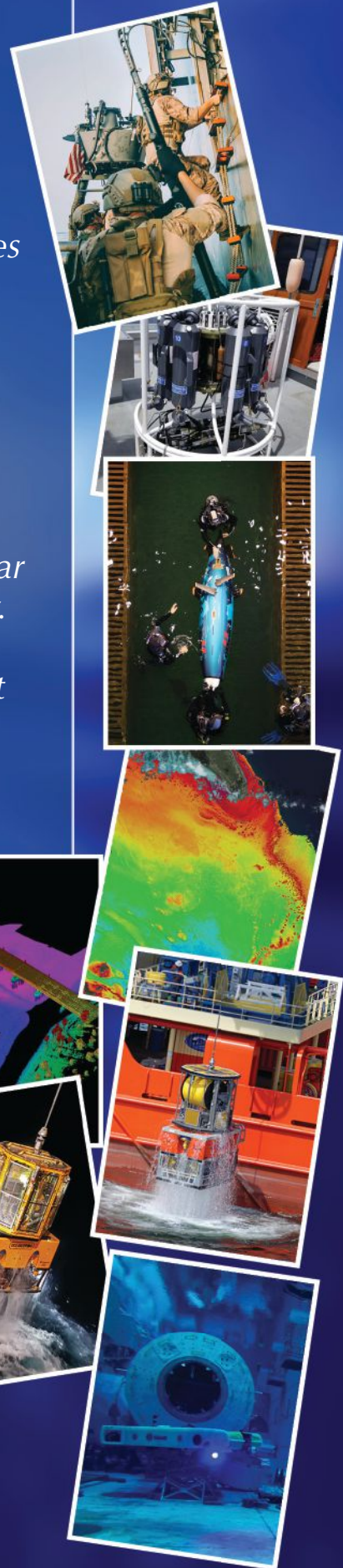


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Dr. Sandro Carniel and João Alves, NATO STO CMRE

JANUS Enables the Future of Underwater Comms

Arise in collaborative AUVs, robotics and sensors is allowing a more detailed and thorough knowledge of the oceans. The challenge is how underwater assets can communicate and interact with each other. The density of ocean water is almost 1,000 times that of the atmosphere, preventing electromagnetic waves from traveling effectively, thus hampering fast underwater communications (UWCOMM). The propagation speed of sound is approximately 1,500 m/s in water, versus 300 million m/s for electromagnetic waves in air. In addition, the market for UWCOMM systems, compared to terrestrial communications, has so far been too small to trigger the creation of regulatory authorities.

As a result, while a plethora of open standards and protocols exist for wireless aerial communication, this is not yet the case in the underwater domain. UWCOMM capabilities have remained manufacturer-specific, with proprietary digital coding technologies, introducing obsolescence management risks by imposing specific dependencies that prevent scalable underwater networking. There has been a need for a general interoperable capability between underwater modems from different manufacturers.

To fill this gap, the NATO Centre for Maritime Research and Experimentation (CMRE), based in La Spezia, Italy, with funding from NATO Allied Command Transformation and in collaboration with national labs, academia and industries, developed JANUS, the first digital underwater communication standard. JANUS was adopted as a NATO standard (STANAG4748) in March 2017.

In ancient Rome, Janus was the god of transitions and doorways, depicted as having two faces since he could look into the future and the past. In the same way, JANUS provides a lingua franca that can allow different devices to work interoperably. In a nutshell, JANUS is a modulation and coding scheme (MCS) with mechanisms that specify how to transform the bits into sound that can travel underwater.

JANUS serves military and civilian applications, for NATO and non-NATO use; academia, industry and governments may all benefit from it, enhancing interoperability and coherence. The specification of the signal encoding and message format is fully described and reference implementations are free at www.januswiki.org so anyone can construct a transmitter/receiver to communicate via JANUS with a compliant platform.

While JANUS allows easy adoption by legacy equipment, the protocol also anticipates the use of sophisticated decoders to allow significantly improved performance beyond what is achievable with the current simple, baseline receivers. This anticipates a standardized Internet of Underwater Things, with the aim of originating a widely used protocol, as with Wi-Fi.

CMRE developed the JANUS technical specification from 2008 to 2015, and in the last five years has focused on concept development and new operational perspectives, particularly to support submarine search and rescue (SAR) and deliver data services to submarines. The current doctrine for communications in a submarine SAR scenario is based on the analog underwater telephone and use of the phonetic codes "alpha" to "zulu." An operator is required (who may be needed for other equally critical tasks) to handle the communications on the submarine side. Stress and language phonetic biases may also degrade data exchange. By employing JANUS, the operator may be replaced with semi-automated systems transmitting critical data much more accurately.

JANUS enables more interoperability and interchange, key concepts for NATO, an alliance of 29 nations. CMRE can be a catalyst for the transition of JANUS toward a facilitating standard. Applications such as harbor protection, submerged infrastructure surveys, mine detection, submarine warfare and surveillance could benefit from further JANUS development. **ST**

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2020

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Annual Review & Forecast/Buyers Guide/Directory

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

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

MARCH - digital only

Electronic Charting/Vessel Management/

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APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

MAY

Communications, Telemetry, Data Processing

**BlueTech Expo, June 9 (virtual event)

JUNE

Seafloor Mapping/Sonar Systems/Vessels

JULY - digital only

Deck Gear, Cable, Connectors, Power Systems & Salvage

**OCEANS 2020 Singapore, August 11-14, Singapore

AUGUST

Geophysical Exploration/Seafloor Engineering

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

SEPTEMBER

Ocean Resources Development & Coastal Zone Management

**AUVSI XPONENTIAL 2020, October 5-8, Dallas, TX

**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

**Oceanology International 2020, December 1-3, ExCel London, U.K.

NOVEMBER

Undersea Defense/Antisubmarine Warfare

**UDT 2020, December 8-10, Rotterdam, The Netherlands

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Diving, Underwater Vehicles & Imaging

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)) COVID-19 Pandemic Industry Group Recommendations. The International Marine Contractors Association (IMCA) is part of a COVID-19 Industry Group that has collaborated with the International Maritime Organization (IMO), World Health Organization and International Labor Organization to develop a preliminary list of recommendations for governments and relevant national authorities on the facilitation of maritime trade during the pandemic. This COVID-19 Pandemic Industry Group comprises a broad cross-section of global industry associations with consultative status at IMO representing the maritime transportation sector. The group's initial recommendations cover the following areas: providing access to berths in ports; measures to facilitate crew changes in ports; measures to facilitate port (and related) operations; and measures to ensure health protection in ports. Full details of the recommendations can be found at: <https://tinyurl.com/tmowtf7>.

)) NOAA Sets Up Unmanned Systems Program. To support the growing use of unmanned systems across the agency, NOAA is establishing a new Unmanned Systems Operations Program, AUVSI reported. It will support the "safe, efficient and economical operation" of unmanned systems (UxS) that collect environmental data for its science, products and services. The program will be part of NOAA's Office of Marine and Aviation Operations (OMAO). Responsible for operating, managing and maintaining the agency's fleet of ships and aircraft, OMAO also oversees NOAA's diving and small-boat safety programs. Services to be offered under the program will include training, cybersecurity and acquisition support. Unmanned airborne and maritime systems are transforming how NOAA conducts Earth science. There has been an increase in the use of unmanned technology as a force multiplier for many NOAA programs as a result of the recent surge in their availability. NOAA currently uses unmanned systems for seafloor and habitat mapping, ocean exploration and emergency response.

)) Start-Ups Pitch in to Decarbonize Shipping. Inmarsat has become a founding member of Asia's Decarbonising Shipping initiative, the first of its kind in the region, to harness the power of start-ups to meet UN targets on greenhouse gas (GHG) emissions. The initiative, based in Singapore, is part of the Trade & Transport Impact (TTI) program from venture development firm Rainmaking to bring start-ups together with backers with maritime experience and expertise. Inmarsat joined the first two cycles of TTI, held in Europe in 2019, which scouted more than 1,200 start-ups and led to 24 collaboration projects. Backed by the Maritime & Port Authority of Singapore, the new initiative is expected to identify at least 1,000 projects offering models to tackle decarbonization, with selected start-ups to be matched with maritime industry leaders willing to build collaborative pilot projects. Alongside Inmarsat, other confirmed partners include Cargill, DNV GL, Hafnia, MC Shipping Inc., Vale and Wilhelmsen. The IMO is targeting a 50 percent cut of GHG emissions from ships by 2050, and average carbon intensity (CO₂ per tonne-mile) reductions of 40 percent by 2030 and 70 percent by 2050, compared to 2008 figures. A recent Inmarsat research report predicts the value of ship technology rising from \$106 billion to \$278 billion by 2030, driven in part by innovators and disruptors providing solutions that will help monitor and cut emissions.

)) Telecom Advancements in Arctic. Passage through Northern shipping routes and Arctic waters has received a boost following the doubling of the connectivity speed of the Iridium Certus network, said IEC Telecom. As the shortest sea route between Europe and the Asia-Pacific region, the Northern Sea Route holds immense potential to compete with conventional trade lines. There has been a significant increase in maritime traffic across the main transport corridors in the Arctic, Northern Sea Route in the Russian Federation, the Northwest Passage in Canada and the Arctic Bridge from Canada to Europe. In the Canadian Arctic, traffic has tripled between 1990 and 2015. Cargo volume in the Northern Sea Route has increased by 40 percent between 2016 and 2017. With the Iridium Certus 700 service becoming commercially available at speeds of 700 kbps, the fastest L-band speed in the industry so far, Iridium's network with pole-to-pole coverage will support fishing fleets, commercial ships and other vessels transiting Arctic waters. The oil and gas sector, which has been expanding in the Arctic, will also benefit.

)) Unlocking Genetic Potential of Ocean Microbes. Researchers have made a breakthrough in developing gene-editing tools to improve understanding of one of the most important ocean microbes on the planet. The international project, co-led by scientists at the University of East Anglia (UEA) in the U.K., unlocks the potential of the largest untapped genetic resource for the development of natural products such as novel anti-bacterial, anti-viral, anti-parasitic and anti-fungal compounds. Ocean microbes regulate global cycles of carbon and essential nutrients such as nitrogen and phosphorous. Some are photosynthetic protists, called phytoplankton, that contribute almost as much to global annual carbon fixation as land plants. This study aims to improve understanding of the basic biology and evolution of marine protists, with potentially valuable outcomes for evolutionary studies, nanotechnology, biotechnology, medicine and pharmacology. The project has resulted in the development of new genetic model systems, summarized in a "Transformation Roadmap" outlining DNA delivery methods, gene expression constructs and genome editing approaches. **ST**

Customizable Connectivity

Considerations for Choosing High-Speed, Global Telecom Packages

By Shane Rossbacher

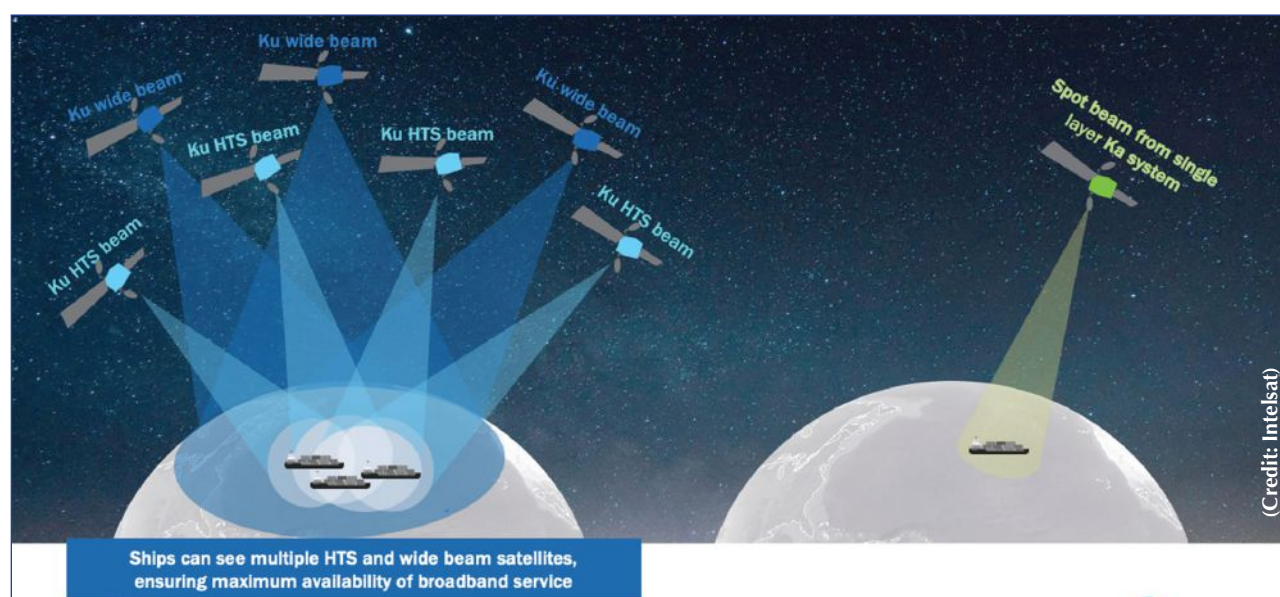
The global maritime trade, transportation and telecommunication sectors are all facing the reality of a new normal. Trade restrictions and tariffs have become more common. Fuel cost increases and moderate growth in global economies have slowed trade. In some cases, national policies have created a heightened sense of protectionism and upended multilateral trading systems. Supply chains continue to shift and rearrange. Natural disasters and climate-related problems have intensified and become more frequent. All of these factors have contributed to creating a new and more challenging environment in which ship operators and distributors must navigate.

In response, it's more important than ever for commercial maritime operators to equip fleets with the technology and tools needed to be agile and competitive in this world of the new normal. This includes tools that

can help ship operators effectively anticipate change and respond appropriately in a variety of local conditions across the globe.

Reliable high-speed global connectivity has emerged as one of the critical keys for success. However, finding the right enterprise-grade broadband connectivity for a fleet requires more than merely shopping around to lower overhead costs—although this should remain a priority. In our technology-driven era, ship operators must leverage connectivity to add value, create a competitive edge and improve margins.

As the maritime industry continues to respond to these shifting trends, it's important to note why connectivity matters and why legacy connectivity packages simply don't cut it any longer. It's also crucial to examine how a flexible and customizable maritime network could help ship operators steer their fleet into the future.





Cargo ships, leisure boats and other sea-based platforms like these could benefit from Intelsat's customized connectivity solution. (Credit: Getty Images)

As an example of cutting-edge services, Intelsat's FlexMaritime solution and related service providers can offer constant connectivity anywhere in the world, in both high-traffic and remote areas, working with the customer to deliver services tailored to specific needs.

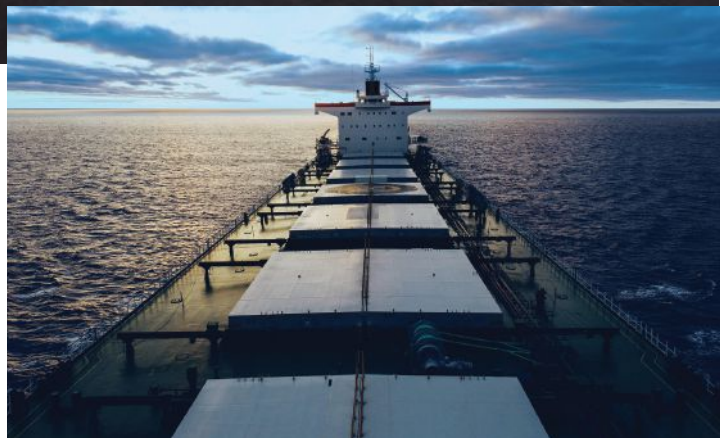
Overcoming Legacy Connectivity Challenges In a Changing Industry

High-speed and reliable global connectivity have become one of the main business drivers for maintaining a competitive edge. Much of the daily activity of fleet operations has become digitized and moved to the cloud, including performance monitoring, cargo management and weather routing.

With so much critical information and activity happening online or via the Internet of Things, ship operators need a robust broadband network that can process and analyze these data in real time with no interference. The modern-day requirements of global shipping and maritime companies necessitate data connectivity that's secure, flexible and high-speed; not just close to the port or along shorelines, but from any point on the globe at any time. Always-on connectivity with a truly global reach boosts operational efficiency while also greatly increasing crew and passenger morale.

This goes beyond the success of a single commercial maritime fleet and actually impacts entire regions and even countries. However, this means commercial maritime operators need a network that allows them the flexibility to maintain coverage anywhere on the globe. When it comes to implementing more advanced networks, the needs of companies operating out of a less connected country will be vastly different from ship operators operating out of a connected port.

Connectivity will only continue to play a major role in the maritime industry moving forward. In its 2019 Lin-



er Shipping Connectivity Index, the UN Conference on Trade and Development (UNCTAD) highlighted seven policy measures to enhance port connectivity. Among these measures, UNCTAD recommended going digital; monitoring port connectivity; and linking domestic, regional and global networks. UNCTAD noted that optimized digitization, for example, has already reduced inventory holding expenditures, optimized vessel speeds and routes, lowered carbon-dioxide emissions and shortened wait times in ports.

However, legacy connectivity services often don't offer the robust and flexible services necessary to handle the complexity, capacity and communications needed for these advanced digitized systems.

One-Size-Fits-All Doesn't Really Fit Anyone

For far too long, commercial maritime operators could only choose from prefabricated network connectivity packages, despite no two ship operators having the exact same needs. The maritime industry is much too vast and complex for that model to work.

By trying to craft something that appeases everyone, these packages actually leave end-users with far fewer options and flexibility. Even worse, this could mean operators are limited in their options based on the pack-

age's fixed offerings, rather than being empowered by true connectivity.

On top of this, much like the water on which it travels, the maritime industry is constantly in flux, and never has that been more apparent than now. From volatile growth rates to shifting trade routes and ever-changing regulations, commercial maritime operators simply cannot rely on antiquated and prefabricated managed network systems to remain competitive.

Volatile Growth Rates. In 2018, world maritime trade slowed to a 2.7 percent growth rate, compared to 4.1 percent recorded in 2017, and below the historical average of 3 percent, according to UNCTAD's Review of Maritime Transport 2019. Although UNCTAD forecasts an average annual growth rate of 3.4 percent between 2019 to 2024, the transformation of the global maritime industry still leaves room for market uncertainty.

Ship operators need to ensure their fleets are running efficiently and optimally to stay ahead of any unexpected market downturns. Prefabricated networks don't allow ship operators the ability to easily scale or shift capacity to respond to real-time demand, leaving them over-paying for unused data.

Shifting Trade Routes. Both national policies and climate change continue to impact trade routes. And as more and more of the global supply chains continue to shift from the Atlantic Ocean to the Pacific Ocean, interest in many of these areas will increase.

For example, the Panama Canal expansion has led to a 20 percent increase in service patterns along the eastern seaboard of the U.S. since 2016, while the west coast has seen a significant decline. Around the world, smaller economies are taking advantage of cabotage restrictions and tariffs in larger neighboring countries to grow their own ports.

Climate change and the subsequent natural disasters that arise due to it are also playing a significant role in altering shipping routes. Climate change has already negatively impacted the aforementioned Panama Canal expansion. Although service patterns increased in the two years following its completion, the country experienced below-average rainfall through the first six months of 2019, which greatly restricted shipping capacity through the canal.

As trade routes continue to shift, ship operators cannot depend on a network package that doesn't allow for flexible regional coverage or true global coverage.

Uncertain International and Foreign Policies. Recent policy changes and new trade tariffs from a host of major economies have added more complexities and uncertainty into global trade. Additionally, new sustainability driven policies have forced cuts to emissions and implemented greater regulatory restrictions across the maritime industry, such as China taking steps to introduce emission control areas in 2019.

While some of these may only be short-term cyclical factors, others are more structural and will continue to impact shippers and other sea-faring companies for the foreseeable future. Further, many of these structural changes, such as the sustainability driven factors, could

very well only be the beginning of even more regulations down the road.

Faced with this uncertainty, maritime ship operators utilizing a pre-designed network system can find themselves boxed in as new tariffs and laws come into play.

A Flexible and Customizable Maritime Connectivity Solution

Based on these growing macroeconomic factors and shifting international policies, pre-designed network packages simply won't suit the needs of the new normal that is redefining the commercial maritime industry. Therefore, ship operators should look more closely at customized packages based on their specific commercial needs.

Consider the analogy of a ball of clay waiting to be turned into a piece of art. The ideal network service package is one that needs to be shaped and customized into a finished solution. Specifically, maritime ship operators and owners can work with a service provider to mold and sculpt the clay (i.e., adding and subtracting services and features) into a customized maritime network solution that truly fits their unique needs.

As a starting point, commercial marine operators should consider two main questions:

Where Is Service Needed? This is a big factor. For smaller shippers, a localized network in one region might suffice, but larger shippers may need global reach or something in between. This question becomes further compounded when coupled with shifting trade routes and changing regulations.

How Much Service and What Kind of Incidental Service Are Needed? The amount of service will vary greatly depending on the ship's and crew's size and needs. It's an important factor to consider, as it doesn't make sense to pay for a large data set when a small one will work.

Incidental services help optimize shipping systems, logistics, monitoring and more. Examples include baseline tech reporting and fleet diagnostics to more advanced services such as telemedicine or electronic training.

Additional features to consider include:

Flexible Capacity. Ship operators need flexible capacity to remain agile in an ever-shifting world without being locked into a pre-set plan. Blocks of capacity that operators can then split between their ships provide the flexibility to reallocate data packets in response to sudden changes.

Global Integration. Shipping companies have come a long way since the days of intermittent communications with headquarters. Having 24-hr. tracking and real-time remote diagnostics at the press of a button allows for more optimal operations and routing. As climate change and natural disasters continue to intensify, global integration can be the difference between a successful shipment or a lost one.

High-Speed Connectivity. No one likes waiting for a website to load or for a document to download. This becomes more than a simple annoyance when an entire crew is waiting on directions from headquarters on an urgent or even life-threatening matter.

Crew Morale. Internet connection and ease of communication with friends and family back home is no longer a perk for crew members; it's often an expectation. Finding a good crew and maintaining that crew means meeting these expectations. This goes beyond simply having down-time entertainment options for crew members and extends to providing training, education and health material.

By the end of this sculpting process, maritime operators and the service providers will ideally have taken the lump of clay and formed it into a perfectly fitting connectivity package for optimal and efficient operations.

The Difference a Powerful Network Makes

Even with flexible and always-on global connectivity, the service won't matter without a powerful network supporting it. Ship operators should seek out a service provider with a network powerful enough to make global, always-on connectivity a reality, not an aspiration.

What separates a regular network from a powerful one? A powerful network will use first-generation, high-throughput satellites (HTS) to deliver bandwidth density to high-traffic routes and provide greater capacity. Additionally, layers of wide-beam capacity satellites can then further reinforce the HTS coverage for increased resiliency. Altogether, this makes more efficient use of the spectrum, which eliminates blockage and interference.

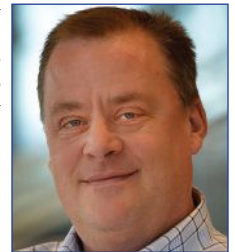
However, just a few HTS and wide-beam satellites won't suffice to provide global coverage, especially in

high-traffic travel routes. A truly powerful network utilizes a fleet of satellites and a mix of terrestrial and teleport infrastructure for guaranteed and available coverage no matter how remote the location.

This is the power of the network for Intelsat's Flex-Maritime solution and its ecosystem of service providers. FlexMaritime offers always-on, global connectivity with a flexible and resilient platform that delivers an unprecedented level of service, coverage and throughput. For instance, large vessel customers using the FlexMaritime global managed service have seen data speeds triple, and, in some cases, increase by a multiple of six.

The new and more challenging environment in which ship operators and distributors must navigate will come with new risks, but also new opportunities. In order to take advantage of these opportunities, maritime operators will need a customized connectivity solution that helps optimize operations so they can steer their fleets into the future. **ST**

Shane Rossbacher is the director of maritime at Intelsat. He joined the company in 2018, bringing more than 25 years of maritime satellite communications experience to his role. Prior to joining Intelsat, he held business development leadership roles at Inmarsat, Globe Wireless and Rydex.



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Every Picture Tells a Story

Using Data Visualization to Protect Great White Shark Population

By Roger Noble

Great white sharks enjoy what can only be described as a complex relationship with humankind. On one hand, they have been hunted into official “vulnerable” status, mainly because of demand for their valuable fins or as a result of regional culls. On the other, they are subject to a growing number of protection and conservation schemes that seek to boost population numbers and ban often cruel hunting practices.

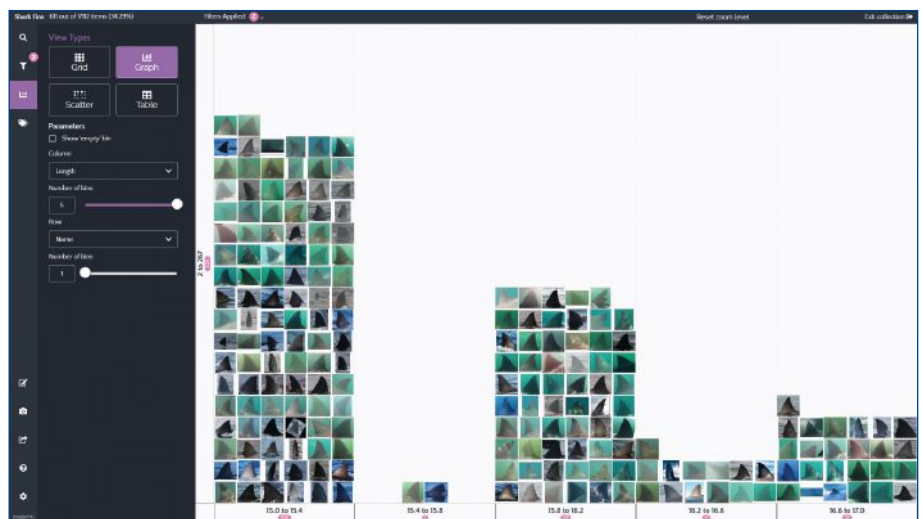
Sharks are not just at risk because of culls driven by fears they will attack people out at sea, but because they can get caught up in large-scale fishing equipment or damaged by climate-driven change to their habitats.

Fins support a number of lucrative lines of business. Shark fins in general have long been prized as a key ingredient in shark fin soup, a Chinese dish served at celebrations and banquets. It can be traced as far back as the Emperor Taizu of the Northern Song, who reigned from 960 to 976. Legend states that he introduced shark fin soup to showcase his wealth, power and generosity.

Popularity of the soup has declined globally in recent times. This is partly as a response to conservation efforts but also because of reports about high levels of mercury and methylmercury in concentrations high enough to be considered unsafe for human consumption.

However, claims that low instances of cancer in sharks together with their remarkable ability to recover from injuries has driven a new market for shark cartilage-based medicines, pills and powders.

Despite the completion of multiple clinical trials that have disproved the theory that ingesting shark cartilage



Zegami sharks collection; graph view of the largest fins.

can cure cancer, demand for these products continues to exist.

As the world's largest known predatory fish and one of the oldest established species on the planet, great white sharks play a vital role in balancing the global food chain. However, there is a relative shortage of information on record (compared to land-based animals) about how great whites live their lives.

The number of great whites still in existence globally is also up for debate and is changing as a result of preservation efforts for their food sources, such as seals. Much has been written about the return of great white sharks to Cape Cod, as well as their disappearance from South African shores.

Uncovering information on the great white shark is essential to conservation—and the vital efforts to identify, classify and understand available data are increasingly driven and supported by new technology.



fishermen and divers, who submit photographs when they spot sharks in the wild.

During the height of the white shark season off Central California each autumn, researchers visit elephant seal rookeries at the Farallones, Año Nuevo Island and Point Reyes. The rookeries attract large groups of white sharks, which surface the ocean as the team launches seal decoys. As the sharks emerge, researchers take the opportunity to take photos of their dorsal fins.

As a result of this activity, the aquarium has built a catalog of over 2,000 images of great white sharks'

Tracking Great Whites off the California Coast

The world famous Monterey Bay Aquarium has worked for the past 15 years to track individual white sharks in the eastern Pacific area as part of its Conservation Research and Education Program.

The aquarium and research partners, including Stanford and California State Long Beach Universities, use electronic-tracking tags and genetic analyses using tissue and blood samples collected from adult and juvenile sharks to identify and monitor the great white shark population. This is making significant contributions to knowledge about where white sharks in the eastern Pacific Ocean travel, where they live and their basic physiology.

"Of the 501 or so species of sharks, 79 are imperiled, according to the International Union for the Conservation of Nature," the aquarium says. "White sharks are top predators in the sea, but they're in a great danger of being depleted."

Programs coordinated by the aquarium include juvenile white shark research. This involves fitting juveniles with an externally attached, pop-up satellite tag with a tiny computer that collects and stores data on temperature, depth and light, which are used to estimate the juvenile's position.

On a pre-programmed date, the tag pops off and floats to the surface. At the surface, it transmits data to the aquarium via satellite. If the tag is recovered, even more data are retrieved. To date, scientists have tagged and tracked 18 juveniles and 167 adults.

The aquarium also promotes policies in the U.S. and internationally to end practices that threaten all shark species: the targeting of sharks for their lucrative fins, and the use of indiscriminate fishing practices that catch and kill sharks in gear intended for other species.

More recently, it has introduced Zegami data visualization software to bring structure to its large collection of visual data, which includes pictures of great white sharks spotted off the coasts of California, right down to Baja, Mexico.

So far, the research team has identified and researched 475 individual white sharks. This has been done by a team of researchers from the aquarium and Stanford University with help from members of the public, including

fins that help its research team track the movements of sharks. Sharks are easily distinguished by their fins, with each shark's dorsal fin having a series of notches and ridges as individual as a human fingerprint.

Scientists believe these notches and ridges are caused by cuts and scrapes, and by the bites of parasites called copepods when the sharks are young and their skins are soft. Over time the bites heal over and create unique patterns that mean they can be individually identified.

So familiar has the aquarium's team become with local great white sharks, which return to the California area on an annual basis, that they have been able to give individual names to many of them.

While some have descriptive names like "Middle-notch," or "Split-fin," one is named "Tom Johnson" after the naturalist Tom Johnson, who took the first photo of this shark in 1987, and "Leno" has a fin resembling the profile of the famous U.S. late-night TV host Jay Leno.

Dr. Salvador Jorgensen, senior research scientist at Monterey Bay Aquarium, observed: "White sharks are probably the best known apex marine predator on the planet, so it's no surprise there's a huge amount of interest around them—and the amount of photos we're sent is testament to that. We have some sharks on record that have been tracked over 25 years. However, it was becoming increasingly challenging to manage our growing collection."

Visualizing Unstructured Data

The aquarium chose Zegami data visualization technology because it provides a simpler way to navigate and catalog its collection and quickly identify an individual shark in the images. The software allows the team to display all of its pictures on a single screen, making it much quicker for them to scan through for a match to a new photograph, for example.

The software was first developed in response to the need for easier ways to search through unstructured data like images and sound, which now make up as much as 85 to 90 percent of the information stored by organizations.

Originally inspired by Microsoft PivotViewer software, Zegami was founded in 2016 after a successful

“The aquarium uses its extensive collection of photographs to determine whether the population of great white sharks is stable or has changed in the last five to 10 years in line with conservation programs.”

collaboration with the Weatherall Institute of Molecular Medicine at the University of Oxford.

The many challenges of this research program meant that Zegami was developed so that it could be used to visualize any kind of data, including images, video, documents or more traditional data sources like databases and spreadsheets.

Examples of projects using Zegami have included applications as diverse as the Pittsburgh Pirates analyzing data on thousands of players from the college system and around the world to find the best talent available, and the Australian Plant Phenomics Facility monitoring large-scale investigations into plant growth in variable conditions.

Most data visualization tools are built with structured data in mind, due largely to the fact that working with unstructured data requires a wholly different understanding and approach.

Unstructured data might comprise images, video, emails, documents and social media posts. Working with such data can be difficult due to its very nature: file sizes are frequently large, so they are difficult to collect, store and move around.

Processing this kind of data requires a lot of computational power and memory, frequently exceeding the capabilities of a single machine. It is only relatively recently, with the advance of cloud computing, that the capability to manage data of this kind effectively has become more accessible.

How Does the Technology Work?

Metadata (data that describes, identifies and signposts data) is an important element of storing unstructured data like the aquarium's photographs.

On average, we can spend up to 2.5 hr. a day just searching for information among unstructured, uncategorized data to help us do our jobs.

Unlike structured data, large, disparate sources of data must be processed and analyzed before they can be qualified, understood and then effectively used.

Humans are extremely good at understanding the messy, unstructured nature of the world, and making sense of unstructured data has normally been the preserve of people examining records outside of any database.

But applying human intelligence directly to the scale of data being amassed in the information age is simply not feasible. The processing performance of the human brain has its own limitations and cannot scale at the same rate that unstructured data are growing.

This is where machine learning and artificial intelligence (AI) enter the picture. These techniques have the

ability to consume large amounts of data streamed from varied sources and to make sense of it all in a systematic way. Through the large-scale processing of hundreds of thousands or even millions of pieces of data and content in a relatively short period of time, AI can extract quantifiable information in a manageable format.

And by delegating tasks such as face detection, object detection and metadata extraction to AI, humans can step away from the repetitiveness of manually annotating data to make better use of their cognitive functions.

This is important because, in many cases, the evaluation of content is highly subjective and not suited to processing even by advanced AI techniques. Such crucial, subjective judgments might relate to financial, quality, research or progress decisions over large visual data sets. Key decisions can be made with more speed and more clarity when salient information has been extracted automatically from thousands or even millions of files.

Future Plans

The aquarium uses its extensive collection of photographs to determine whether the population of great white sharks is stable or has changed in the last five to 10 years in line with conservation programs.

One of the many challenges for great white sharks is that they take a long time to reach adult maturity, which means any recovery from decline will be slow to manifest itself.

The research will also help to identify areas that are important for feeding or as nurseries. “This is more important than ever at a time when the health of our oceans and the safety of our sharks are both under critical threat,” said Jorgensen.

From Zegami's point of view, we're delighted to be able to help Monterey Bay Aquarium with this project: The team's passion for ocean health and the preservation of white sharks is hugely inspiring. We've been able to work across a large collection of images to make a powerful tool for them, which we hope will contribute to the conservation of these threatened sea creatures.

Our ultimate aim with Zegami is to build technology that enables organizations to recognize patterns quickly, understand information and find hidden insights by allowing users to search, sort, filter, group and analyze large collections of images and data simply and intuitively. We want to make data visualization into a technique that is available to everyone, not just data scientists. The Monterey Bay Aquarium image library is a great example of how that can work in practice. **ST**

Roger Noble is the founder and CEO of Zegami.

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Human-Machine Interaction

The Challenges of New Teamwork for Smart Ship Navigation

By Dr. Seojeong Lee • Dr. Margareta Lützhöft

The concept of a “smart ship” implies that a ship is equipped with various kinds of software systems such as automation processing, decision algorithms, and the introduction of artificial intelligence (AI) or machine learning systems. If human and machine cooperate and navigate in a collaborative way, we may achieve human-machine teaming, which means that a machine could be a member of a bridge team and engine control team.

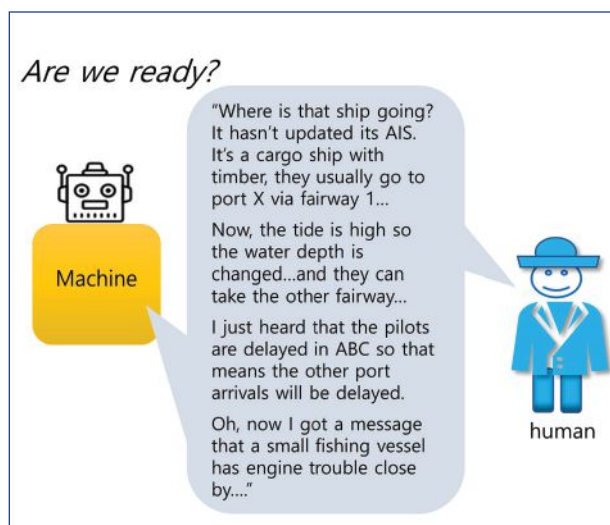
There are likely to be many ways to achieve this, but the two main avenues appear to be: change the humans to work better with machines, or change the machines to work better with humans. Prioritizing humans, we prefer the latter.

Handing over the watch on board is an interesting context to explore as a backdrop to human-machine teaming. A human-machine handover could be the same as between officers of the watch regarding information sharing.

If humans are not satisfied with handing over responsibilities to a machine because of safety and trust issues, introducing automation will not work and may become just another burden for humans. For humans and automation to form a work team, they need be able to collaborate and communicate. They also need to be able to handover the watch completely. Can this be done in the same way as between humans? Is the machine reliable and trustworthy enough? Does the handover vary depending on the machine’s capabilities? Should the handover be defined differently depending on the level of communication the machine can provide? There are many questions to ask.

Checklists

When analyzing sample watch change checklists, we considered both directions: from human to machine and vice versa. We identified five alternatives to describe whether or not a checklist item is applicable, why it is not



Hypothetical situational interaction between human and machine.

applicable, and what might be needed for it to become applicable.

One is straightforward, meaning that an item on the list is already numerical or otherwise known to the machine. Two is whether an item is quantified, namely, whether a situation can be graded on a scale of severity. Three is whether an item can be procedural, meaning if language/text can be formalized into a procedure. Four is whether an item is indeterminate, unknown or uncertain as to where it can be done and/or how. Five is an item that is not applicable (N/A).

Challenges to Handover

The International Chamber of Shipping (ICS) Bridge Procedures Guide (BPG) provides Checklist B12 for changing over a watch. Certain aspects appear to introduce challenges for human-machine handover. The main

challenge seems to be mixed information formats and the lack of a fluid, updatable and complete representation (mental model) of dynamic situations and reality. This is a known challenge for machines and systems, as yet unsolved, and one that needs more consideration.

Currently, information is received from a number of sources and in various formats (numeric, natural language, radio, email, fax, etc.). This is integrated into a mental model of the situation and context, present and future, by the watchkeeper, adding details about “likely futures” based on experience. For example, information about ships in sight might be managed by visual sensors, while information about “known” ships can come from ship and/or shore communication over radio. Conditions likely to be encountered fall in the same category.

In ship security, the difficulty might be to describe a “suspicious situation.” The current security status may be set to a number, but setting boundaries and triggers for transitioning to higher or lower levels is a challenge. Is a fast boat a risk? Is a fast boat with many people in it a risk? Is it a speedboat or a yacht?

The watch change of the engine room is also carried out according to instructions or checklists provided, for example, by the chief engineer and a company’s standing orders. Many items on such a checklist are indeterminate, mainly because of the open-ended character of the task. This may mean that the tasks are hard to quantify, depend heavily on human experience and expertise, or possibly could/should be reformulated and rewritten.

An example is work that is risky, which needs to be preceded by a risk analysis. Problem one is to define what is risky. For example, consider going into a chain locker. This is an area with risk of low oxygen levels due to rust. The space should be opened and ventilated, with a person on watch outside the space. Defining risk for a machine would likely entail long lists of possible situations and combinations. A machine has little ability to judge likelihood, severity and even how realistic certain unexpected combinations of contextual aspects are.

It is imperative to address these issues to support humans and machines when they make spot decisions, prioritize and make informed judgments about the future. The completeness of the representation, the “mental model,” will be lacking for a human-machine team until, and if, future technologies can fill the gaps.

Levels of Human-Machine Teaming

The scope and content of a handover should be defined differently depending on the scope of information provided automatically by the machine. For example, if some parts of the system on board are automated and some are not, the details of handover between human and machine should consider this.

If it is a complete handover, the machine should be able to provide the necessary information as if it were a handover between humans. It takes a considerable amount of time and effort to fully automate and perform tasks the same way as humans. It may never be entirely



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possible, but, on the other hand, it may not be necessary. Currently, most machines are in the pre-fully automated stage.

NATO suggests three levels for human-machine collaboration: unidirectional, bidirectional and collaborative. At the unidirectional level, the machine only provides outcomes from executing given functions, so that the human can use the outcomes for the rest of task. At the bidirectional level, human and machine can exchange information in a query-based way. Humans primarily initiate and lead this exchange, and machine-learning algorithms provide answers. At the collaborative level, human and machine can adapt to each other and achieve dynamic teaming.

RIA (robotic, intelligent and autonomous) systems are discussed in ISO 9241-810 as a new part of ISO 9241-Ergonomics of human system interaction. ISO RIA design approaches include: augmentation—the system improves human performance; replacement—the system replaces human functions and/or entire human jobs; remoteing—allows the user to act on the physical environment at distance; and teaming—the human and machine work together for a common goal.

Of course, there are many levels of automation systems and many design approaches. This article suggests the NATO and ISO frameworks as examples for consideration.

Depending on the level of human-machine collaboration, the system design approach will be different and

should be matched to the level of automation, as appropriate.

Conclusion

Smart ship navigation can benefit from advances in onboard technical systems. Machines should function as an adaptive team player in the way they communicate and have joint awareness with humans of context and goals. If the goal is complete watch change between human and machine, we have to strive for efficient human-machine handover.

We used current checklists for watch change for deck and engine officers to identify gaps and challenges for human-machine watch change. Some items can be directly applied to a human-machine handover, but many of them need to be revised.

We also discussed potential factors regarding the level of automation and design approaches. A central issue is constructing a rich and dynamic mental model of a situation that is shared between human and machine. Humans use multiple data types and modes of communication and data collection to merge and integrate information into a dynamic mental model of what is going on. This process is a challenge for machine learning and artificial intelligence. The development of smart functions such as artificial intelligence should be progressed in this direction to support effective and safe human-machine collaboration.

Acknowledgments

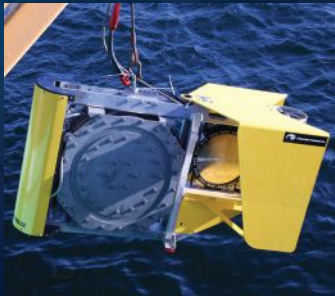
This work was supported by Korea Maritime and Ocean University and Western Norway University of Applied Science.

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For a list of references, contact Seojeong Lee at sjlee@kmou.ac.kr. **ST**

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Dr. Seojeong Lee is a professor at Korea Maritime and Ocean University. Her academic background is in software design and software quality, and she has been applying her software background in the maritime sector. Since 2009, she has been attending the IMO NCSR Subcommittee (formerly NAV) meetings and IALA e-NAV Committee meetings. She led the SQA part of IMO MSC Circ.1512 Guideline on SQA/HCD for e-navigation. In 2018, she developed the Guideline of Software Functional Safety for Korean domestic maritime industries.



Dr. Margareta Lützhöft is a master mariner, trained at Kalmar Maritime Academy in Sweden. She earned a bachelor's degree in cognitive science and a master's in computer science. In 2004, she received a Ph.D. in human-machine interaction. She is a professor of maritime human factors and leader of the MarSafe group at the Western Norway University of Applied Sciences. Her research interests include human-centered design and the effects of new technology.



Q&A: Katha Kissman

The Harbor Branch Oceanographic Institute Foundation (HBOIF) Board of Directors has announced the retirement of HBOIF President and CEO Katha Kissman.

"Katha has been an outstanding chief executive of HBOIF, both increasing the foundation's endowment and also instituting the strong financial and management controls that a world-class foundation demands," said HBOIF Chair Michael O'Reilly. "We have valued Katha's leadership, energy and enthusiasm, and we commend her for creating a best-in-class structure at HBOIF. She has been an outstanding leader for HBOIF and her leadership will be sorely missed."

Kissman joined HBOIF full time in July 2014 after serving as its interim since October 2013. During her tenure, she has worked with the board to increase the foundation's endowment from \$60 million to over \$79 million and has overseen the granting and management of over \$31 million in grants.

The board has designated Barbra Kavanaugh as interim CEO. Kavanaugh has had a 30-year career in both the nonprofit and public sectors, and she will join HBOIF this summer. Kissman will remain as CEO through June to ensure a smooth transition.

In honor of her tenure as the head of HBOIF, *Sea Technology* asked Kissman for her thoughts on her time at the foundation and her upcoming plans.

Congratulations on your retirement! What prompted you to decide to retire at this point in time?

I am about to turn 65, so it seems like a good time to start looking to my next life chapter.

In addition to travel, I also wish to return to Michigan to be able to see my parents on a regular basis. They are in great health and good spirits, and I want to spend

quality time with them while we can all still enjoy each other.

I'd like to give our readers an overview of your background. What work did you do before HBOIF, and how do you think it prepared you to run HBOIF?

Except for my very first job in a personnel recruiting office and then helping my parents open their real estate development office, I have been committed to the non-profit sector my entire career.

I have served in staff leadership positions with Volunteers of America, Leadership America, Round House Theatre and Arena



(Left) HBOIF President and CEO Katha Kissman and Florida Department of Environmental Protection Southeast District Director Jason Andreotta accepting the Leadership and Achievement Award on behalf of Florida Governor Ron DeSantis during the 2020 Love Your Lagoon event. (Right) Kissman at the 2020 Love Your Lagoon event.



2019 Indian River Lagoon graduate research fellows.

Stage. I was also on the founding teams of the American University of Sharjah, U.A.E., and the American University of Kuwait.

I continue to be a BoardSource senior governance consultant, as well as an independent nonprofit organizational development and interim leadership consultant.

Originally, I came to the Harbor Branch Foundation as an interim, after having served interim engagements with ARNOVA, the National Flute Association, the Organization of American Historians, the Linguistic Society of America, the National Crime Prevention Council, Hope for the Warriors and Interages.

I've also co-authored "Transformational Governance: How Boards Achieve Extraordinary Change" with Beth Gazley [ASAE Foundation/Wiley] and authored BoardSource's "Taming the Troublesome Board Member" and "Trouble at the Top: The Nonprofit Board's Guide to Managing the Imperfect CEO."

You increased the foundation's endowment from \$60 million to over \$79 million. How did you set and work toward this goal?

I was just one part of the fantastic team that made this happen. The Harbor Branch Foundation Finance Committee [Chair Marjorie Raines, CFA, former executive vice president and chief investment officer for international of the Chubb Corp; Mike O'Reilly, retired vice chairman and chief financial officer of the Chubb Corp.; John Papa, retired treasurer of Johnson & Johnson; and Mike Toner, retired executive vice president of General Dynamics] is comprised of extremely knowledgeable and experienced individuals. We also work with our independent investment consultant, Ed Michelson of the Atlanta Consulting Group, to achieve the best investments possible.

The objective of the HBOIF endowment funds is to earn the highest possible total return [capital appreciation and income return] consistent with prudent levels of risk, with long-term rates of return to be equal to an amount sufficient to maintain the purchasing power of our investment assets and provide necessary capital to fund an annual spending policy.

The current spending policy and the long-term objectives of preserving and growing the assets are balanced by considerations given to reasonable expectations of investment returns, gift contributions, operating expenses and inflation.

While growing this endowment, we have also provided over \$31 million in grants while maintaining a significant principal.

Can you give us a sense of your day to day as chief executive—what do you focus on daily, weekly, monthly, annually? How did you establish strong financial controls and a sound structure to manage grants and other processes at HBOIF?

Running a nonprofit is running a business. I have professional staff to manage, and I need to work within an adopted budget. The difference is that we do not have shareholders who earn profits from our work. Rather, we have stakeholders.

By agreeing to use our funds for the good of a stated mission and these stakeholders, we don't pay taxes, and for those who donate to us who are eligible, they receive a tax incentive for doing so.

We are good at what we do because our board has followed recommendations for and established best practices that are commonly accepted for nonprofit organizations.

What are the projects you're proudest of in the last seven years?

Helping this incredible board better understand and embrace the opportunities to engage in impactful, best practice grant making.

Providing seed funding for a wide variety of impactful projects and activities at Harbor Branch, which have in turn been leveraged to obtain additional external research grants. In fact, FAU [Florida Atlantic University] Harbor Branch has increased its external research portfolio by almost 100 percent between FY18 and FY19, which was built in large part by the foundation's seed funding in 2015, 2016 and 2017. In fact, FAU Harbor Branch is the single largest source of research funding at FAU (34 percent compared to the next largest at 16 percent—the Engineering program).

Growing a small annual Love Your Lagoon event netting \$25,000 per year to one consistently netting over \$100,000 for the past five years.

Funding impactful research on the health of the Indian River Lagoon.

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“During her tenure, she has worked with the board to increase the foundation’s endowment from \$60 million to over \$79 million and has overseen the granting and management of over \$31 million in grants.”

ida Highway Safety and Motor Vehicles as a model for other specialty license plate recipients.

Do you wish you could have done anything differently?

I have read mountains of grants proposals and progress reports since 2014 and visited with the Harbor Branch scientists, their labs and their lectures. I wish I had been invited onto a research cruise with some of the Harbor Branch scientists so that I could have witnessed their great work in action.

What advice would you give to your successor?

Stay the course and know that your efforts contribute to good science, which will hopefully inform policies and solutions that help humanity.

J. Seward Johnson Jr. passed away in March. Did you know him? If yes, are there any memories/thoughts you’d like to share of him?

I had the pleasure of interacting with Mr. Johnson when we brought one of his sculptures back to the Harbor Branch Campus—a bust of Harbor Branch’s founder, his father, J. Seward Johnson, Sr. He was very kind and so very complimentary of the work of the foundation since my arrival.

It has also been a deep pleasure to work directly with his sister and brother-in-law, Jennifer Johnson Duke and Joe Duke.

What do you hope your legacy will be at HBOIF?

To be remembered for working hard to ensure past, and provide a framework for future, quality funding for the Harbor Branch Oceanographic Institute at FAU.

Any plans during retirement?

Subject to the vagaries of life, I intend to walk the Camino de Santiago de Compostela in northern Spain in August. **ST**

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BlueTech Expo

Since the inaugural event in 2018, IOSTIA's BlueTech Expo (BTE) has taken a very different tack from more traditional academic ocean events. With a specific focus on fostering stronger collaborative bonds between industry and government, and its convenient annual location in Washington, D.C., it should really come as no surprise how quickly this event has taken root and grown.

In fact, it is this growth that will be most obvious to all who will be participating this year. A larger exhibition will feature a diverse line-up of technology providers and cutting-edge solutions and will emphasize how our blue tech industry and government's applications are being re-defined by innovation.

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Capitol Hill Ocean Week

The biggest news for 2020 is the co-location of BlueTech Expo with the iconic Capitol Hill Ocean Week (CHOW).

CHOW and BlueTech Expo have been loosely coordinated since 2018, with the idea that more events equals a greater focus on ocean issues during that week—a desirable outcome.

CHOW's program helps bring attention to larger ocean issues and draws a large delegation of attendees to D.C. each year. With BlueTech Expo's complementary technology focus, running the events in tandem provides both industry and government attendees a convenient single stop at the Ronald Reagan Building and International Trade Center.



“Through the online platform, attendees of both events can still look forward to exploring the novel technologies that can address pressing issues, such as CHOW’s 2020 theme of biodiversity.”

Unfortunately, with the widespread impact of the COVID-19 global pandemic, our inaugural event with CHOW has changed rather dramatically. The face-to-face event at the Ronald Reagan Building is going online as a virtual conference and exhibition to be held on Tuesday, June 9, 2020. It is our expectation that the traditional format will return in 2021.

Through the online platform, attendees of both events can still look forward to exploring the novel technologies that can address pressing issues, such as CHOW’s 2020 theme of biodiversity. With over 1,000 attending, we expect this to be one of the biggest ocean science and technology events held this year.

Highlights

In addition to all the exciting components of Capitol Hill Ocean Week, what can attendees expect from BlueTech Expo? For starters, the event will once again feature an expanded exhibition, with companies representing the wide scope of solutions and services that have come to define our industry.

New in 2020 is the Innovation Alley, where we will be featuring blue tech start-ups bringing their innovations to the government market for the first time. Alongside the exhibition, presentations and tutorials will run throughout the day providing important information for vendors and buyers alike.

As previously mentioned, in 2020, CHOW is placing a spotlight on biodi-

versity and the actions we can take to conserve the variety of life on Earth for the long-term health of our communities and the planet. Understanding and measuring biodiversity, including quantifying the extent and number of marine species over time and space, presents an enormous challenge. New advances in technology are painting a clearer picture of the state of our ocean and Great Lakes and providing critical information to help us be more effective stewards.

There are a lot of great reasons to visit the BlueTech Expo and CHOW virtual conference and exhibition in 2020. On behalf of our sponsors Kongsberg Maritime, Teledyne Marine, eTrac and Oceanology International Americas, and our members and staff, we invite you to experience BlueTech Expo online this year.

Visit www.BlueTechExpo.org to learn more about the virtual event, how to attend, and our exhibit and sponsor opportunities. **ST**



international

Shipping Industry Asks UN To Keep Global Supply Chain Moving

The International Chamber of Shipping (ICS), representing the world's national shipowners' associations and over 80 percent of the world's merchant shipping tonnage, and the International Transport Workers' Federation (ITF), which speaks on behalf of approximately 2 million seafarers who operate the world's commercial ships, wrote a letter to the United Nations regarding COVID-19. During this pandemic, the letter asks for governments to understand that around 90 percent of global trade is transported by commercial shipping, which moves the world's food, energy and raw materials, as well as manufactured goods and components, including vital medical supplies and products sold in supermarkets that are necessary for societies to function. The letter emphasizes the need to keep supply chains open and maritime trade and transport moving.

AAPA Says US Ports Are Complying with Federal Agencies on Coronavirus

The American Association of Port Authorities (AAPA) has issued a statement that recognizes the threat to both human health and world economic stability related to the coronavirus (COVID-19) pandemic: "In the U.S., ports are closely following instructions and protocols from appropriate federal agencies to quickly respond to the coronavirus threat. Like AAPA, they believe the most important things are to ensure that as few people as possible become infected, that those who have been infected are well treated and receive quality care, and that we mourn for those whose lives have been tragically cut short by this pathogen crisis."

The statement goes on to say: "The overall economic impact of this type of crisis can easily run into the tens of billions of dollars. Due to the coronavirus outbreak, cargo volumes at many U.S. ports during the first quarter of 2020 may be down by 20 percent or more compared to 2019."

Approval for Cryo Regas System

Bureau Veritas Marine & Offshore (BV) has issued the first approval in principle for a new cold energy cryo-powered regas system—a cold power generation technology based on the Organic Rankine Cycle, a technology used in multiple onshore LNG terminals for decades—for use in FSRU applications. This will be the first time the system has been developed for use in a floating terminal. The approval has been issued to both Mitsui O.S.K. Lines Ltd. (MOL) and Daewoo Shipbuilding & Marine Engineering Co. Ltd. (DSME).

Industry Supports Ocean Protection

Subsea UK has teamed up with Big Blue Ocean Cleanup to support an ocean protection project and raise awareness of the initiative across the U.K.'s £7.8 billion underwater engineering industry.

Big Blue Ocean Cleanup is an international agency that works to prevent pollution through initiatives such as offshore and beach cleaning and educational programs. The data collected through its academic research arm is used by businesses, governments, universities and individuals to help keep the oceans clean.

Tanker Deemed Cybersecure

Korean Register (KR) has completed a comprehensive cybersecurity survey of the chemical/oil tanker *Songa Hawk* and has certified the ship to be fully compliant in all areas; the very first ship to achieve the certification.

Songa Shipmanagement manages and operates 18 chemical/oil tankers and five semisubmersible vessels.

Patent for Better Ship-Shore Comms

AecorLink has been granted a new patent on its company's communication platform. The patented technology will further enhance the capacity for shore-ship communication via microwave links, improving the capability to provide high-speed, stable data connections.

New Distributor for SRV-8 ROV

RJE Oceanbotics has partnered with Wight Ocean Ltd. for distribution of its SRV-8 underwater ROV in the U.K. The eight-thruster ROV offers high maneuverability, ease of use, portability and ruggedness. Wight Ocean Ltd. was recently founded by Graham Lester, an expert in underwater vehicles and subsea technology.

JFD Makes Acquisition

JFD has acquired Fathom Systems, a provider of diver communications, gas analysis, diver monitoring and integrated diving control systems for diving support vessels (DSVs). This deal will expand JFD's portfolio of innovative diving solutions for the oil and gas, defense, renewables, decommissioning, and aquaculture market sectors.

Fugro, SEA KIT Partnership

Fugro has announced a strategic partnership with SEA KIT International, winner of the Shell Ocean Discovery XPRIZE. SEA-KIT will work with Fugro to develop a new range of agile and compact USVs that can deploy ROVs and AUVs for marine asset inspections.

The first USVs will be launched before the end of this year, and a larger USV model is being designed for delivery in 2021. These inspection-related USVs are being developed alongside Fugro's range of USVs for hydrographic data acquisition.

USCG Approves Bawat BWTS

Danish company Bawat's ballast water treatment systems (BWTS) has been awarded type approval by the U.S. Coast Guard (USCG). The system uses heat pasteurization to kill potentially dangerous aquatic organisms, instead of filters, UV lights, electrolysis or chemicals.

Acquisition of Global Marine Group

J.F. Lehman & Co., a middle-market private equity firm focused exclusively on the aerospace, defense, maritime,

government and environmental sectors, announced that an investment affiliate has completed the acquisition of Global Marine Group (GMG), headquartered in Chelmsford, U.K.

With a legacy dating to 1850, GMG is a provider of subsea cable maintenance and installation services to the telecommunications, offshore wind and utility markets worldwide.

Patents for 3D at Depth

3D at Depth Inc. was recently awarded multiple patents from the U.S. Patent and Trademark Office. Four of the patents were issued domestically in the U.S., with an additional series pending for international markets.

United States Patents 10,502,829 and 10,545,233 were developed by 3D at Depth to address the challenges of offshore metrologies and measurements in relation to inertial and acoustic positioning systems. The new patents have a direct impact on customers' survey campaigns in the offshore energy and maritime sectors.

First Vehicle Carrier at Port Canaveral

The official grand opening of the Port Canaveral vehicle processing facility was marked with the arrival of 730 new vehicles aboard the massive 653-ft.-long vessel *Wisteria Ace*, the first vehicle carrier to call at the port's facility. The new automobiles were discharged at the port's 16-acre auto-processing facility, located alongside South Cargo Pier 4. Another carrier was scheduled to arrive soon after, with more than 850 new autos aboard.

New Sonardyne Structure

The owners of Sonardyne have formed a new parent company to increase the breadth and capabilities available to customers across the organization's growing family of independent subsidiaries. Sonardyne Group will align and harness the joint strengths of Chelsea Technologies, EIVA, Wavefront Systems, 2G Robotics and Sonardyne International, while maintaining the operating independence of each company.

Sonardyne International's Managing Director John Ramsden is now Sonardyne Group CEO, and Graham Brown is the managing director.

MacGregor Grows Base in Americas

MacGregor, part of Cargotec, announced that following the acquisitions of Rapp Marine and TTS in 2018 and 2019, respectively, customers in the Americas will benefit from extended coverage and capability to support all their service needs. Plans for 2020 include establishing a regional hub that will manage spare-part stocks, order handling and shipping, and the provision of technical support and product training.

Curated Services via Smartphone

MarineMax Inc. has acquired the Boatyard digital platform to transform the boating customer experience. The platform will include an expansive range of on-demand services from qualified service providers, accessible with only a few clicks on a smartphone. **ST**



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Particle Size Analyzer



LISST-Deep now has a depth rating of 4,000 m. It is available in two versions: Type B with a 1.25- μ m to 250- μ m size range, and Type C with a 2.5- μ m to 500- μ m size range. The increased depth rating applies to the external battery housing. Sequoia Scientific Inc.

Ship Design Software Updates

Functionality has been added to the Common Structural Rules (CSR) Prescriptive Analysis (PA) and CSR Finite Element Analysis (FEA) applications. The software provides users with an easy way to evaluate designs. Common Structural Rules Software LLC.

Digitized Monitoring

This pipeline protection technology has integrated electronic sensors that can communicate directly via a user-friendly “digital technician” app, giving access to pre- and post-dive data, as well as on-the-spot installation guides, product information and training support. By reliably monitoring and quantifying riser and pipeline stress and strain, the solution provides continuous performance modeling capabilities to support product life extension. Trelleborg AB.

Hull Cleaning

Hull Skating Solutions (HSS) are individual proactive condition-monitoring services that are tailored for each vessel. They utilize a proprietary algorithm and big data to accurately predict fouling development and cleaning schedules. Jotun Group.

Bathymetry Sonar

SeapiX-C solid-state 3D multibeam sonar has real-time georeferenced static bathymetry capabilities for instant monitoring and decision making. It enables operators to directly see where they are positioning the legs of platforms on the seabed. iX-blue.

Hybrid Acoustic Inertial Navigator

SPRINT-Nav Mini offers guidance and control outputs—orientation, velocity, altitude and depth—in a single instrument weighing just 0.7 kg in water for the 300-m-rated version. It replaces the need for three separate instruments: AHRS, DVL and pressure sensors. Sonardyne International Ltd.

In-Situ Fluorescence, Turbidity



C-FLUOR probes are sensitive single-wavelength instruments with a digital output option. ASCII data can be polled every 0.5 sec. or streamed at variable rates as fast as 16 readings per second. Combining a maximum requirement of 22-mA current draw at 12 VDC input with a T99 of less than 0.6 sec., the probes require low levels of power. Turner Designs Inc.

Handheld UVC Lamps

Fluorescent lights sanitize work sites from the coronavirus. IND-HL-UVC-FL26-50 has full, 360° UVC illumination. IND-HL-UVC-FL1524-50 is a longer version of the IND-HL-UVC-FL26-50. Larson Electronics LLC.

Sunlight-Readable Display

RRD-19T River Radar Display is designed for river-based commercial vessels. It features a 19-in. display with portrait orientation. The portrait format is ideal for allowing operators to see farther down the river while highlighting traffic, weather and markers in narrow channels. Seatronx.

Collaborative Workspace

Podium brings together applications, data and people across the maritime community, connecting any data source or third-party application and integrating them within its unique timeline architecture. Users can quickly visualize correlated data streams in an agile dashboard environment, transforming operational decision making. StratumFive Ltd.

Alloyed Steel Hard-Wire Cutter

Xuron Model 2193 features full blade bypass cutting, which causes the wire to break, rather than being squeezed and deformed as happens with standard cutters. Leaving flat ends on both sides of the cut wire, the bypass cutting combined with a high-leverage cutting head minimizes the user's required hand pressure. Xuron Corp.

Bottom Pressure Recorder

RBRquartz³ BPR|zero is a special version of the RBRquartz³ BPR, implementing an internal barometer and switching valve. The novel AzeroA technique is used to provide in-situ reference measurements to correct for long-term drift in the Paroscientific DigiQuartz pressure gauge. RBR Ltd.

Offshore ROV

Gorilla is a 1.5 x 1-m underwater robot capable of diving down to 600 m, designed for offshore inspection tasks such as drilling platforms or offshore wind turbines. It is equipped with an intelligent dynamic positioning (DP) system based on rim-driven thruster technology. Copenhagen Subsea A/S.

Propulsion Automation

AI-ready FuelOpt can achieve di-

rect fuel savings of up to 15 percent. It gathers vessel data in real time from the sensors on board a vessel. Propulsion, satellite weather, crew reporting and other data are integrated into Fleet Analytics to convert big data into knowledge and insight about operational performance. Lean Marine Sweden AB.

Intelligent, Spot-Free Wash-Down

Simply attach your water supply hose to DTS+Mobile and choose between unfiltered water for washing or purified spot-free water for rinsing. The purified water can also be used to fill your freshwater tank. FCI Watermakers Inc.

UV Fights Fouling



This light system uses lens optics to focus the UV light of energy-efficient LEDs to keep irradiated surfaces permanently free of bio-fouling. It was developed for continuous deployment in the Baltic Sea for underwater sensors. IOW.

Color-Coded pH Sensors

Application-driven designs are categorized into three groups: the entry-level 100 series for cost-effective measurement in general process applications; the high-performance 500 series for harsh industrial applications; and the 700 series for specialist applications. Digital and analog options are available, with digital offering advanced in-built diagnostics. ABB.

Edge Sealer for Anti-Slip Tapes

Flex-Tred Edge-Sealing Compound is a one-part, high-solids, elastomeric sealant ready to use without mixing, priming or heating. It has outstanding water and moisture resistance and resists cracking, chipping and peeling. Wooster Products Inc.

Multibeam Echosounder Updates

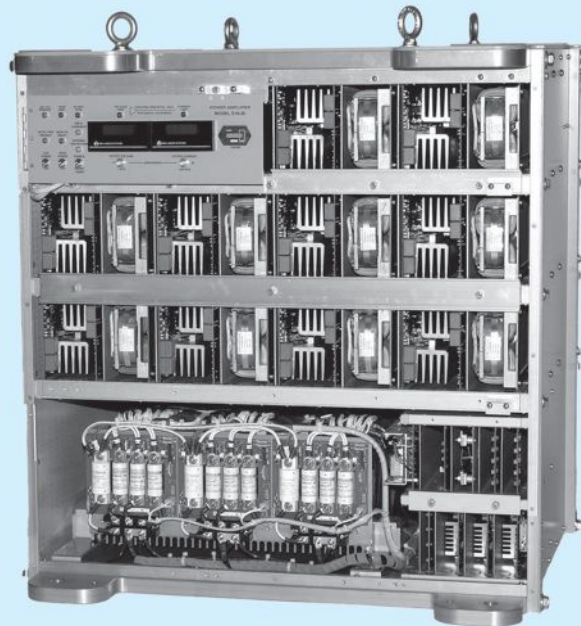
SeaBat T-series v.2.0 increases beams from 512 to 1,024 for improved target detection capability. The visualization feature update to the Teledyne Marine Sonar User Interface (SUI) adds color by depth. Normalized Backscatter output covers the surface-based SeaBat T20-P and SeaBat T20-R. The backscatter is compensated for the sonar settings' effects. Teledyne RESON.

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environmental monitoring

Great Lakes Monitoring Demo

Chelsea Technologies was invited to take part in the Great Lakes Practicums to demonstrate the efficacy of its portable ballast water compliance monitor FastBallast, alongside monitoring technologies from five other manufacturers.

The Practicums were also an opportunity to introduce the FastBallast flow-through unit, which can be installed on a ship for long-term ballast tank monitoring.

Attendees included state and federal authorities, shipowners and environmental organizations.

The primary objective was to demonstrate the usability and practicality of the different systems available.

Each participant was provided with five samples of lake water to test for viable organisms, with each sample in the series being more dilute than the previous. The samples were tested by each equipment manufacturer, who also demonstrated their methodology and discussed the scientific merits behind the various analytical methods. The organism counts recorded by the manufacturers were later compared with microscopy analysis of the samples.

FastBallast is a rapid, onboard compliance monitor that incorporates Single Turnover Active Fluorometry (STAF) to provide an accurate assessment of living phytoplankton cells within a 20-mL ballast water sample. FastBallast generates a data set of 480 fluorescence measurements over 8 min. as the sample is stirred. The data are analyzed in real time using a patented method based on Poisson theory, which works with phytoplankton cells of any size to provide an accurate measure of cell density.

Over the last 200 years, the Great Lakes have experienced significant changes to their ecosystems as more than 180 invasive species have taken up residence across the region. The invasion is causing millions of dollars in damage, not only affecting the local ecology but also threatening human health and local

industries, including tourism, fisheries and agriculture.

Particle Size Analyzers for USACE Research

Sequoia Scientific Inc. has delivered five LISST-200X submersible particle size analyzer systems to the United States Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi. Each system comprises Sequoia's flagship LISST-200X laser diffraction particle size analysis instrument and accessories designed for both lab and in-field applications of the instrument.

The USACE will initially use the advanced LISST-200X technology in their sensitive habitats working unit that is focused on understanding dredge and placement activity impacts on corals and submerged aquatic vegetation. The instruments are planned to be deployed in the Honolulu, Hawaii Harbor and eventually in Florida and other East Coast sites.

Data Platform for Ghana Ports

OceanWise was recently involved in a project with Ghana Ports and Harbours Authority (GPHA), dubbed as the trade and logistics hub of Western Africa. The project involved installing a comprehensive environmental monitoring system at two key GPHA ports: Tema and Takoradi.

The tide and weather system is designed to deliver essential real-time tide and weather data to the GPHA operators, hydrographers and pilots who will rely on the data to make important operational decisions and ensure safety at the port. The data from the tide and weather stations are collected, managed and published in the OceanWise data publishing platform Port-Log.

The tide gauges also form part of the GLOSS network (Global Sea Level Observing System), established by the Intergovernmental Oceanographic Commission (IOC) of UNESCO in 1985. The two tide gauges at Tema and Takoradi are

part of over 300 gauges that make up this important data network.

AZFP for Deep Observatory

The SeaCycler is a long-term interactive deep-ocean observatory equipped with a large payload of oceanographic instruments. It was a key part of the VITALS project that was examining atmospheric gas exchange and deep convection in the Labrador Sea.

An ASL Environmental Sciences' Acoustic Zooplankton Fish Profiler (AZFP) (multifrequency 38/70/125/200 kHz) has been added to the instrument payload of the SeaCycler to continuously record acoustic backscatter in the water column.

Shipping Modifies Clouds

A container ship leaves a trail of white clouds in its wake that can linger in the air for hours, caused by small airborne particles of pollution, according to a new study funded by NASA and the U.S. National Science Foundation. The research is the first to measure this phenomenon's effect over years and at a regional scale. Satellite data over a shipping lane in the south Atlantic show that the ships modify clouds to block an additional 2 W of solar energy, on average, from reaching each square meter of ocean surface near the shipping lane.

The result implies that globally, cloud changes caused by particles from all forms of industrial pollution block 1 W of solar energy per square meter of Earth's surface, masking almost a third of the current warming from greenhouse gases. Without the cooling effect of pollution-seeded clouds, Earth might have already warmed by 1.5° C, a change that the Intergovernmental Panel on Climate Change projects would have significant societal impacts. For comparison, today, the Earth is estimated to have warmed by approximately 1° C since the late 1800s.

The results suggest that a strategy of spraying salt particles to make low-level marine clouds more reflective, known as marine cloud brightening, could temporarily slow global warming. **ST**

contracts

ChartWorld International Ltd., Limassol, Cyprus, has signed a new distribution agreement and has launched the distribution of C-Map Professional+ charts as S-63 data sets. Navico Norway AS.

Damen Shipyards Group, Gorinchem, Netherlands, has signed a contract for an ASD Tug 2312. The new vessel will operate as part of the Forth Estuary Towing operation and provide opportunities to service emerging markets, such as decommissioning and offshore wind. Forth Ports Ltd.

Arctic Rays LLC, Groton, Massachusetts, has a new Northeast sales representative, with territory including the New England states, plus New York, New Jersey and Pennsylvania. Electronic Sales of New England.

Gaslog Ltd., Piraeus, Greece, has opted to apply A-LF Sea hull coating as part of its current drydocking program. A-LF Sea minimizes bio-fouling and hull resistance, resulting in reduced fuel consumption and engine emissions. Nippon Paint Marine.

OceanGate Inc., Everett, Washington, has selected a preferred provider of aerospace-grade prepreg carbon-fiber material for use in the manufacturing of new carbon-fiber pressure vessels for deep-sea manned submersibles. Toray Composite Materials America Inc.

Incat Tasmania, Derwent Park, Australia, has announced an order for a new-generation fast ferry. The 76-m bespoke high-speed, wave-piercing catamaran ferry will accommodate up to 700 passengers and 79 cars when it enters service on the new route between Jindo and Jeju early 2022. Seaworld Express Ferry.

Oceaneering International Inc., Houston, Texas, has been awarded a contract for an FLNG vessel maintenance build and inspection

and maintenance program. Work will include an asset register build, a full maintenance build program, a risk-based inspection assessment and the development of a corrosion management strategy. Golar LNG.

Nauticor GmbH & Co. KG, Hamburg, Germany, has signed a letter of intent for cooperation in developing a joint LNG supply infrastructure in the Baltic Sea range, delivering via both bunker vessels and trucks, with a focus on ports along the German Baltic Sea coast. Novatek Green Energy Sp. z o.o. **ST**

meetings

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

JUNE

June 9—BlueTech Expo, virtual event at www.BlueTechExpo.org.

June 9—Capitol Hill Ocean Week, virtual event at capitolhilloceanweek.com.

June 17-19—International Workshop of Marine Technology - MAR-TECH, 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 14—Restoring Estuarine and Coastal Habitats in the North East Atlantic, London, England. roger.proudfoot@environment-agency.gov.uk.

July 15-16—American Society of Naval Engineers Multi-Agency Craft Conference, Baltimore, Maryland. 703-836-6727, [asne](http://asne.org)

hq@navalengineers.org or www.navalengineers.org/Symposia/MACC-2020.

AUGUST

August 4-6—Technology, Systems & Ships, Arlington, Virginia. www.navalengineers.org/Symposia/Technology-Systems-and-Ships-2020.

August 11-14—Oceans 2020 Singapore, Singapore. info@oceans2020singapore.org or <https://singapore20.oceansconference.org>.

August 18-21—International Partnering Forum on Offshore Wind, Providence, Rhode Island. www.offshorewindus.org/2020ipf.

SEPTEMBER

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

September 9-11—Noia Oil & Gas Conference & Exhibition, St. John's, Canada. kmorrissey@noia.ca or www.noia.ca.

September 14-17—Fleet Maintenance and Modernization Symposium, Virginia Beach, Virginia. www.navalengineers.org/Symposia/Fleet-Maintenance-and-Modernization-Symposium-2020.

September 21-25—NMEA/RTCM Conference & Expo, Orlando, Florida. 410-975-9425 or www.nmea.org.

September 23-24—Oil Spill India, Mumbai, India. www.oilspillindia.org.

September 23-24—Remote Hydrography Conference, Southampton, England. tinyurl.com/y7v95eeg.

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

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

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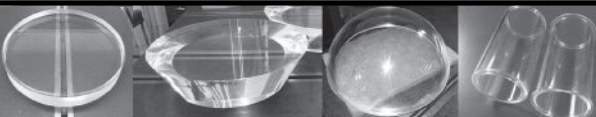
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Marine Big Data Should be Accessible to Everyone—Dr. Mike Osborne

Dr. Mike Osborne is the managing director of Ocean-Wise Ltd. He is a physical oceanographer with skills in environmental and engineering support, marine data management and GIS. He has managed high-profile projects globally and has been pioneering the use of GIS in the marine environment for almost 20 years. He was the Association of Marine Scientific Industries Business Person of the Year in 2017.



Blue Marine Foundation (BLUE) is a charity dedicated to restoring the health of the oceans by addressing environmental pressures, such as overfishing. The foundation's mission is to protect at least one-third of the world's ocean by 2030, with the remainder being managed in a responsible way, using a combination of top-down intervention to improve governance and bottom-up project delivery to help local communities who are at the front line of ocean conservation.

BLUE realizes the importance data can play in enhancing ocean understanding, especially when data help connect people across generations. This is achieved only when data from multiple sources are combined and communicated in a way that makes them relevant, interesting and digestible by a non-expert. Rather than just promoting this approach, BLUE is funding projects that help create awareness and knowledge and bring forward this development.

One such project is the Big Marine Data project (www.bluemarinefoundation.com/projects/big-data), led by the University of Southampton's Geodata Institute and involving Plymouth Marine Laboratory, marine data management and mapping experts Ocean-Wise, and the U.K.'s Royal National Lifeboat Institution (RNLI). The project investigated how data from dis-

parate sources can be collated and integrated effectively, historically and in near real time to inform safety and risk at the coast and inshore waters.

The understanding gained is essential if we are to harness the volumes, variety and velocity of data, which present both an opportunity and a challenge. In this context, marine data have often been forgotten and lagged behind their terrestrial counterparts, but through initiatives such as the Big Marine Data project, this is no longer the case, with more interest and focus on our seas and oceans than ever before.

BLUE's aims run parallel to the Sustainable Development Goals of the United Nations (UN), in particular SDG-14 (Life Below Water), which includes the prevention and significant reduction of marine pollution; the sustainable management and protection of marine and coastal ecosystems to avoid significant adverse impacts; addressing the impacts of ocean acidification; and effectively regulating overfishing.

As with BLUE, the UN understands that reliable sources of data are essential to achieving these goals and monitoring performance. As a consequence, the UN established the Expert Committee on Global Geospatial Information Management (UN-GGIM) to develop the policies and instruments and support the capacity building for member states that are required to deliver the accurate and timely data that will make it possible to achieve the goals.

Working in collaboration with the International Hydrographic Organization (IHO) Marine Spatial Data Infrastructure and Open Geospatial Consortium (OGC) Marine Domain Working Groups, the Marine Expert Group of the UN-GGIM is helping to deliver the UN SDGs, particularly SDG-14, to the marine scientific and technology communities by promoting the importance

of good data governance and interoperability. This means ensuring these communities are aware of the efficiency and other gains that can be achieved by adopting open standards and systems, such as the ISO 19100-based S-100 standard for hydrographic data and information, and by encouraging data owners to make their data more widely available, i.e., to make it findable, accessible, interoperable and reusable (FAIR).

Of course, making data "FAIR" provides the sources but not the solutions that users and policy makers require as input to decision making. Neither does it on its own address the importance of describing data quality to facilitate data assessment and help ensure data are used appropriately. There will be a growing need to automate these processes as new sensors, autonomy and improved measurement techniques increase the volumes of data being collected.

The Big Marine Data project explored all these possibilities, culminating in the development of a web observatory and several prototype applications to inform the level of risk, as well as having the capability to consume data in a real-time environment and bringing together geospatial, environmental, operational and historical data sets in meaningful ways.

These efforts were echoed by Liu Zhenmin, the UN's under-secretary-general for Economic and Social Affairs, at the opening address of the recent eighth session of the UN-GGIM as he expressed the need for reliable, timely, open and disaggregated data to support all phases of disaster risk reduction and management. For this reason, and to help the international community meet the UN's SDGs, an enlightened and modern approach to marine data acquisition, management and governance has never been more important. **ST**

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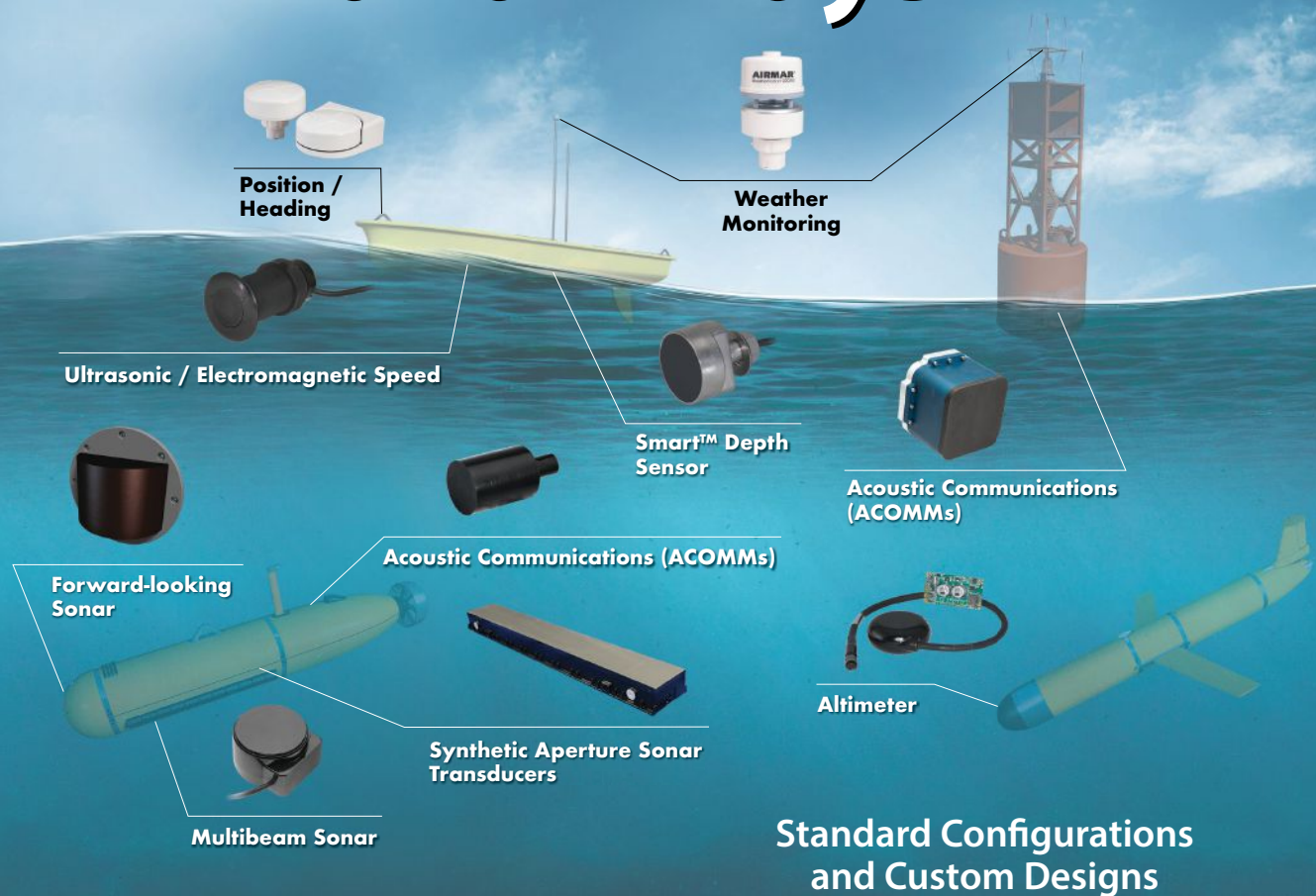
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