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The background of the cover is a photograph of a yellow crane arm on a ship's deck, extending over the ocean. The sky is a mix of orange, pink, and blue, indicating a sunset or sunrise. The crane arm is the central focus, with its various joints and cables visible. The ocean is dark and calm, reflecting the colors of the sky.

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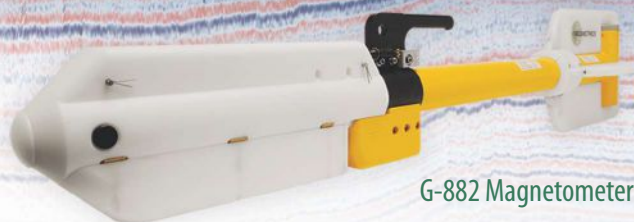
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COVER IMAGE

A Neptune 3000 coiled rod CPT system installed on the aft deck of the RV *Shearwater* during geotechnical survey operations along a burial route for a proposed power cable. This photo was taken June 2018 offshore Massachusetts by Justin Bailey, senior project manager and professional geologist with Alpine Ocean Seismic Survey Inc.

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Embracing a New, Digital Era

Today's shipping environment is beset with challenges, ranging from the introduction of stringent regulations and persistently low freight rates to fluctuations in trade patterns and commodity prices. Now more than ever, it is crucial for shipowners and operators to adapt to these volatilities within the business landscape in order to thrive and remain relevant.

Big data and digitalization are reshaping the way businesses operate. An increase in connectivity and accessibility has allowed the streamlining of business models to achieve greater commercial and operational efficiencies.

However, the shipping and logistics industries have not always been quick to adapt to these innovations. Indeed, when compared to other industries, shipping has been lagging behind in the wholesale adoption of digitalization. A smart shipping survey conducted in January 2018 found that, while the majority of maritime industry executives believe digitalization and big data will transform the sector, only 8.7 percent currently see it as a major part of their operations.

That said, shipowners and operators are now increasingly recognizing the need to embrace digitalization and new technologies in order to achieve greater efficiencies in shipping and logistics and thrive in the current competitive landscape.

A growing number of maritime companies are investing heavily in digital strategies. Industry giants such as CMA CGM and Maersk have recently announced various initiatives and collaborations to drive the use of innovative technologies across their respective businesses. Similarly, key maritime hubs such as Singapore and Denmark have laid out their respective roadmaps and visions to develop innovation and push ahead with digital transformation in the coming decade. To further encourage and propel the shipping industry to digitalization, more than \$500 million has been invested into digital and technology start-ups.

While digitalization in shipping might still be in its infancy, the benefits and opportunities for the shipping and logistics industries have not gone unnoticed and are now at the cusp of transforming these industries.

As just one example, GAC (Gulf Agency Company), with more than 300 offices across 50 countries, collects an immense amount of data from its day-to-day operations. The information allows us to provide useful and relevant insight on emerging trends—in effect, first-hand market intelligence—to customers, enabling them to make informed commercial decisions. The data allow us to tailor our solutions to individual customers according to the markets in which they operate.

Digitalization is driving supply chains to become more efficient, agile and customer-focused than ever before. Customers today expect fast and seamless delivery. However, structured and siloed supply chains can slow the process significantly, thus resulting in lost revenue and time. In a survey of 200 maritime industry executives conducted by Navis, respondents on average said supply chain processes could be improved by 50 to 60 percent if the industry updated its IT systems and shared more data. Digitalization allows companies to shift away from uncoordinated efforts toward an integrated operating model—one that provides greater transparency, traceability and predictability.

There is no doubt that digitalization provides unparalleled opportunities for the shipping and logistics sector. It's time for all players within our industry to step up and integrate digitalization into their overall business strategy, leverage data insights and make informed decisions to ensure the commercial viability of their businesses. **ST**

EMPOWERING



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THE FUTURE IS ELECTRIC

)) First International Polar Ship Routing Measures. The International Maritime Organization (IMO) approved the Bering Strait and Bering Sea ship routing measures proposed by the U.S. and Russia. Taking effect December 1, 2018, the six two-way routes and six precautionary areas are the first internationally recognized ship routing measures the IMO has approved for polar waters. In November 2017, the U.S. and Russia proposed a system of two-way routes for vessels to follow in the Bering Strait and Bering Sea in response to increased shipping traffic. Located in U.S. and Russian territorial waters off the coasts of Alaska and the Chukotskiy Peninsula, the routes are designed to help mariners avoid shoals, reefs and islands and to reduce the potential for marine casualties and environmental disasters. The routes are voluntary for all domestic and international ships and do not limit commercial fishing or subsistence activities.

)) EU-Funded Project to Enable Autonomous Navigation in Close Proximity. Hull to Hull (H2H), an EU-funded research project to develop technical solutions for safer navigation in close proximity of other stationary or moving vessels and objects, is in its concept definition phase and will move on to the technology adaption and integrations work package (WP03) this summer. H2H will develop solutions using the European Global Navigation Satellite System (EGNSS), EGNOS and Galileo that can enhance safety in busy waters and create the fundamental conditions for autonomous vessel navigation. The project is coordinated by Kongsberg Seatex. Partners include SINTEF Ocean and SINTEF Digital, KU Leuven, and Mampaey Offshore Industries. H2H is divided into nine work packages, of which four are led by Kongsberg Seatex. The pilot system will be developed in WP03; the aim is to define precise sensors and communication systems and develop an integrated solution based on the best available technology. Demonstrations are scheduled for 2019 and 2020.

)) IoT Uptake on the Rise in Maritime. Original research commissioned by Inmarsat suggests that the maritime industry is more amenable to adopting analytic, management and operational tools applied through the Internet of Things (IoT) than many commentators have supposed. The “Industrial IoT: Maritime” report provides a cross-sectoral study on digitalization in the global supply chain. The full report, based on 750 interviews conducted by technology market research company Vanson Bourne, investigates use of, attitudes to and predictions for IoT-based solutions across the maritime, transport and logistics, energy, mining and agriculture sectors. The 125 maritime respondents include owners from across the board in terms of fleet size, with owners from Greece making up the largest constituency (25), followed by Japan (20) and Germany (15). Ship types are spread across the container, tanker, bulker, gas, offshore and fishing vessel segments. Respondents suggest that their average expenditure per business on IoT-based solutions will amount to \$2.5 million over the next three years. They say that IoT-based solutions will attract a larger share of their IT budgets than any other next-generation technology. Route optimization is identified by 57 percent as in use or on trial. With regulations inexorably tightening on ship emissions, 65 percent of respondents say they already use IoT-based solutions to monitor fuel consumption, rising to 100 percent by 2023.

)) AUV Demand to Increase Through 2022. The latest edition of “World AUV Market Forecast” shows global AUV demand growing 37 percent over the 2018 to 2022 period, with the military sector accounting for 72 percent of the market by 2022. The military sector will see demand grow at 10 percent CAGR over 2018 to 2022. The commercial sector will see the largest growth (74 percent) as AUVs continue to be adopted in oil and gas operations. Commercial AUV demand is to grow at 15 percent CAGR over 2018 to 2022, driven by rapid growth in life-of-field inspection. Development of subsea hosting and subsea intervention technology will drive demand for oil and gas applications. New subsea-hosted AUVs will allow for more cost-effective inspections and interventions of subsea infrastructure than an ROV or surface vessel. Other applications such as pipeline inspection, site survey and rig move/hazard survey will see growing demand over the forecast. The research sector will account for 25 percent of global AUV demand by 2022. Increased capability of AUV batteries and propulsion systems will allow AUVs to explore more extreme environments with a reduced environmental impact. Increasing environmental awareness and scientific interest in understanding the world’s oceans drives demand in the sector. Growth in the research sector will be limited to a 3 percent CAGR over the forecast period, attributed to smaller AUV fleet sizes required for projects.

)) Dutch Maritime Sector Recovering. Despite the beginnings of a Dutch maritime recovery in 2017, turnover still decreased from €7.3 billion to €6.9 billion for yards and suppliers collectively, according to the Netherlands Maritime Technology (NMT) trade association. The total workforce decreased by about 3 percent. The decline in both figures appears to have leveled off. A total of 58 seagoing vessels were delivered in 2017 (compared to 42 in 2016). The turnover of the approximately 800 maritime suppliers in the Netherlands amounted to €3.4 billion in 2017 (€3.8 billion in 2016). Turnover for ship repair in 2017 was €381 million (€442 million in 2016). There were 155 vessels delivered in 2017 (116 in 2016). The coming years will see all kinds of environmental regulations come into force that affect shipping. Dutch yards and maritime suppliers believe they have positioned themselves to offer the innovative solutions required to supply vessels and the technologies that meet the most stringent requirements. **ST**

Deep-Learning Technology

Artificial Intelligence for Offshore, Subsea Applications

By Jeppe Nielsen

We live in the emerging age of robots and artificial intelligence, and the particular disciplines of deep learning and computer vision are about to transform the way we work.

EIVA is a supplier of high-end software for the offshore and subsea industry, and we are in the process of introducing these technologies into both our existing and new product offerings. The end-goal is higher efficiency and, thereby, cost reductions, as well as enabling entirely new capabilities that have not been possible previously.

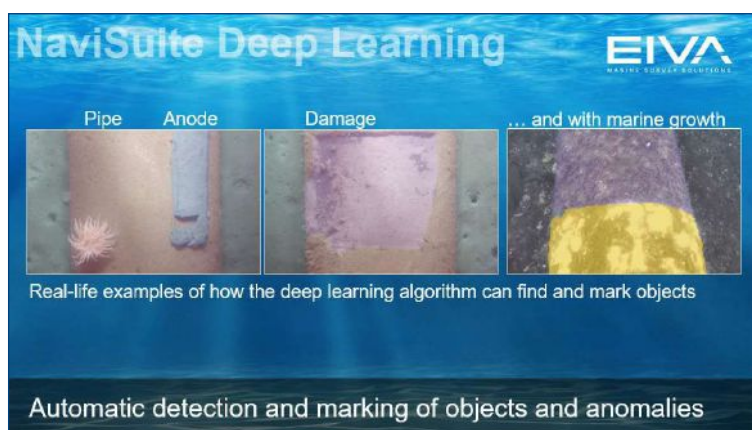
Cost Reduction of Anomaly Detection

The EIVA NaviSuite software is now using deep-learning technology to automatically detect and mark typical anomalies for underwater pipeline inspections. In other words, the software can automatically identify and mark objects such as pipelines, anodes, damages, joints, debris and oil seeps. The object detection happens in real time on live camera feeds, for example, during an ROV survey, or alternatively on recorded videos during the post-processing of data.

Each camera frame or still image is investigated, and the software classifies the objects identified in the image and assigns confidence certainties to each object found. A single object is typically seen in many video frames/images, and the software filters this out so that a single “event” is generated for each identified object of interest.

From the user’s perspective, the entire process is automated, and the resulting event registrations are no different than event registrations made manually by the user. This means that the introduction of the deep-learning-based automatic registration is seamless and fast.

The software can process some 500 images per second and is consequently able to process as many as 20 camera feeds in real time—or inspect a recorded video with more than 20 times the normal speed—freeing up the user to spend time on other tasks.



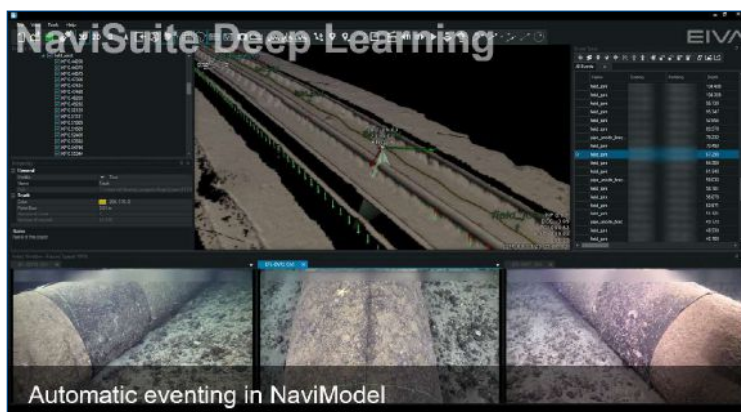
Examples of identification and marking of objects through deep learning.

Deep-Learning Challenges

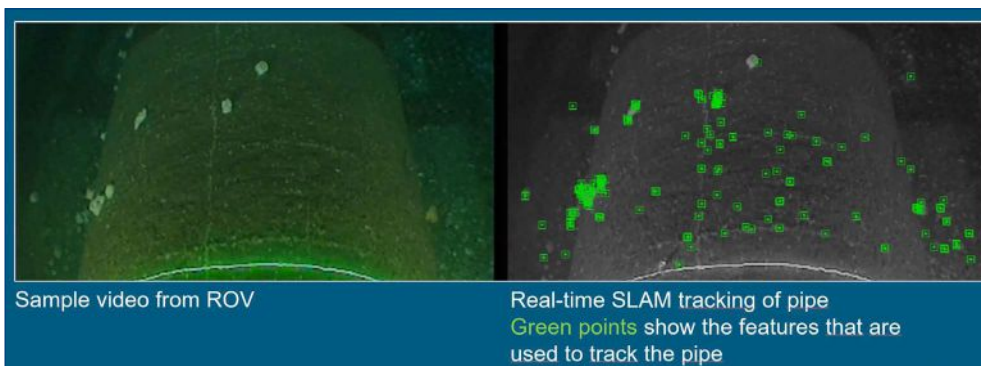
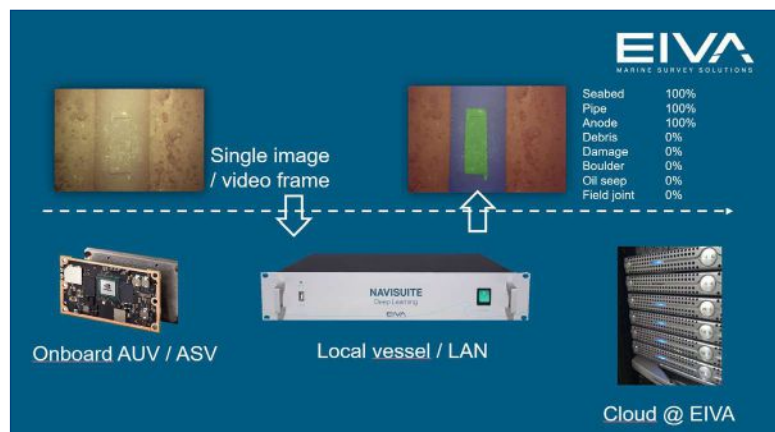
The technology behind deep learning is widely available, and due to the computing power of modern graphics cards, it can perform impressive things. However, the technology is not the challenge: getting it to work is. We encountered, and found solutions to, three main challenges.

The first challenge is that anomaly detection requires historical data. Deep-learning systems are trained—not programmed in the traditional sense. You need many positive data samples (with the objects you want to recognize) and negative samples (without the objects) to do so. By definition, deep learning is good at recognizing objects similar to what it has seen before. However, damages and other anomalies are relatively rare and tend to be unique, which introduces the challenge of finding enough data for training the deep-learning models.

Simply put, you cannot train damage detection on a pipeline with no damages; you need data across many pipelines, especially older ones that include examples of the type of anomalies you’re looking for. This means that asset owners potentially have to rely on data from other



(From top to bottom) Example of eventing in connection with a pipeline inspection in the EIVA Navi-Model software. The three possible forms of deep learning available in NaviSuite. Computer vision in EIVA NaviSuite.



asset owners with older assets in order obtain enough data to train a functioning deep-learning model.

This is where EIVA is in a unique position, having customers across the world with tens of thousands of inspection projects already carried out using EIVA's software. This has enabled us to gain access to a lot of historical data in order to make the deep-learning software perform well.

The second challenge is variance and data quality. Our industry has traditionally used laser lines and applied video overlays for imagery. Special effort has gone into the deep-learning software to ignore such irrelevant information.

More important is the variance in design and conditions: Pipelines simply don't look the same. We are talking about different pipe dimensions and insulation, field joint types, anode types and seabed types, as well as a variance in marine growth, camera quality and water quality. Consequently, you need a lot of different data to

make deep learning work in the real world.

The third, and largest, challenge is that data management is a huge task. You need massive amounts of data, as in millions of images and videos and tens of thousands of verified positive examples of each object type. EIVA is lucky that our customers have thousands of projects already fully "evented," that is, possess images already classified and easily available through automated exports of events with the "closest images" and "nearest video clips," otherwise the task of getting data sorted would be impossible.

Additionally, in order to have the software mark the identified objects, you need to have the training data annotated as well. That is, all training samples must have clear markings of where the objects are. This has to be done for all the thousands of training images. EIVA implemented a web-based tool that allows crowd sourcing of this annotation, i.e., letting internal and external staff annotate each image by hand.

Usage

The deep-learning functionality is made available in three forms: cloud—any EIVA NaviModel user with a proper internet connection can utilize the computing power of the EIVA-hosted deep-learning service; on premises—a 2U rack server allowing for the deep-learning capabilities to be installed on premises at customers' facilities, for example, on a vessel; and onboard electronics—where the deep-learning functionalities are integrated onto autonomous platforms such as AUVs and ASVs, enabling these platforms to utilize the features.

For both the cloud and the on-premises rack server, the user interface is from EIVA's NaviModel or NaviPac software, where the user can activate the automatic eventing on live-video/still-image feeds or on recorded data. Thus, all images are investigated, and objects found

are created as events at the proper locations in 3D.

Computer Vision-Based Tracking

Another discipline being introduced into the EIVA NaviSuite software is computer vision. Computer vision enables the software to identify small recognizable features in videos/images and track these, that is, find them in subsequent video frames. The software will easily find and track hundreds of such feature points in real time, and by using triangulation, calculate the camera position relative to each of these points. By calculating the camera position, all feature points are also positioned in 3D. The technique is called SLAM (simultaneous localization and mapping) and gives us a number of interesting features—all from a single camera.

Since we calculate the movement of the camera for each video frame, a single camera is now also able to produce a navigation track. This is in itself a new product, and the implications for the subsea in-

dustry can be huge because subsea positioning has so far depended on very expensive (and physically large) gyros, whereas now, a small, low-cost motion sensor and a camera can achieve the same effect. For small AUVs and ROVs, where the payload capacity is limited, this can be a game changer.

Since all feature points are calculated in 3D in real time, a point cloud of surrounding objects exists in real time. The AUV can use this for obstacle avoidance, distance keeping or for structure tracking.

New Autonomous Mission Possibilities

For AUV/ASV operations, the deep-learning and computer vision capabilities give us a number of interesting opportunities that enhance the mission success rate and reduce resurvey time.

For example, for pipe tracking, the software will continuously detect if the pipeline can be seen in the video feed. Consequently, the camera is now a real-time pipe

tracker. This can be used by the AUV for two things: First, to verify position, and second, to verify the video feed quality (if the software can see the pipeline, then the video quality is acceptable).

The software also detects anomalies such as damages in real time, and the AUV can use this to circle around and get more data, thereby ensuring that more data are available on points of real interest.

These capabilities are being tested during 2018 in real-world projects using EIVA NaviSuite software and small-EIVA electronics.

Looking a bit further into the next few years, a number of entirely new capabilities lurk on the horizon with the further development of EIVA NaviSuite. Deep learning and computer vision can find, follow and inspect structures, including risers and anchors that are positioned at somewhat uncertain points in the water column and would be very difficult to inspect with today's pre-programmed AUV technology.

Advanced navigation is also possible, where the software can detect reference points in a subsea reference map. An example could be the automatic detection of anode and valve areas to navigate safely inside subsea fields or to follow subsea structures such as pipelines autonomously in order to navigate between fields. This solves two challenges: It avoids the need for acoustic positioning systems, and it enables safe in-the-field use of autonomous vehicles.

The applications of the machine learning techniques such as the ones described in this article represent the very near future—and they are only the beginning of new possibilities. **ST**



Jeppe Nielsen has a background in computer science, development processes and strategy. He has been the CEO of EIVA a/s since 2011. He has 20 years of experience with the management of complex technology projects, software development, innovation management, product development, business development and sales.



SEG18

The Society of Exploration Geophysicists 2018 International Exposition and 88th Annual Meeting (SEG18) in Anaheim, California, October 14 to 19 will feature robust, cutting-edge education programming, including 151 technical program sessions with more than 1,080 presentations, 10 special sessions and one special global session. Also offered are 14 continuing education courses; five Business of Applied Geophysics Plenary Sessions; ancillary education sessions, including a career workout workshop; 2018 SEG Distinguished Instructor Short Course; EAGE EET 13; and 22 post-convention workshops.

Topics

Darryl Willis, vice president of oil, gas and energy at Google Cloud, will be the keynote speaker, presenting “The Cost of the Status Quo – Get on Board or Get Left Behind” during the opening session and presidential address to take place on Monday, October 15, from 8:30 to 10 a.m. Willis is an accomplished global senior executive with expertise leading businesses across the oil and gas industry. He has a proven track record of delivering growth and improving profitability for enterprises in the United States, Russia, Asia and Africa. He has earned a reputation as an inspiring leader who develops people, builds high-performing teams and gets business results.

The brand new hot topic Machine Learning and Data



Analytics for E&P will be highlighted with five oral and five poster sessions on classification for interpretation, noise attenuation and seismic processing, facies classification and reservoir properties, seismic imaging and inversion, and various machine learning applications. The special session,

Recent Advances and the Road Ahead, will discuss the recent progress and future opportunities and challenges of data analytics and machine learning for geoscience applications.

Following the conference on Thursday and Friday are 22 post-convention workshops, featuring a wide range of technical topics, including new ones such as cloud computing and deep learning in subsurface exploration.



Sessions

Also new this year are the Business of Applied Geophysics (BAG) Plenary Sessions focused on the business impact of applied geophysics for the oil and gas industry. Separate from the technical sessions and workshops, these plenary sessions bring together leaders from operating companies, governments, service providers, educators and consultants who will discuss the business opportunities and challenges of the economic application of geophysics in the oil and gas business. BAG sessions include: Southern Gulf of Mexico: Challenges and Opportunities; Digital Transformation – Business Opportunities and Challenges; Operating in a Regulatory Indus-

try; Impacting Society: Frontiers for Geophysicists; and Geophysical Return on Investment for Unconventionals.

Ancillary education sessions will be offered, including a career workout short course, where attendees will increase career awareness and acquire skills aimed at professional and personal development and career mobilization; EAGE EET13: Velocities, Imaging, and Waveform Inversion – The Evolution of Characterizing the Earth's Subsurface; Google and Friends Hackathon for Data Science and Machine Learning; and the SEG Distinguished Instructor Short Course: Seismic Attributes as the Framework for Data Integration throughout the Oil-field Life Cycle, by Kurt J. Marfurt. Visit seg.org/am/aes for more information.

Courses

Continuing education courses targeted toward geophysicists of all levels are offered during the weekend before the official start of SEG18. New courses offered this year include: Ambient Seismic Noise Surface Wave Tomography; Basic Seismic Interpretation; Business Fundamentals for Petroleum Geophysics; Introduction to Artificial Intelligence and Machine Learning; and Practical Seismic Surface Wave Methods: Basics to Cutting Edge.

Events

Other SEG18 events include the world championship of the Student Challenge Bowl and other student and evolving professional networking opportunities; the SEG/

AGU Near-Surface Geophysics Technical Program Special Session on Hydrogeophysics; and the SEG Women's Network featured events.

This year's Annual Meeting introduces one-on-one partnering, whereby attendees will have an opportunity to pre-schedule private, 30-min., face-to-face meetings with the other 6,000-plus attendees.

SEGratis Membership

New this year, nonmembers will further connect to the world of applied geophysics thanks to the SEGratis Membership, a free gift of an annual membership with a paid nonmember registration (eligible through November 30, 2018 by completing the curriculum vitae at seg.org/join).

This free membership opportunity is not automatic; registrants must apply for membership.

Location

Southern California is a beautiful location for SEG18, offering a wide variety of nearby geological wonders, from the Newport-Inglewood and San Andreas Faults to oil drilling in the heavily populated residential areas of Signal Hill to Ubehebe Crater in Death Valley. In addition, nearby Los Angeles and Hollywood offer many opportunities to turn your trip into a family vacation that will be remembered for years to come.

Early bird registration ends August 21. Find out more about SEG18 at seg.org/am. **ST**

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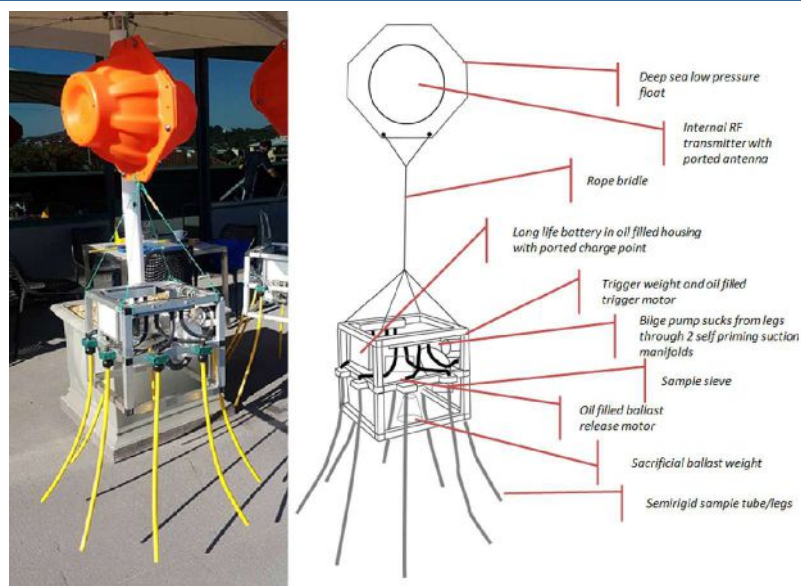
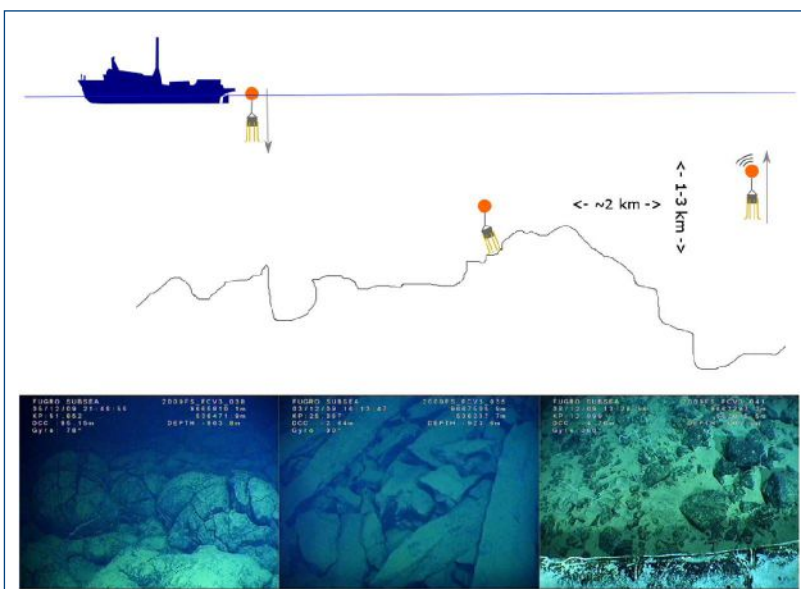
By John Parianos • Anthony Manocchio

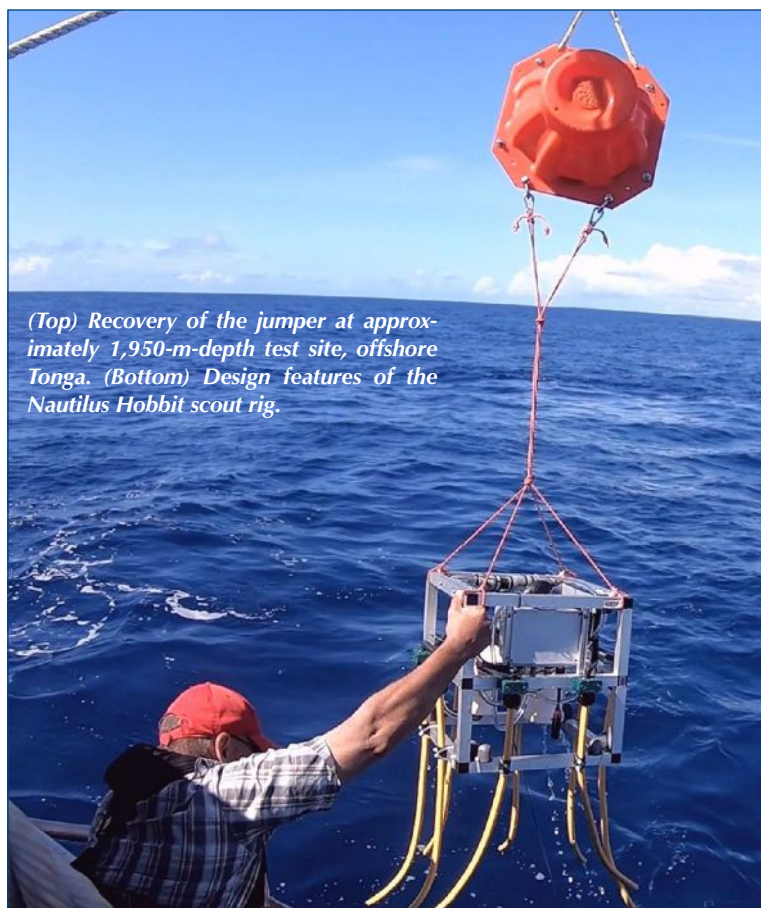
It is geologically apparent that the deep ocean floor is highly prospective for high-grade seafloor massive sulphides (SMS), but discoveries have been limited by the high cost of exploration. Indeed, this limits investment in commercial exploration, even with currently high market prices for metals such as copper, gold, zinc, silver and lead. Academic groups funded from the public purse are thus responsible for more than 80 percent of discoveries in recent years, but high operating costs also restrict their search space.

Existing exploration technology for both marine and land-based deposits demonstrates that there are very likely no “silver bullets” to solve this problem. However, recent marine expeditions by Nautilus Minerals have shown that a step change reduction in exploration cost is possible through careful management (and some hard work) involving simple and fit-for-purpose subsea tools. This promises to lead to increases in coverage and exploration efficiency, which should lead to many more discoveries in the extensive ocean environment.

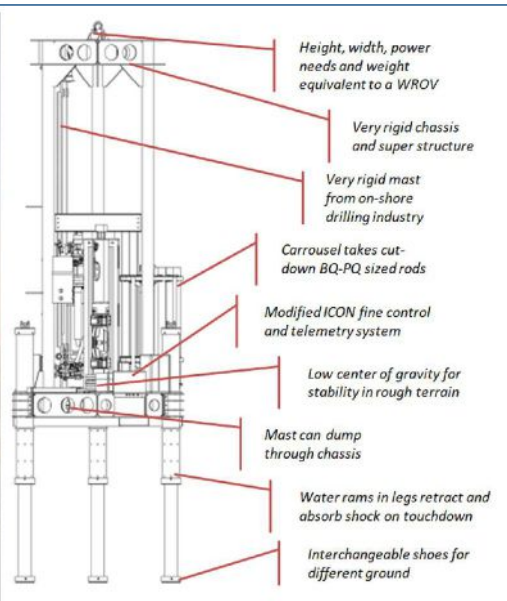
Nautilus has demonstrated a simple three-stage process: 1) work out exactly what you need; 2) build a device that allows you to do the job off a low cost base; 3) apply to long-endurance expeditions.

(Top) Schematic of Jumping Spider operation and ROV photographs of some expected seafloor conditions. (Bottom) Design features of the Nautilus Jumping Spider autonomous sediment sampler.





(Top) Recovery of the jumper at approximately 1,950-m-depth test site, offshore Tonga. (Bottom) Design features of the Nautilus Hobbit scout rig.



SMS exploration can be considered a linear process. Just as on land, we manage an exploration project pipeline. At sea: we start selecting terranes, then generating and testing (and rejecting) numerous targets, resulting in delineation of a few prospects, which are narrowed further to just very few deposits that have the quality worth mining. We are constantly trying to improve in operations at all levels of this pipeline, but currently we are focusing on two points: regional sampling for target generation

and scout drilling for prospect delineation.

As an exploration and mining company, Nautilus prefers to rent or buy marine equipment, but in some cases we need to build and develop fit-for-purpose tools. Our philosophy is to strive for simple and lightweight equipment, with an eye toward the cost of the entire spread, i.e., deployment from lower-cost vessels with readily available, less experienced crew.

Also worth noting is that our exploration approach does not need to be especially comprehensive. With such a large area available for search, we can afford to miss some targets, so long as we compensate by finding and testing many others.

'Jumping Spider' Autonomous Lander

Anomalous levels of certain metals can often be found around metal deposits due to chemical and physical dispersion (geochemistry). On land, grids of sediment samples have sometimes helped explorers vector in on the deposit. In 2016/2017 Nautilus demonstrated the effectiveness of low-cost grid sediment sampling in the highly sedimented environment of the East Manus Basin (Papua New Guinea). In this case, we utilized decades-old sediment coring technology, but the subsequent challenge was to extend this type of sampling to rocky low sedimented areas.

We also realized that a further reduction in cost was possible, allowing for even more extensive sampling programs. For first-pass surveys at least, precision subsea navigation is not needed, and in low sedimentation areas, just a little sediment should be enough to recognize anomalous levels of geochemical pathfinder elements. Thus, an autonomous lander is a potential solution.

Nautilus designed a lightweight lander that can be deployed and recovered like a lobster cage. This could allow fishing boats to be used, instead of high-specification research ships. A simple unit would enable nonspecialist personnel to work with such landers at sea, and a low unit cost would afford relatively high equipment failure

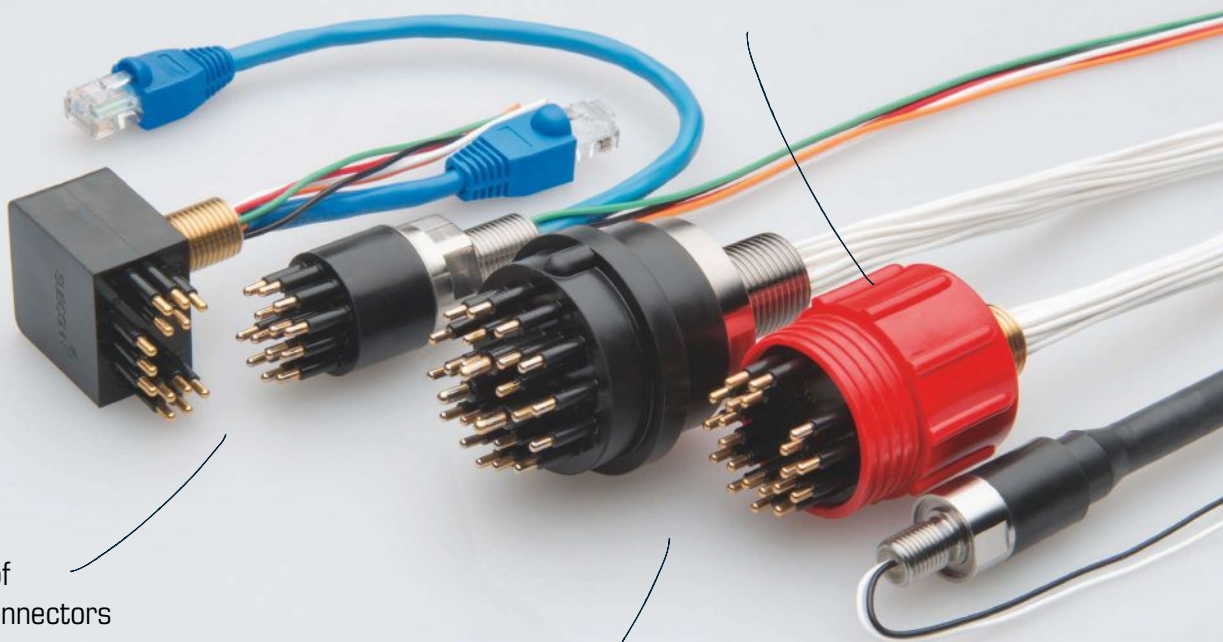
or loss rates. Other operational benefits of autonomous landers versus suspended samplers also apply, e.g., the ability to do multiple deployments at any one time. This is not a new concept; think of the free-fall grabs used for polymetallic nodule exploration in the Clarion Clipperton Zone.

Nautilus's first-generation autonomous sampler has been nicknamed the "Jumping Spider" due to the eight sample tubes protruding from the lander. The lander is



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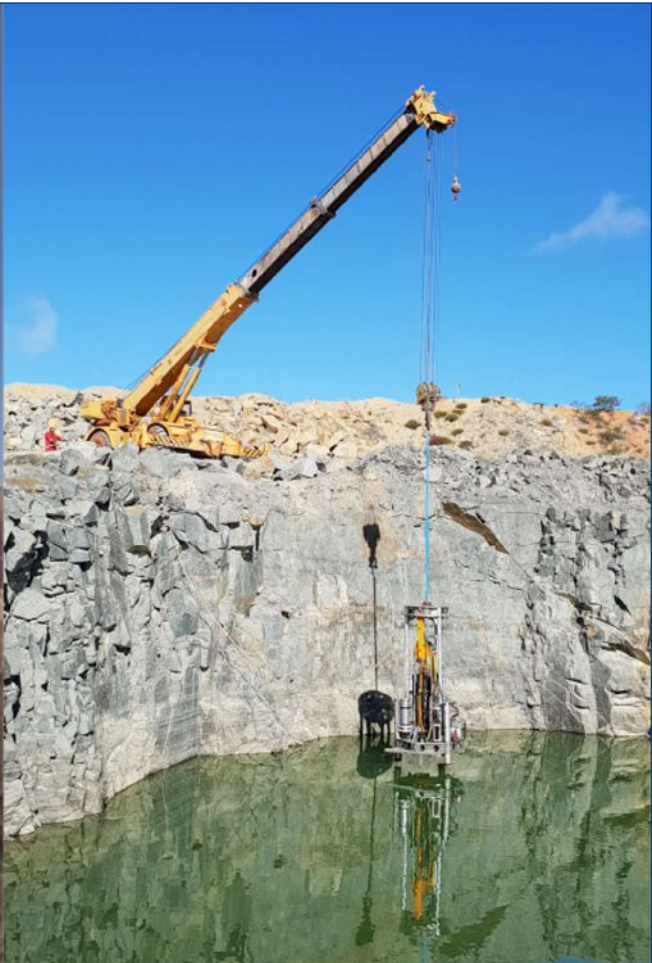
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Land-out test of Hobbit scout rig at 28.5° off vertical (left); endurance test rig in a flooded quarry (right).



designed to land on rough terrain, with the tips of some of the tubes (semi-flexible, geochemically inert) contacting the seafloor (typically rugged, weakly to moderately sedimented basaltic lava or breccia). On landing, a seafloor trigger starts both the suction system that delivers any sediment up the tubular legs and into the sample housing and the preset timed release of a sacrificial ballast weight via an electric drive. Following the release of the ballast weight, a deep-sea float returns the sampler to

surface for collection, with detection via radio or Iridium beacon and light.

Other features include: either a mounted Iridium beacon or radio transponder ported into the float to aid locating and surface recovery; a galvanic fail-safe release; use of industry standard (certified) sample sieves; elimination of potential contaminant metals (e.g., copper containing brass); elimination of sediment trap points along the sample transport path; self-priming design of the suc-

Technique	Necessary	Optional
Scout Drilling	Work off a relatively cheap vessel and LARS. Land quickly in rough terrain, no need to level the hole. Be able to do several holes in a single deployment to improve production and save money. Due to low cost, be able to test more prospects in a given program. Penetrate far enough into the ground (which typically has 0.5 to 5 m of sediment) to find any mineralization or barren rock. Collect enough samples to make a call on the prospect.	High recoveries are not essential. Full penetration of the deposit is not essential. Precise placement with respect to the boundaries of the prospect/deposit is not essential.
Resource Drilling	Drill as much as possible the full thickness of the deposit. Cover the deposit on a systematic grid or pattern. Collect all or most of the material intersected to allow an unbiased grade and size estimate to be defended to investors.	If used on deposits likely to have resources, then cheap operation rates are less critical, as success will “unlock value.”

tion and sample system; use of food-grade mineral oils in compensated motors and battery; and use of a low-cost biodegradable sacrificial ballast weight.

Operational trials of the two prototype jumpers were carried out offshore Tonga May 2018, with a final successful deployment and recovery with sample to approximately 1,950 m (essentially the required operating depth).

'Hobbit' Scout Drilling Rig

A much more significant technical challenge than seabed sampling is seabed drilling. A seabed drill needs to: land securely in often rough terrain; forcefully drive a drilling bit into the seabed; constantly change power and speed in response to ground conditions; effectively recover a sample from many meters under the surface without destroying, dropping and/or washing the sample away; and collect and store the sample without causing contamination from adjacent ground.

Nautilus has completed four drilling programs in Papua New Guinea using four different drilling rigs, and this experience was used to design the drilling rig described here. The two most significant contributions to cost were: time taken to land a typically delicate and large footprint drill rig, and vessel-spread day rate with associated custom winch (often active heave compensated) and custom launch and recovery system.

There is also the problem of being spoiled for choice. Most SMS explorers have dozens to scores of targets to

test in the vertical dimension or under shallow cover. A more permissive approach is especially relevant for inactive SMS systems, which often can be difficult to map due to collapsed chimneys and at least minor sediment cover.

Note that most of these target areas are expected not to pass testing. They will prove to be composed of barren rock and clay after just a few meters of drilling. Thus, numerous shallow scout holes should more cost effectively shift exploration focus to the few targets with a solid chance of proving to be a deposit.

In drill testing targets, the sample quality requirement is different to that needed to define a formal mineral resource. Nautilus built the Hobbit scout rig, which may not be incapable of doing resource drilling, but does have limitations, especially in terms of drilling cost effectively at depths over 6 m (with a capacity limit of 18 m).

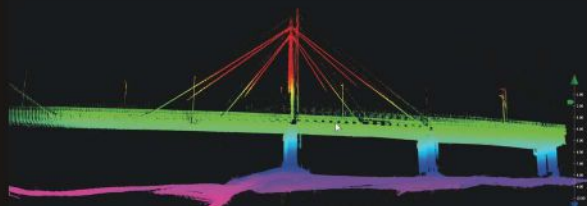
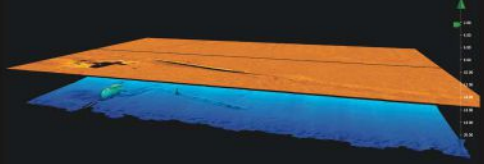
To reduce build cost and related risks, Nautilus built the Hobbit scout rig via extensive modification of a second-hand, single-shot, shallow-water drill rig. Rig size, weight and power are limited to that of a typical work-class ROV (including tether management system). This allows a wide range of vessels of opportunity with a WROV spread to be used without major setup costs. Rig functions are limited to the essential, which streamlines to only a few skilled operators. Fast landing and setup are aided by incorporation of an integrated damping landing system, very low center of gravity, small footprint, and the acceptance that effective shallow scout drilling can



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be off vertical. This also allows for an improved offshore operating weather window. To improve deck turnaround time, rods and barrels are swapped out via a second carousel.

Core recovery has proved to be problematic in Nautilus's previous programs, so even though this is a scout rig, considerable effort has gone into trying to improve recovery. This includes: reducing vibration via high levels of rigidity in the chassis and superstructure; use of a rigid marinized land-based drill mast with mast dump capability that contacts the seafloor directly; use of industry standard triple tube tooling and short sample lengths; and installation of precise drill parameter sensors and feedback.

Finally, we aim to reduce downtime by improving reliability via keeping systems as simple as possible; use of tried and tested drilling equipment wherever possible; and use of robust physical tooling and removal of computer interlock and limiting systems that have shown to be problematic in the offshore environment.

Some limitations of the Hobbit scout rig are: it does not utilize a wireline system (requiring all rods to be tripped between cored lengths); it does not have the ability to deploy casing; and it has a limit of about 1.2 m for a fixed collar.

The Hobbit scout rig has not yet been used operationally but is deemed ready to deploy for its first program. It has undergone three phases of testing to date: function testing in air; land-out testing onto broken ground

in air and semi-submerged endurance testing (flooded quarry sump). All testing to date has been successful and, indeed, slightly exceeded our expectations for performance and reliability.

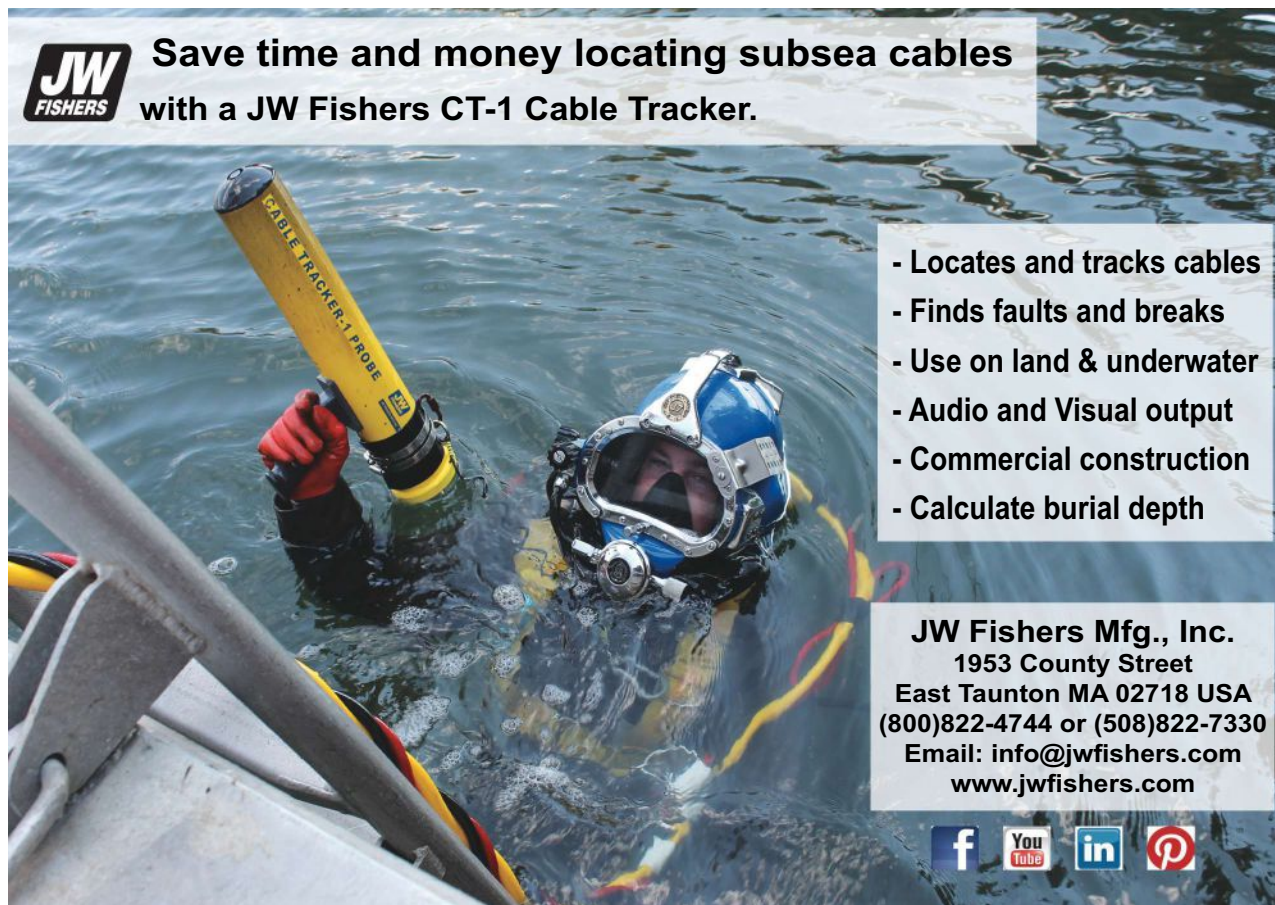
Deep seabed mining holds great potential for engineering development, including the autonomous Jumping Spider sediment sampler and the Hobbit scout rig, both to be operational later in 2018 or 2019. Future refinements could include: expanding Jumping Spider samplers to collect other sample types and carry other systems, e.g., a standardized camera and lights system designed for other samplers and landers; and developing the Hobbit scout rig into a reverse circulation system, which would make it faster, simpler and possibly more capable for mineral resource sampling. Nautilus is also looking at other exploration systems, for example, further developing our own lightweight towed geophysics package. We are open to sharing our current level of IP in these systems with interested parties, as we see ourselves fundamentally as end-users more than developers.

References

For a list of references, contact John Parianos at jmp@nautilusminerals.com. **ST**

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USV-UUV Swarm

Vehicle Combo for Deep-Sea Exploration, Mapping

By Gunnar Brink • Meret Garvelmann

The Shell Ocean Discovery XPRIZE is a global research competition aimed at exploring and mapping the deep sea. The competition offers a total prize money pool of \$7 million and is intended to promote the development of maritime technologies and thus advance deep-sea exploration. Thirty-two teams from all over the world started this challenge in 2016.

To date, the exploration of the deep seafloor has been limited by the extraordinary physical challenges of this extreme environment, high costs, limited technological advances and a lack of investment. Therefore, the aim of the Shell Ocean Discovery XPRIZE is to enable us “to fully explore and map the ocean floor, and uncover our planet’s greatest wonder and resource for the benefit of humanity.”



Great Diver. (Bottom) Water Strider.

The competition will be held in two rounds. Nine of the original 32 teams have won the first round and have qualified for the final, which will be held at the end of 2018. The task: All drones must map at least 250 sq. km of unexplored seabed at a depth of 4,000 m within 24 hr. Up to 50 high-resolution photos of interesting archaeological, biological or geological features must be provided. No persons are allowed in the competition area, which means that the drones must be controlled autonomously. All the necessary equipment must fit into a standard 40-ft. container. No device may remain in the sea after 24 hr. in the test area.



(Top and bottom credit: Fraunhofer IOSB/Eduard Maydanik)

	Great Diver	Water Strider
Length	260 cm	594 cm
Width	95 cm	287 cm
Weight	340 kg	250 kg

With the currently available sonar technologies, at least three vehicles are required for an area of the given size to be investigated, but the available space in the containers is not sufficient for commercially available vehicles. Another challenge is that GPS cannot be used for localization underwater, and at a depth of 4,000 m, USBL is too inaccurate and LBL would take much longer than 24 hr. with today's usual procedure of deployment, calibration and recovery, so the teams had to find another way to locate the positions of their vehicles.

Another difficulty is the distance between the shore and the competition area, which can be up to 50 mi. To cover this distance, the underwater vehicles need a

higher battery capacity. However, larger batteries require more space—space that is not available in the container.

Tech Concept

The team of the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB, the Arggonauts, uses a vehicle swarm approach to make it possible to cover the entire area, with an inverted LBL approach for precise localization of the diving drones. To have enough space in the containers, inflatable catamarans are used as support vehicles for the diving robots. These have the task of pulling the underwater vehicles to their location to minimize battery use of the underwater vehicles. The underwater and surface vehicles are never used individually but always together to form the swarm. Five unmanned vehicles of each type were planned for the Shell Ocean Discovery XPRIZE. As a result, an autonomous, unmanned swarm of these underwater vehicles with accompanying unmanned surface vehicles (USVs) can take over all deep-sea mapping and exploration activities without the costs becoming too high.

The diving vehicles are navigated by means of inertial navigation systems (with optical ring gyros), USBL and an inverted moving LBL algorithm, which can determine the vehicle's position with an accuracy of up to 0.60 m at a depth of 4,000 m.

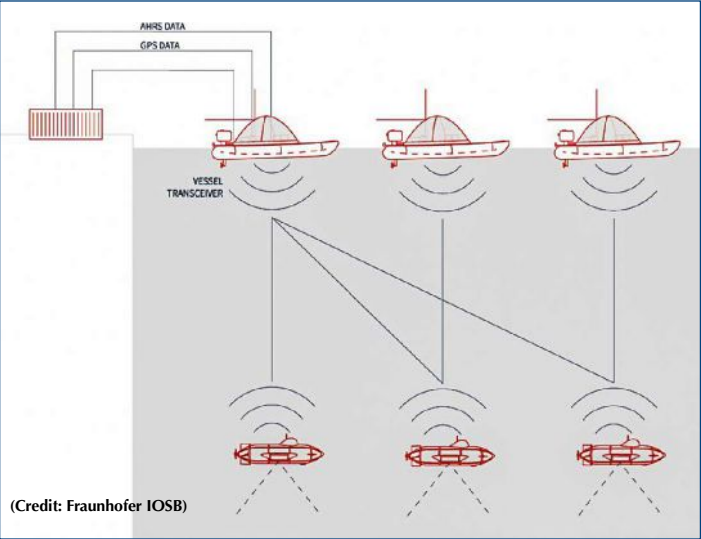
The SPRINT-Nav 300 (INS) from Sonardyne International Ltd. was chosen by the Arggonauts team for an underwater navigation instrument. It comprises the SPRINT INS sensor, Syrinx 600-kHz DVL and a highly accurate pressure sensor in a single enclosure.

The acoustic USBL modem S2CR 7/17 from EvoLogics is used for communication between the vehicles. The same modem is used on all vehicles, both at depth and on the surface.

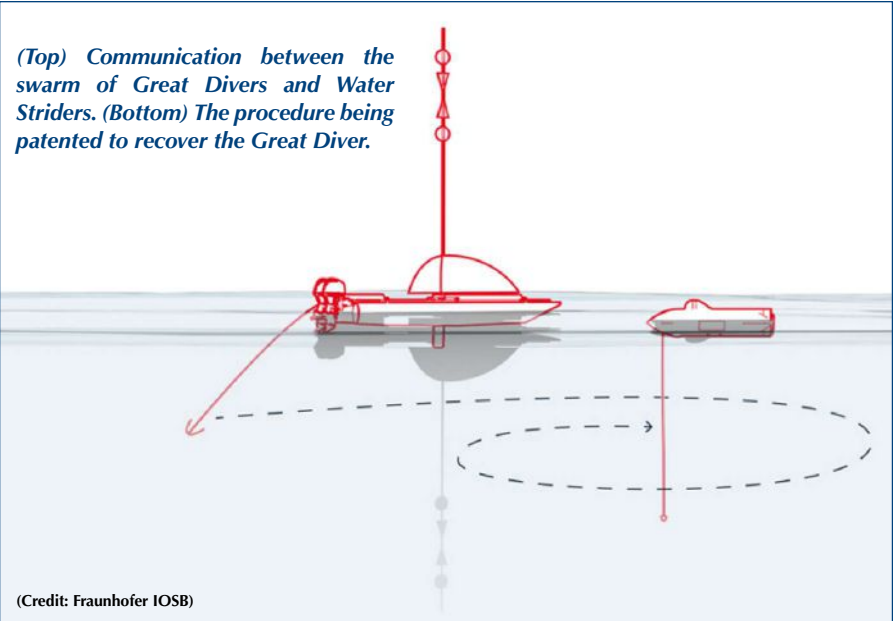
Great Diver, Water Strider

The Arggonauts named their AUVs "Great Diver" and their surface vehicles "Water Strider." Each Great Diver is an autonomous deep-sea robot to be used in a swarm for the task of mapping an area of up to 100 sq. km in 24 hr.

With a length of only 260 cm and a weight of 340 kg, it is very small and light for a deep-sea vehicle. The Great Diver is mainly free-flooded; with the exception



(Credit: Fraunhofer IOSB)



(Credit: Fraunhofer IOSB)

of a titanium pressure chamber in the body of the vehicle, seawater flows through most of the robot. Syntactic foam provides the necessary buoyancy. The robot is driven by a pressure-neutral, direct-drive electric engine and steered via rudders. The engines can reach a maximum power of 900 W.

In addition, one of the Great Divers used in the swarm has a powerful, pressure-neutral, flat LED flash system and four special onboard 20-MP cameras. They are equipped with special lenses developed by Zeiss for this competition. These compound lenses take into account the external water medium as well as the light path through the dome of the housing, made of borosilicate glass. The use of several cameras allows 3D images to be captured, and this enables a so-called spatial filtering during the post-processing of the images. The software removes disturbances such as marine snow that are located between the camera and the object.

The mapping work is carried out with an interferometric Bathyswath sonar produced by French company ITER Systems. The interferometric sonar technology allows for a wide swath—800 m or more for a flying height of 80 m, providing high area coverage per hour. The Bathyswath also has low power consumption (less than 20 W), reducing the AUV's battery requirement.

The Water Strider is an inflatable catamaran. This USV is responsible for transporting, launching and retrieving the Great Diver. It is also capable of receiving GPS coordinates and sending them to the deep sea.

A CAN bus communication system is used to save on costs and weight. This reduces the size of the cable looms, which is an advantage due to the limited space available.

Communication

The Arggonauts use the Evologics' acoustic modem S2CR 7/17 to establish communication between the Great Diver and the Water Strider. The Great Divers create a formation underwater, which is accompanied on the surface by the Water

Striders. This means that a Great Diver is always underneath the associated Water Strider.

Acoustic signals are sent with identical modems from the Water Strider to the seafloor and thus to the Great Diver. The Great Diver's acoustic modem can detect these signals, allowing the distance between the two vehicles to be calculated and information to be transmitted to the Great Diver. The acoustic underwater modem enables data transfer of up to 6.9 kbit/s over a distance of up to 8,000 m. The frequency band ranges from 7 to 17 kHz. The modem of each diving vehicle also includes an atomic clock and thus offers a uniform system time and the possibility to measure the time-of-arrival distance for a one-sided, unreturned transmission.

Great Diver Recovery

After completing the mission, the Great Diver begins to send out signals indicating its position. For this, AIS, adopted by the International Maritime Organization (IMO) as a binding standard, is used; a radio system that improves the safety and control of shipping traffic through the exchange of navigation data and other information from the ship. These signals serve as a warning to other ships that may be in the same area in order to avoid collisions. They also enable the Water Strider to find the Great Diver autonomously, even in high tide, and return to the coast.

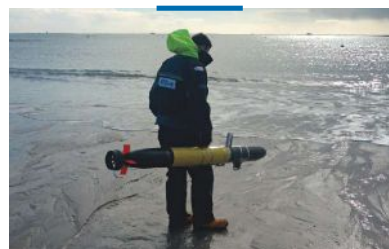
The recovery procedure, for which we have applied for a patent, begins with the Great Diver reaching the surface then unrolling a 30-m-long line. A weight is attached to the end of this line to ensure that the line hangs vertically downward. The Water Strider lowers another line into the water with a winch. This line has a length of up to 25 m, and at the end of the line, there is an anchor with a locking mechanism. The surface vehicle begins to circle the Great Diver more and more closely. As a result, the line attached to the Water Strider comes to lie almost horizontally just below the sea surface. The Water Strider



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“Despite the relatively small size of the vehicles used, it is now possible to chart very large areas. With the swarm approach, the number of vehicles can be varied... The autonomous return system and the communication system allow an uncomplicated use of the swarm.”

circles around the Great Diver until the anchor catches the latter's vertical line. Once the line is caught, the closing mechanism of the anchor closes, and the Water Strider can start towing the Great Diver back to the base.

After leaving the test area, only 48 hr. remain to bring the vehicles ashore, download the data, select and edit the images and convert the raw data into the required format. The Qimera software produced by QPS/Saab will be used for the bathymetric evaluation.

Conclusion, Future Developments

The idea of a swarm approach enables the Arggonauts to overcome the challenges of the Shell Ocean Discovery XPRIZE competition. Despite the relatively small size of the vehicles used, it is now possible to chart very large areas. With the swarm approach, the number of vehicles can be varied as required, depending on the area to be covered. The autonomous return system and the communication system allow an uncomplicated use of the swarm. Due to its small size and low weight, the transport and operation costs are significantly reduced, compared to large research vessels.

After completing the Shell Ocean Discovery XPRIZE, the Arggonauts plan to spin off a company to design and carry out further developments. The Water Strider will be made even more robust and efficient. We want to enable the use of smaller, cheaper manned ships simultaneous with a large number of diving and unmanned surface vehicles. This will appeal to smaller, specialized companies and those involved in scientific research. The compact design of our products will significantly lower the cost of seabed exploration.

Acknowledgments

The authors would like to thank the Fraunhofer Executive Board and our sponsors Evonik, Hays, Zeiss, QPS, Storymaker and Dell. **ST**

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Autonomous Underwater Helicopters

AUV with Disc-Shaped Design for Deepwater Agility

By Dr. Daxiong Ji • Dr. Chen-Wei Chen • Dr. Ying Chen

With China's "far-reaching" sea development strategy, the country has greater demand for seabed observation, resource exploration, pipeline monitoring and maintenance, rescue and salvage, archaeological projects, and other ocean technology applications. A new deepwater AUV with enhanced maneuverability will help meet the need for such complex operations.

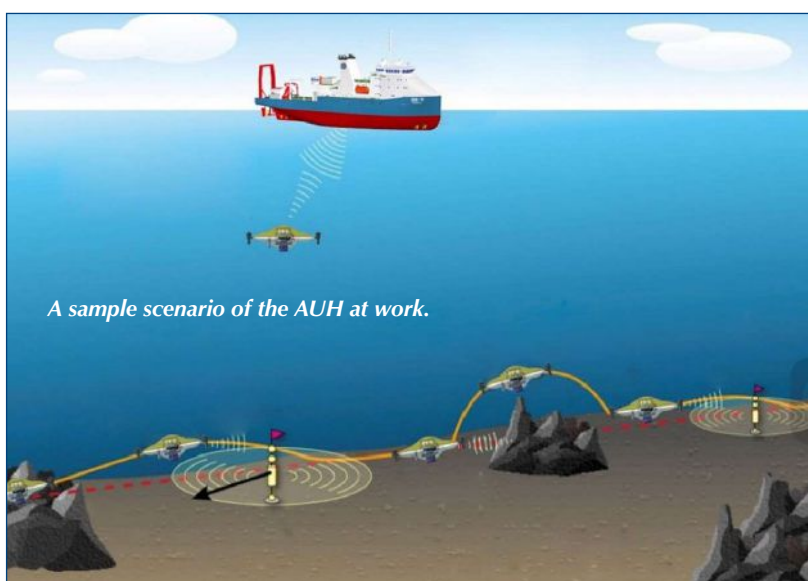
The average flow in the deep ocean is very slow; the horizontal velocity is equal to or less than 0.01 m/s, and the vertical velocity is 10^{-7} m/s. The flow resistance requirements of a submersible vehicle are not high for complex deep-sea applications—but the work performance requirements are demanding for a deepwater AUV. To this end, we propose a new type of submersible: a disc-shaped autonomous underwater helicopter (AUH) with the capabilities of hypermobility along the seabed for up to a week at a time, fixed-point hover, free take-off and landing, and round-trip operations between large-scale undersea nodes.

Design

We set out to build an autonomous underwater helicopter system integrated with five modules: hull form, power system, propulsion system, control system and navigation system.

The AUH's 3D hull form design was based on nonuniform rational B-splines (NURBS) surface modeling, using the evaluation of singularity-free equations of motion (EOM) in six degrees of freedom (6 DOF) of Kirchhoff's method, with kinetic energy modeling and a computational fluid dynamics study.

The hull design also took into account high-performance experimental methods of circular captive model maneuvering tests, pressure testing of maximum 60 MPa,



A sample scenario of the AUH at work.

and verification testing of movement on a dual 6-DOF platform. The multi-objective function was solved by a linear weighting method, multiplication and division method, ideal point method and multi-objective genetic algorithm.

The maneuvering coefficient for modeling equations of motion of submarine dynamic stability in the horizontal and vertical planes was evaluated using a system identification method, including added mass coefficient, damping forces coefficient and hydrodynamic parameters of a POD vectoring propulsion and buoyancy regulation system. AUH motion simulation was carried out by Euler-Rodrigues quaternion, Euler angle and/or direction cosine formulations.

The POD propulsion system was integrated with an axisymmetric body, struct and propeller. An electric motor in the axisymmetric body drives the propeller. Power, data transmission and system control are connected by cable and a slip ring device. The slip ring device enables the POD to rotate 360°. POD propulsion and a buoyancy

regulation system constitute an advanced hybrid propulsion system.

Applying these methods achieves parametric optimization of the AUH slenderness ratio, volume-weight ratio and layout of the hybrid propulsion system to solve the trade-off problems of maneuverability versus motion stability.

The resulting vehicle is 1 m in diameter, 0.45 m high, 60 kg in weight and depth-rated to 1,000 m.

Navigation System

The combined positioning and navigation method of a strapdown inertial navigation (SINS) and an acoustic DVL is used for vehicle cruise. SINS measures the velocity and posture (including heading angle, longitudinal inclination angle, yaw angle, etc.). The DVL measures the absolute speed. The two kinds of data are organically fused by a Kalman filter to provide accurate position and navigation for the AUH.

The AUH is able to dock at the mothership or the base station by adopting the combination navigation method of the reverse supershort baseline and strapdown inertial guidance during docking. The AUH also has the capability to reverse ultrashort baselines and perform long baseline fusion positioning.

Control, Propulsion System

The control and propulsion system adopts a hybrid structure that combines distributed control with sensor centralized control based on CAN bus. The system uses

the control computer as the core. Four thrusters are configured on the AUH. The system adopts the CAN bus to carry on the distributed control while the attitude sensor, Doppler meter, depth meter, altimeter and other sensors rely on centralized control. At the same time, the system is configured with interfaces related to modules of energy, navigation, optical communication and others.

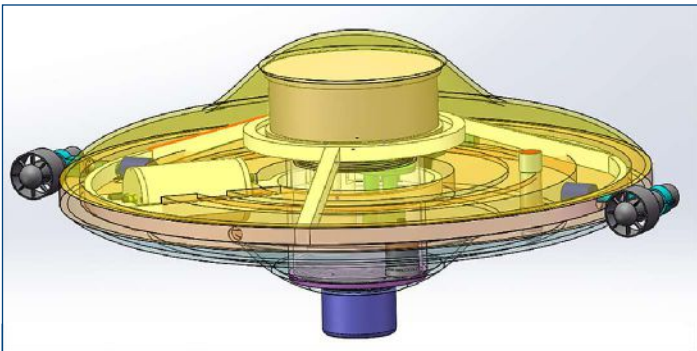
The whole system is designed for effective management. The hardware-in-the-loop simulation system is used to detect and verify the hardware interface, function and fault processing. In order to improve anti-jamming and adaptive ability, the control quantity is solved by a self-disturbance control method. The control quantity is decoupled, thrust distribution is obtained, and the expected speed of the underwater helicopter propeller and the desired adjusting position of the buoyancy adjusting control module are both achieved.

In order to enhance the memory and deep-learning ability and to improve the agility of the underwater helicopter, the machine-learning algorithm based on a cognitive neural network is used to construct the offline learning and online learning networks for motion control. The underwater helicopter control system software runs in the Linux operating system written by the object-oriented C++ language. This mode enhances the reaction time and general rapidity of the software control.

The whole system applies the centralized processing method. The core of the software system is a central database that constructs the star topology structure. Each node of the star topology structure communicates with the central database. The software system not only guarantees the nodes are independent but also eliminates point-to-point direct communication. This reduces interdependence and prevents the whole software system from crashing because of individual node damage.

Testing

A pool experiment was carried out successfully. The prototype of the AUH finished two quadrilateral



(Top) An illustration of the AUH prototype. (Bottom) The AUH prototype in the water.

trajectories in horizontal and vertical planes, respectively.

The prototype was then tested in the sea in Zhoushan in March 2018 at 10-m depth. The results show that the underwater helicopter can realize clockwise and counterclockwise 360° turns at a performance period of up to a week, with a steering rate reaching 180°/s and zero turning radius. The prototype maintained a fixed depth of about 1 m and was able to perform hovering and path-closed loop control.

Conclusion

A new autonomous underwater helicopter was designed to meet China's new demands for deep-sea engineering. The test results show that the prototype meets the design requirements.

Work will now focus on how to perfect engine buoyancy.

Underwater helicopters can help to realize scientific and technological breakthroughs in seabed monitoring, resource exploration, rescue and salvage and general underwater mobility, all of which will play important roles in China's future.

Acknowledgments

This work was supported by National Natural Science Foundation of China (No. 51679213) and National Key Research and Development Program of China (2017YFC0306102).

References

For a list of references, contact Chen-Wei Chen at cw.chen@zju.edu.cn. **ST**

Dr. Daxiong Ji is an associate professor at Ocean College, Zhejiang University. His research interests include control and navigation of ocean robotics.



Dr. Chen-Wei Chen is a lecturer at Ocean College, Zhejiang University. His research interests are in novel AUV design, hydrodynamic shape design, computational fluid dynamics and marine vehicle simulation.



Dr. Ying Chen is a professor at Ocean College, Zhejiang University. His research focuses on ocean technology.



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MacArtney and OSIL to Provide Products and Service for Chinese Ocean Science Industries

MacArtney Singapore entered into an exclusive sales agreement with Ocean Scientific International Ltd. (OSIL). The agreement covers the ocean science industry and aims to improve business relations in the Chinese market by supplying complete systems such as mooring, sediment samplers, box cores and giant piston cores, launch and recovery for existing and new research vessels and providing after-sales service.

Aerodynamically Alleviated Vessels Provide Options for Efficient Passenger Transport

A2V is involved in projects ranging from maritime airport connections and coastal passenger transport to opening up of isolated regions and coastal surveillance. With ships already in service in Gabon and Geneva Lake, the company is working on a 45-kt. fast-transport vessel for the Gironde Estuary. The 18-m-long catamaran would take 40 passengers between Royan and Bordeaux in France. A2V is also working on alternatives to diesel-based propulsion systems through aerodynamic alleviation to provide fast transport with half the power required by conventional vessels. An electric version of the A2V-shuttle based on batteries is under development.

Dutch Nonprofit to Deploy Ocean Plastic Cleanup and Monitoring System

Seiche Water Technology Group will provide an AutoNaut USV and technologies to monitor marine life during the first deployment of an ocean clean-up system by The Ocean Cleanup. Seiche systems for passive acoustic monitoring (PAM) will be deployed to track whales and dolphins. The Ocean Cleanup develops advanced technologies to rid the world's oceans of plastic. A full-scale deployment of these systems is estimated to clean up 50 percent of the Great Pacific Garbage Patch in five years.

International Women's Shipping and Trading Group Granted Consultative Status at IMO

The International Maritime Organization's (IMO) governing body has granted consultative status to the Women's International Shipping and Trading Association (WISTA) International. WISTA says its efforts to provide a voice for female executives in the maritime industry support the overarching principles in IMO's strategic plan, especially the promotion of gender equality. WISTA International was formed in 1974 and now has more than 3,000 members worldwide.

Port State Control Annual Report Released

ClassNK has released its annual report on Port State Control, and the report shows that fire safety-related deficiencies continue to be the most frequent detainable deficiency, followed by deficiencies in ISM, lifesaving appliances and safety of navigation. The report also pro-

vides detailed analyses on detentions by flag state, port state, ship type, ship size and ship age, as well as a summary of amendments to international conventions such as the SOLAS Convention.

Silent Thruster Earns Award in Scotland

Copenhagen Subsea produces a silent marine thruster—with no gearbox or oil inside and lubricant provided solely by surrounding seawater. At the 2018 Undersea Defence Technology (UDT) conference and exhibition in Glasgow, the product earned the Babcock Innovation Zone Best Pitch award for its innovative approach to sustainability. The competition included 11 start-ups and small businesses that pitched ocean technology innovations to a panel of judges.

Damen Offers Ballast Bunkering for Newbuilds and Repair Yards Worldwide

The new inland coastal tanker *Elena H.* will make her maiden voyage from the Netherlands to Argentina on her own keel, and following her arrival, she will remain permanently in local waters. To meet the BWM Convention's D2 standard, Damen's InvaSave supplied clean D2-standard ballast water for the new vessel in the Netherlands. As part of a cooperation between Damen Green Solutions and Damen Shiprepair & Conversion (DSC), this ballast water service is available to fill/empty ballast tanks of newbuild vessels in an IMO-certified manner.

New Shipbuilding Concept Focuses on Modular Designs and Sustainability

NAVAIS is a multiannual research and innovation program for the shipbuilding industry that will increase efficiency of design and flexibility of production networks with an investment of €6.5 million from the European Commission over a period of four years.

NAVAIS will develop a platform-based modular product family focused on sustainability in ship design. NAVAIS will support the transfer from an engineered-to-order business model to an assemble-to-order business model, which will allow shorter process lead-times and better integration of the SME supply chain.

Safety Equipment to be Assembled in Japan

Now that it has obtained Japanese government approval to supply life rafts to Japanese-flagged vessels and carry out final assembly in the country, Viking Life-Saving Equipment is establishing a local subsidiary to bring new value to Japanese shipowners and managers. Viking Japan builds upon an alliance with MOL Techno-Trade that began five years ago when Viking's products were first added to the maritime supplier's portfolio. Yasin Kasa will lead the new subsidiary in Tokyo.

Oceanscan Adds USBL for 4,000-M Depths

Oceanscan has added Sonardyne underwater acoustic positioning technology to its rental fleet. The Mini-Ranger 2 ultrashort baseline (USBL) vessel-based systems and Wideband Sub-Mini 6 (WSM 6) transponders were acquired following demand from clients in the offshore wind and shallow-water hydrographic survey markets.

Mini-Ranger 2 offers an operating range of 995 to 4,000 m and the ability to simultaneously track up to 10 subsea targets at fast update rates.

Surface Vehicle to Study Sediment Movement

A USV designed and built by Unmanned Survey Solutions has been purchased by Trondheim University for research studies in Norway, including mapping lakes and river sediment. The Inception Class Mark 2 USV is designed for hydrographic surveys and data acquisition in ports and harbors, lakes and rivers, shallow coastal or enclosed inland areas. The university will receive an R2SONIC 2020 MBES, SBG Ekinox2 inertial navigation system (INS), Valeport sound velocity sensors and Hypack software for data post-processing.

Rolls-Royce Commercial Marine Sold to Kongsberg for £500 Million

Kongsberg Gruppen ASA and Rolls-Royce plc have agreed Kongsberg will acquire Rolls-Royce Commercial Marine. The final purchase price will be determined based on Rolls-Royce Commercial Marine's cash, debt and working capital at the time of the transaction. The transaction is structured as an acquisition by Kongsberg of the marine products, systems and aftermarket services businesses carried out by subsidiaries of Rolls-Royce plc.

Ocean Infinity Expands with Vessel Contract

Ocean Infinity has agreed to a seven-year contract with Island Offshore for *Island Pride*. The vessel will expand Ocean Infinity's platform for AUV data acquisition and analysis and support a variety of operations globally. *Island Pride* is a multi-functional subsea support and construction vessel of UT 737 design. The vessel is 103 m in length with a beam of 21 m and free deck space of 880 sq. m and is equipped with a deepwater crane and two work-class ROVs.

Total and CCCC Expand Cooperation

Total and China Communications Construction Co. (CCCC) have signed a mutual preferred supplier agreement to extend their existing relationship worldwide. CCCC is a fully integrated engineering company, and Total is a global integrated energy producer and provider.

Cox Powertrain to Distribute in Africa

Cox Powertrain announced Seascope Marine Services as its exclusive distributor for South Africa and the Sub-Saharan region. Seascope Marine is the first distributor of Cox's CXO300 diesel outboard engine to be named outside of Europe, the U.S. and Australasia.

Ship Design Training for Vietnam

Vietnam has developed an official marine strategy to expand its maritime economy. Educating ship designers and engineers is a key component. To help realize Vietnam's maritime vision, a training course on SSI's ShipConstructor software will be held at Vietnam Maritime University, the country's main facility for training in the maritime field. **ST**



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Sharktech Onboard Digital Control System Offers a Wide Range of Sensor Integration

Metal Shark is working with ASV Global to introduce Sharktech autonomous vessels with dynamic collision avoidance that considers data from multiple radars, day-light and thermal cameras and AIS to steer clear of obstacles. The system allows autonomous or remote operation of navigation and safety lighting, hailers and sirens, as well as fire pumps, monitors and fire-fighting equipment; hydrographic survey equipment; equipment for acoustic, oceanographic or meteorological monitoring; and FLIRs.

Nordic Hamburg Installs High-Speed Satellite Antennas on Dozens of Ships

Nordic Hamburg has chosen KVH's TracPhone V7-HTS antenna equipment and the AgilePlans subscription-based Connectivity as a Service (CaaS) program to bring fast, global connectivity to its vessels. Installations for 13 vessels have been completed, with plans for an additional 12 through 2018. The TracPhone V7-HTS is a 60-cm Ku-band satellite communications antenna that utilizes high-throughput satellite (HTS) technology with connectivity from KVH's mini-VSAT Broadband network.

Expanded Global AIS Service Available

exactEarth and IHS Markit will provide a new combined tracking service, AIS Platinum, offering unprecedented frequency and coverage of vessels worldwide. AIS Platinum will provide a fast flow of real-time intelligence to assist organizations that require time-critical intelligence. The solution has been developed with exactEarth's global real-time satellite AIS service, exactView RT powered by Harris, which will consist of a system of more than 60 maritime satellite payloads.

Mission Planning Underway for Under-Ice AUV

A workshop was hosted by ISE and Australia's Antarctic Gateway Partnership to finalize details for nupiri muka's first field season. Nupiri muka is an ISE Explorer AUV owned and operated by the University of Tasmania as part of the Antarctic Gateway Partnership, a research Initiative of the Australian Research Council. Deploying the AUV beneath Antarctic ice shelves will allow the collection of data vital to understanding the physical, chemical and biological processes at work under Antarctic ice.

AML Relocates for High MVP Demand

The demand for AML Oceanographic's real-time underway profiling system, Moving Vessel Profiler (MVP), has swelled as organizations seek to improve data quality on hydrographic and ocean science surveys. An influx of orders has caused the company to outgrow its Nova Scotia office space, prompting a move to a new location to accommodate a higher volume of MVP builds. The move comes less than three years after the manufacturer opened a second location across the country in Dartmouth, Nova Scotia.

Panama Canal Expansion Marks Two Years

The Panama Canal marked the two-year anniversary of its canal expansion, the largest enhancement project in the waterway's 103-year history. The route has recorded milestones such as: a new monthly tonnage record of 38.1 million tons in May 2018; the transit of the canal's largest cruise ship to date, the *Norwegian Bliss*, weighing more than 168,000 gross tons and carrying nearly 5,000 passengers; and the transit of the largest capacity container vessel to date, the CMA CGM *Theodore Roosevelt*.

VescoPlastics Celebrates 60th Anniversary

This year marks the 60th anniversary of VescoPlastics and Vesconite, its first engineering plastic. Founded by Alain Leger, an entrepreneurial engineer, Vesconite started in response to a need for an alternative to nylon bushings that swell in humid underground mines. Years of testing resulted in a thermopolymer with low-friction properties that could be machined to close tolerances. The company has grown into an international enterprise.

Manned Submersible Tests at 4,000 M

OceanGate held a successful unmanned depth test of the manned submersible Titan to validate the hull to a depth of 4,000 m. Titan is the world's first privately owned five-person submersible to reach this depth, opening more than 50 percent of the ocean to manned exploration. Designed and engineered by OceanGate, Titan is constructed from carbon fiber and titanium and is the largest submersible of its type in the world. The sub is scheduled to survey the wreck of the RMS *Titanic* in 2019.

FairfieldNodal is Now Fairfield Geotechnologies

Fairfield Geotechnologies (formerly FairfieldNodal) has relocated its headquarters to the Houston energy corridor. While engineering, field service, manufacturing and the operational center will remain at the company's Sugar Land, Texas, location, the new corporate office will be located in the Air Liquide building at Memorial City.

New Test Bed Available for Load Tests

Yale Cordage has acquired a Sahm Splice test bed for testing of synthetic and wire rope, shackles, chain and slings up to 1,300,000 lb. With a maximum test sample length of 116 ft. and a 15-ft. stroke, it is one of the largest test beds in the eastern U.S. The machine includes built-in programs for load testing, including cyclic, bend over sheave and proof load testing.

Port Canaveral Celebrates 65 Years

Port Canaveral will celebrate sixty-five years of operation on November 4, 2018. The Canaveral Port Authority plans a series of activities celebrating the port's history and its role in economic growth of the Central Florida region.

In the first of a series of events this summer, Canaveral Port Authority staff took part in a ceremonial flag raising of a new Port Canaveral anniversary flag, similar to an event held at the port 65 years ago.

Largest U.S. Containership Christened

Matson Inc. and Philly Shipyard Inc. christened the largest containership ever built in the U.S. in a ceremony at the Philly Shipyard on June 30. The new vessel is named Daniel K. Inouye in honor of Hawaii's late senior U.S. Senator, a supporter of the U.S. maritime industry and its role in Hawaii's economy. The vessel is the first of two new ships being built at a cost of approximately \$418 million and the first of four new vessels that Matson will put into its Hawaii service during the next two years.

City of Virginia Beach Develops Broadband Underwater Cabling Hub

Activity in subsea cabling is thriving on the U.S. shores of the city of Virginia Beach, Virginia, with more cables to come. The city's mayoral candidate, Ben Davenport, heads a broadband taskforce in an effort to make the city a hub for data-centered industries. Currently, cabling that stretches across the Atlantic from Spain, Rio de Janeiro and South Africa to Virginia Beach is installed or in process, and Davenport notes the city is a key cabling landing site between New York and Florida.

The city is also undergoing a telecommunications infrastructure overhaul to ensure super high-speed networks.

AUVSI Forms Policy Advocacy Committee

The Association for Unmanned Vehicle Systems International (AUVSI) has formed an advocacy committee to focus on policy positions to support the unmanned vehicle industry.

The committee will be chaired by Thomas Reynolds, vice president of business development for Hydroid Inc./Kongsberg Maritime. Reynolds previously served as a commissioned officer in the U.S. Navy, where he served as commander of the Explosive Ordnance Disposal (EOD) Task Group, U.S. Fifth Fleet, among other roles.

Knud E. Hansen Expands to Canada

Knud E. Hansen now has a permanent presence in Canada. The burgeoning east-coast port of Halifax, Nova Scotia will serve as the home base for Senior Naval Architect and Project Manager Sam Stark.

The new location will allow the company to focus specifically on the growing maritime sector in Canada, as well as the increase in demand for ship tonnage in the Arctic region.

Company Awarded \$164 Million in Contracts

Great Lakes Dredge & Dock Corp. has received several major dredging awards totaling \$164 million, including: the Long Beach project (coastal protection, New York, \$54.4 million); the Myrtle Beach project (coastal protection, South Carolina, \$34.8 million); the Nags Head Beach project (coastal protection, North Carolina, \$34.7 million); the Chesapeake Beach project (coastal protection, Maryland, \$4.8 million); the Corpus Christi La Quinta Channel Widening project (capital, Texas, \$21.0 million) and the Delaware River Deepening Variation Order (capital, Delaware, \$14.3 million). **ST**



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Safe, Green Line of Tugboats



The RSD Tug 2513 is fully focused on ship handling and offers 70-t bollard pull. New compact multi-purpose vessels, the ASD Tug 2312 and ASD Tug 2813, offer 60-t and 80-t BP respectively. Damen Shipyards Group.

Water-Resistant Position Sensors

P-Series high-pressure and water-resistant LVDTs are built for reliable position measurement in deep subsea environments and applications such as pressure test vessels and hydraulic actuators. They serve as ideal replacements for load cells, pots and magnetostrictive sensors. NewTek Sensor Solutions.

Carbon-Reducing Fuel Additive

The FS Marine+ solution can be used with almost any type two- or four-stroke engine running on HFO, MGO or MDO. It uses an onboard

hydrogen synthgas generator to inject a gas and liquid water/methanol solution into an engine's combustion chamber. FuelSave GmbH.

Transaction Platform Update

An updated version of a transaction management platform offers a unified user interface, enhanced tagging, rich message composition, and a new sign-in system that leverages multiauthentication to enhance communication and document security. SEDNA Systems.

Immersible Connectors

SOURIAU SWIM connectors are for use in shallow immersion depths down to 300 m. They can be used on surface drones for environmental evaluation, on maritime surveillance equipment, for oil exploration, weather buoys, commercial diving and ocean-class ROVs. Esterline Connection Technologies.

Offshore Logistics Software

Marlin is a platform that combines temporal project planning with 3D spatial situational awareness. It can be used in emergency response, SI-MOPS, integrated activity planning, geophysical/geotechnical operations, offshore logistics and supply vessels. ION Geophysical.

Upgraded pH Sensor

SeaFET V2 implements several upgrades to the original Shallow SeaFET, Shallow SeapHOx and Deep SeapHOx. It has improved reliability, data quality and deployment endurance, as well as redesigned electronics and autonomous sampling. Sea-Bird Scientific.

Portable Tidal Gauge



TideStation (Portable) is a self-contained observation hub for monitoring tide and meteorological equipment and communications. It offers a choice of UHF or GPRS telemetry with connection to pressure or radar sensors and interface to meteorological systems. Valeport Ltd.

Acoustic Measurement Buoy

Equipped with solar panels, the SYPOD buoy can be used autonomously or cabled. It has a single-channel acquisition system, which can be connected to a hydrophone for underwater acoustical measurements or to other sensors. Data are transmitted in real time through Wi-Fi, 4G or radio. RTsys.

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Data Processing Software Update

The new release of the Qimera software incorporates results from usability studies, as well as bug fixes and general maintenance. Qimera 1.7.0. allows QPDs up to 4 GB. Changes to the user interface affect workflows involving the filter toolbar, slice editor, swath editor and the SVP editor. QPS bv.

Quick Lens Mounting

The Bayonet Mounting System (QRS) allows for 1/4-turn installation and removal of wet lenses on the housing lens port and arm. Mounts include: female on M67 housing MB1; male for 67-mm macro lens; male for UWL-09F; lens holder 67 mm for UL arm; and female on arm MB2. Fantasea Line.

Multifunction Displays

The Raymarine Axiom XL multifunction displays are fully waterproof and can be installed in both open cockpits and enclosed bridge stations. Each model uses in-plane switching and optical bonding display technology to deliver wider viewing angles, sharp contrast and unmatched readability in bright sun. Available in 16-, 19-, 22- and 24-in. sizes. FLIR Systems Inc.

Safer Off-Load Hooks

Cranston-Eagle Marine off-load hooks are engineered so that only when weight is removed and the cable pulled will the locking mechanism open—there is no on-load release capability. Built of 100 percent stainless steel for use in extreme environments, hooks are available in capacities from 2.5 to 12 mt, and in cable- and boat-mounted configurations. Delta "T" Systems Inc.

Fast Patrol Boat

The Munin S1200 comes with a triple Mercury Verado 400 outboard installation, and the same platform can be delivered with sterndrives, surface drives or a waterjet installation. Options include a large bimini with a full-height windscreen or a short windscreen. Open scuppers on both sides of the stern make the cockpit self-draining. Norsafe.

Thin LED Strip Lights

The E45 Slim Light is potted into an aluminum channel and installs with powder-coated clips. Ideal underneath a gunwale, shelf, step or other site with limited space, E45 Slim Lights have a 50,000-hr. life. Lights are sealed with TPE end caps for UV and chemical resistance superior to PVC or rubber. TecNiq Inc.

Industrial-Grade LCD Monitor



The SXOBH-49-XTR monitor is a 49-in. super bright waterproof sunlight readable monitor. It has 1920 x 1080 full HD resolution and more than 2,500 nits of brightness, with impact-resistant glass. TRU-Vu Monitors Inc.

Hybrid Battery Packs

Two UB-50-12 hybrid battery packs are available in 2.4-kWh and 3.6-kWh configurations for ships and offshore platforms. They incorporate UltraBattery technology and a scalable battery rack system. Each battery pack includes internal cables and frame kit. Eco Marine Power.

Satellite Compass

The SC33 is capable of utilizing multiple GNSS systems, such as GPS, Galileo, GLONASS and QZSS for an accuracy of $\pm 0.4^\circ$ for heading/roll/pitch and 3 m for position. The unit has temperature and pressure sensors that output that data to the NMEA2000 network. Furuno USA Inc.

Cable Transit Design Tool

Roxtec Transit Designer is an online application where users enter cable or pipe estimates, sealing or certification requirements, installation preferences and material quality. The tool filters the input and generates drawings, bill of material, certificates and installation details. Roxtec International AB. **ST**



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A Brief History of Underground, Undersea Piping

What do modern day people and ancient Egyptians have in common? Underground piping. The very first metal piping can be traced back to copper pipes buried and used by ancient Egyptians to carry wastewater. The first manufacturers of modern metal pipes appeared well over a century ago in Great Britain.

Keeping track of buried or undersea pipelines is a challenge. The Global Positioning System constellation of satellites revolutionized efforts to address this tracking issue.

For undersea pipes, regulations require they be buried from several feet to several meters under the bottom to prevent snagging by anchors and fishing. Additional and increasingly strict rules exist for piping in heavily polluted areas. This depth of burial makes it difficult to locate pipelines with conventional metal

detectors as they are often beyond the device's detection range.

JW Fishers Mfg. has developed a solution: the PT-1 Pipe Tracker, a magnetometer that detects variations in pipeline (couple or ends) to help in tracking and location. The geological survey company Light-house has successfully used the PT-1 Pipe tracker on a project in the Caspian region of Eurasia.

KVH Rolls Out Cybersecurity Protection

KVH Industries Inc. has announced "6-Level Cybersecurity," a group of initiatives to provide proactive cybersecurity protection for the KVH hardware and maritime VSAT satellite network. KVH's cybersecurity strategy addresses seafarer training, as many incidents can begin unknowingly with the crew. All vessels subscribing to KVH's mini-VSAT Broadbandm connectivity service will be able to receive

the KVH Videotel "Cybersecurity at Sea" training program at no cost.

Other levels of KVH's cybersecurity strategy involve: satellite network security; terrestrial network security; hardware and network configuration; protected internet egress; and response to threats and incidents.

Satellite Link Enhances Remote Vehicle Control

Saab Seaeye has enhanced global remote control of its electric underwater robotic vehicles via satellite link and 4G networks. Remote control of the Leopard electric robotic work vehicle has been upgraded to include control of the TMS. Such remote operations will bring considerable savings to the oil and gas industry by reducing the need for offshore piloting personnel and advancing the potential for long-distance control of remote resident systems. Other robotic work and inspection vehicles can be controlled in this way, including the Sabertooth, a hybrid system that



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can operate as a roaming AUV and an ROV that can perform light work tasks.

Grant for Inshore Survey USV

Marine-i, the EU-funded program to boost the marine technology sector in Cornwall and the Isles of Scilly, has made a grant award to Ultrabeam Hydrographic for the Ultra-USV, a 3-m catamaran designed to gather fast, accurate and highly detailed survey data in challenging locations. The Ultra-USV can hold its position accurately even in river currents and can achieve much closer inspection of features than conventional craft.

The grant will enable a fully engineered prototype for extensive sea trials, with a view to bringing the USV to market by the end of 2018.

Pilot Project for Vessel Maintenance, Innovation

Tufton Oceanic's asset management company Oceanic Marine Management (OMM) and Lloyd's Register (LR) will collaborate on a project for maintenance optimization and digital innovation that will cover two vessels in the OMM fleet and provide the strategy to implement condition-based monitoring.

The initial stages will use a reliability centered maintenance approach utilizing LR's RTAMO software.

Cloud Data Centers in Norway

Equinor and Microsoft have entered a strategic partnership agreement to shape and accelerate the development of fit-for-purpose IT services for the energy industry and secure a faster transition to the cloud.

Cloud services from Microsoft's new data center locations in Norway are planned to come into operations late 2019.

Search Engine for Certified Suppliers, Manufacturers

Bureau Veritas Marine & Offshore launched the Approval Explorer, a free web application at <https://approvalexplorer.bureauveritas.com>. The tool uses a powerful search engine that allows all

maritime stakeholders to identify, locate and contact Bureau Veritas-approved service suppliers or manufacturers, as well as search for certified products and materials, all around the world.

Testing of JANUS Protocol Capabilities

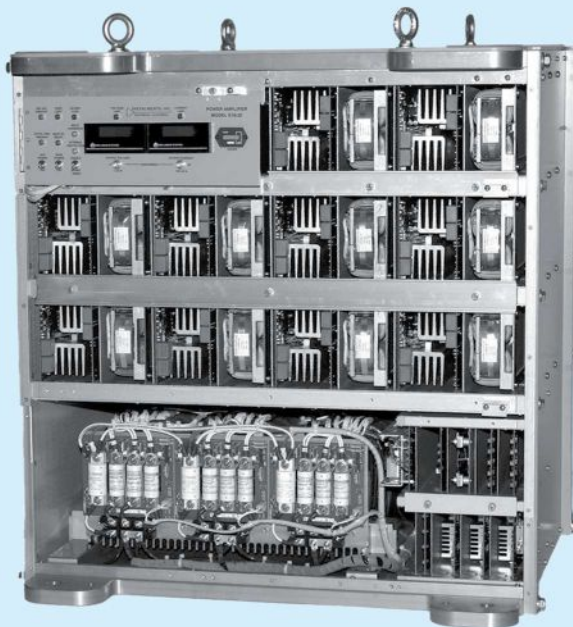
Teledyne Benthos took part in a JANUS Interoperability Fest hosted by the NATO STO Centre for Mari-

time Research and Experimentation (CMRE), based in La Spezia, Italy. The Teledyne Benthos UTS-9400 deck box and ATM-900 Series modems proved their ability to provide an interoperable real-time implementation of the JANUS protocol utilizing commercial-off-the-shelf acoustic communication hardware.

JANUS is the new NATO underwater acoustic communications standard. **ST**

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New Marilyn C. Link Memorial Internship

In honor of the late Marilyn C. Link, whose service to the Harbor Branch Oceanographic Institute Foundation and the Harbor Branch Oceanographic Institute (HBOI) at Florida Atlantic University (FAU) will be deeply missed, the board of the foundation has established the Marilyn C. Link Memorial Internship.

Beginning in fiscal year 2020, the foundation will annually fund one intern competitively selected with a focus on ocean engineering/technology to participate in the HBOI Summer Internship Program.

This year will mark the 45th year hosting outstanding ocean science and engineering students from around the U.S., which began when Link was Harbor Branch's first managing director. There are currently 617 alumni of this program who have gone forward to distinguished careers in the sciences.

More information is available at www.fau.edu/hboi/education/internship.php.

OSIL Marine Snow Catchers For NASA Research

Ocean Scientific International Ltd. (OSIL) has equipped the NASA EXPORTS Field Campaign with three marine snow catchers and will contribute to the upcoming PACE (Plankton, Aerosol, Cloud, ocean Ecosystem) mission to provide insight into Earth's ocean and atmosphere using remote sensing.

The catchers are large-volume water samplers that allow collection and characterization of suspended and sinking particles in the water column. This provides a greater understanding of the export processes of the oceanic organic carbon cycle (removing carbon from the upper ocean) and can help predict how these processes may change in the future.

Gypsum Affects Arctic Nutrient Cycling

Tiny gypsum crystals can make phytoplankton so heavy that they rapidly sink, thereby transporting large quantities of carbon to the ocean's depths. Experts from the Alfred Wegener Institute recently observed this phenomenon for the first time in the Arctic.

As a result of this massive algal transport, in the future, large amounts of nutrients could be lost from the surface waters. The rapid export of phytoplankton could have a number of effects on the carbon cycle in, and productivity of, the Arctic at scales that we cannot yet accurately predict.

Once the phytoplankton die, they begin to sink. Yet only a small fraction actually reaches the seafloor. The vast majority of phytoplankton remains in the uppermost water layers, where it is broken down by bacteria, releasing their nutrients and carbon dioxide. Incorporated gypsum crystals drag the phytoplankton lumps down so

quickly that there's no time for them to be broken down, causing more phytoplankton mass to reach the seafloor.

If these crystals drag down phytoplankton before the bacteria can decompose them, the upper water layers could lose nutrients.

This loss could in turn affect the marine food web and the fishing industry. **ST**

people

Damen head of communications **Sylvia Boer** has been appointed president of the Netherlands WISTA, the Women's International Shipping and Trading Association. In addition, WISTA Norway has opened its doors to its first male member, Nor-Shipping Director **Per Martin Tanggaard**, who has also signed up as the first male mentor for WISTA Norway and YoungShip's Female Maritime Mentorship program.



Modus has hired **Luke Barnes** as commercial manager. With significant experience in the subsea industry, Barnes has previously worked in commercial roles with CodaOctopus and most recently with the Global Marine Group. He is particularly knowledgeable in the offshore renewable energy industry.

Teledyne Optech Research Scientist and Development Manager **Vinod Ramnath** was awarded the Sebastian Sizgoric Technical Achievement Award by the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) at the annual JALBTCX Airborne Coastal Mapping and Charting Workshop in Providence, Rhode Island, for his contributions to the development of the world's most advanced bathymetric system.

Newport Shipping appointed CEO **Erol Sarikaya** to lead a new focus on comprehensive drydocking and a unique ship repair financing proposition, whereby shipowners can stagger 60 percent of their drydocking payments into monthly installments, with only 40 percent of total maintenance costs due upon the vessel returning to service.

The National Subsea Research Initiative (NSRI) elected two new board members, **Simon Cheeseman** and **Claus Hjoerringgaard**, as the organization expands its capabilities in the renewables, mining, defense and aquaculture sectors. A former marine engineer, Cheeseman is responsible for managing ORE Catapult's marine renewables strategy, identifying wave and tidal technology innovation needs. Hjoerringgaard, managing director of Wood Clean Energy, has more than 25 years of experience within the energy sector. **ST**

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contracts

Bollinger Shipyards, Lockport, Louisiana, has chosen its Tampa Shipyard to design and build up to three heavy polar icebreakers and three additional medium-sized breakers under consideration by the U.S. Coast Guard. Bollinger plans to staff the Tampa production facility with more than 1,000 full-time workers as early as 2020.

Maersk, Copenhagen, Denmark, will install integrated SSAS on 300 vessels over six months. Maersk uses vessel tracking services that combine vessel data with satellite and terrestrial AIS and provide position reports every 10 minutes both in open-ocean and coastal waters. Begun in 2016, this service is now covering up to 2,000 vessels. Big-OceanData.

Kongsberg Maritime, Kongsberg, Norway, will deliver the safety and automation systems for phase two of the Johan Sverdrup development in the Norwegian North Sea, including digital technology for a new processing platform, which is due to start production in 2022. Kongsberg will also provide three subsea production system tie-backs and technology solutions for shore power at Haugsneset. Equinor Energy AS.

ECA Group, LaGarde, France, has chosen a CTG Pipeline Leak Detection system (PLD) for subsea pipeline inspection and oil leakage detection. The 600-m system contains a CTG Uvilux configured for hydrocarbons. The PLD system will be integrated into ECA's ROV, the H800-SUR, alongside a hydrophone, water sampler and sediment sampler. Chelsea Technologies Group.

Forum Energy Technologies, Houston, Texas, will deliver a submarine rescue vehicle (SRV) and an ROV and associated launch and recovery systems, to be integrated with additional equipment for a navy in the Far East. The SRV, an onboard piloted rescue submarine, will op-

erate in depths greater than 500 m and carry 19 people. It will be fully integrated with a hyperbaric rescue facility. Submarine Manufacturing and Products Ltd. **ST**

meetings

SEPTEMBER

September 4-6—ENGenious, Aberdeen, Scotland. chris.brand@bigpartnership.co.uk or www.engeniousglobal.com.

September 4-7—SMM, Hamburg, Germany. +49 40 3569 2445, nora.ebbinghaus@hamburg-messe.de or www.smm-hamburg.com.

September 9-12—IFAC Conference on Control Applications in Marine Systems, Robotics, and Vehicles, Opatija, Croatia. zoran.vukic@fer.hr or <http://ifac-cams2018.com>.

September 18-19—Ocean Renewable Energy Conference, Portland, Oregon. msanders@oregonwave.org or <http://oregonwave.org/2018-conference>.

September 18-19—Teledyne Marine Users Conference, Halifax, Canada. 858-335-6727 or www.teledynemarine.com/events/canadian-users-conference-2018.

September 22-25—SEG 2018, Keystone, Colorado. 720-217-5692, kathybasel@gmail.com or www.seg2018.org.

September 24-26—Submarine Networks World, Singapore. +65 6322 2718, enquiry.sg@terrapinn.com or <https://goo.gl/sZqfF4>.

September 25-28—The National Marine Electronics Association and the Radio Technical Commission for Maritime Services International Conference & Expo, Palm Beach Gardens, Florida. 703-527-2000, info@rtcm.org or www.nmea.org.

September 30-October 07—Breaking the Surface: Interdisciplinary Field Workshop of Maritime Ro-

botics and Applications, Biograd na Moru, Croatia. zoran.vukic@fer.hr or <http://bts.fer.hr>.

OCTOBER

October 1-3—Commercial UAV Expo Americas, Las Vegas, Nevada. KMcDonald@divcom.com or www.expouav.com.

October 1-3—Shallow Survey, St. John's, Canada. Paul.Brett@mun.ca or www.shallow-survey.com/Home.

October 1-5—PLOCAN Glider School, Gran Canaria, Spain. carlos.barrera@plocan.eu or <http://glider-school.eu>.

October 3—Marine Data Management Workshop, Southampton, England. sgaf@bodc.ac.uk or www.oceannet.org/marine_data_standards/workshops.html.

October 3-4—Global Hydro-power Latin America Congress and Exhibition, Santiago, Chile. dkvasnitsyna@vo-stockcapital.com or www.latinamerica-hydrocongress.com/en.

October 3-4—International Conference on Marine Renewable Energy and Maritime Hydrogen Technology, Florø, Norway. maria@maritimsfj.no or <https://bit.ly/2GW2Eo2>.

October 3-4—OilComm and FleetComm, Houston, Texas. 713-343-1875, tle@accessintel.com or www.oilcomm.com.

October 3-5—NOIA Fall Meeting, San Antonio, Texas. achapman@noia.org or www.noia.org/2018-noia-fall-meeting.

October 8-12—Sea Tech Week, Brest, France. jacqueline.rosec-despres@lequartzcongres.com or www.seatechweek.eu.

October 9-10—Dynamic Positioning Conference, Houston, Texas. <http://dynamic-positioning.com>.

Visit: sea-technology.com/meetings. **ST**

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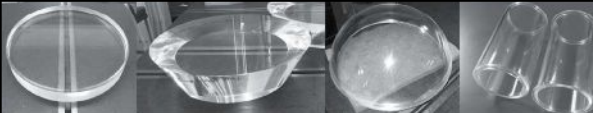
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What Winston Churchill's War Rooms Can Teach Your Business—Dr. Armin Ellis

Dr. Armin Ellis (ate@explorationinstitute.com) is the founder of Exploration Institute (EI), a strategy design company focused on marine, aerospace and new technology industries. EI works with teams to develop superior strategies through technical rigor and execution focus. EI also helps to design war rooms and innovation rooms, dedicated spaces to support better and faster decisions for leaders and teams.



The year is 1940, and newly appointed U.K. Prime Minister Winston Churchill enters his underground Cabinet War Rooms and famously announces: “This is the room from which I’ll direct the war.”

This was no ordinary bunker. It was Churchill’s technological hub, purpose-built and optimized to support sound information processing, good decision making and efficient implementation 24/7.

The most striking part of the War Rooms was the Map Room, covered in maps of the world, with pins marking the movement of troops and logistical resources by land, sea and air. Colored telephones connected the Map Room to the Air Ministry, the Admiralty and other military and intelligence services. Huge amounts of data were converted to visually digestible insights, understandable at a glance.

From that room, Churchill was able to understand the layers of conflict happening around the world, and he was in a position to recognize trends, resources and logistics on both sides. He had access to core tools, primarily first-rate information gathered and processed by experts behind the scenes.

The Map Room’s real power came from the skillful way information was efficiently prepared and presented. This enabled Churchill to see the evolution of the war on all fronts, without becoming over-

whelmed by data. He and others were able to see the big picture, as well as appreciate the finer details.

If Churchill wanted to discuss alternative ideas, even risky or unorthodox strategies, the resources were at his immediate disposal. The support and perspective of stakeholders were available, and his surroundings provided the context and information necessary for his instructions to be easily understood.

Having worked with many leaders and project managers across industries, I’ve noticed patterns for successful execution that are surprisingly in step with Churchill’s practices. My work with decision makers at all levels of leadership, in any organization, has proven to me that we can all get consistently better results and make better decisions by intentionally practicing certain decision-making processes.

As leaders, if we are to take steps that are bold, yet grounded in reality, we must balance both details and vision. To achieve this, a few steps are necessary.

First, devote time and space for making decisions. People often devote time for thinking and planning; they very rarely devote time for the specific act of making decisions. Many leaders put off decisions for as long as possible, but if there is time regularly devoted to making decisions, the quality of decisions improves, along with better execution. I recommend creating a physical location for making decisions, your own version of Churchill’s War Rooms. Proactive, conscious decision making will produce a cadence for your company and can help progress projects efficiently.

Second, use differences of opinion and perspective to your advantage. When building a team, try to include a diversity of ideas. Listen well and apply what you learn to fortify your strategies. Be aware, while diversity of thought is important to help you formulate smart

plans, this does not replace your responsibility as a leader to make that final call.

Third, make sure you have the chance to play with “what if” scenarios, including ideas that may seem risky or impossible. The very practice of playing with ideas expands our ability to understand the nuances of properly carrying them out. Playing with ideas is underappreciated, but results in more comprehensive plans and decisions with better understood reasoning.

Fourth, have a sensible system in place to periodically revisit prior decisions. Know that once execution starts there will be unforeseen outcomes, and having a decision iteration process in place will help your team assess whether they are on track to achieve goals and avoid emotionally charged and reactionary decisions.

Fifth, ensure there is a system for communicating with your team. No matter how good your instructions, if you’re dealing with complex issues, your instructions will be misunderstood (or at least executed differently than you’d expect). Eliminating misunderstandings is impossible, but a communications process enables miscommunications to be reined in and corrected.

Ultimately, difficult decisions must be made, and by basing those decisions on the highest quality data available, taking specific evaluative actions, then selecting the decision from a number of options (ranging from the daring to the obvious), you can create the systematic approach for making good decisions and shore up your business against threats and missed opportunities.

Above all, devoting time and space to making decisions really makes a difference. Churchill didn’t leave insight to chance. World War II is now history, but the legacy of his Cabinet War Rooms continues to provide a valuable model for sound decision making. **ST**

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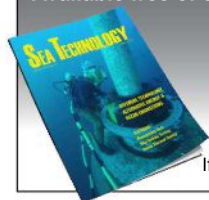
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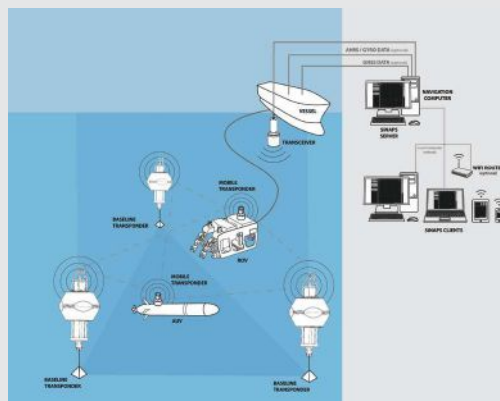
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