MARINE TECHNOLOGY REPORTER

January/February 2021

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Robot Fleet

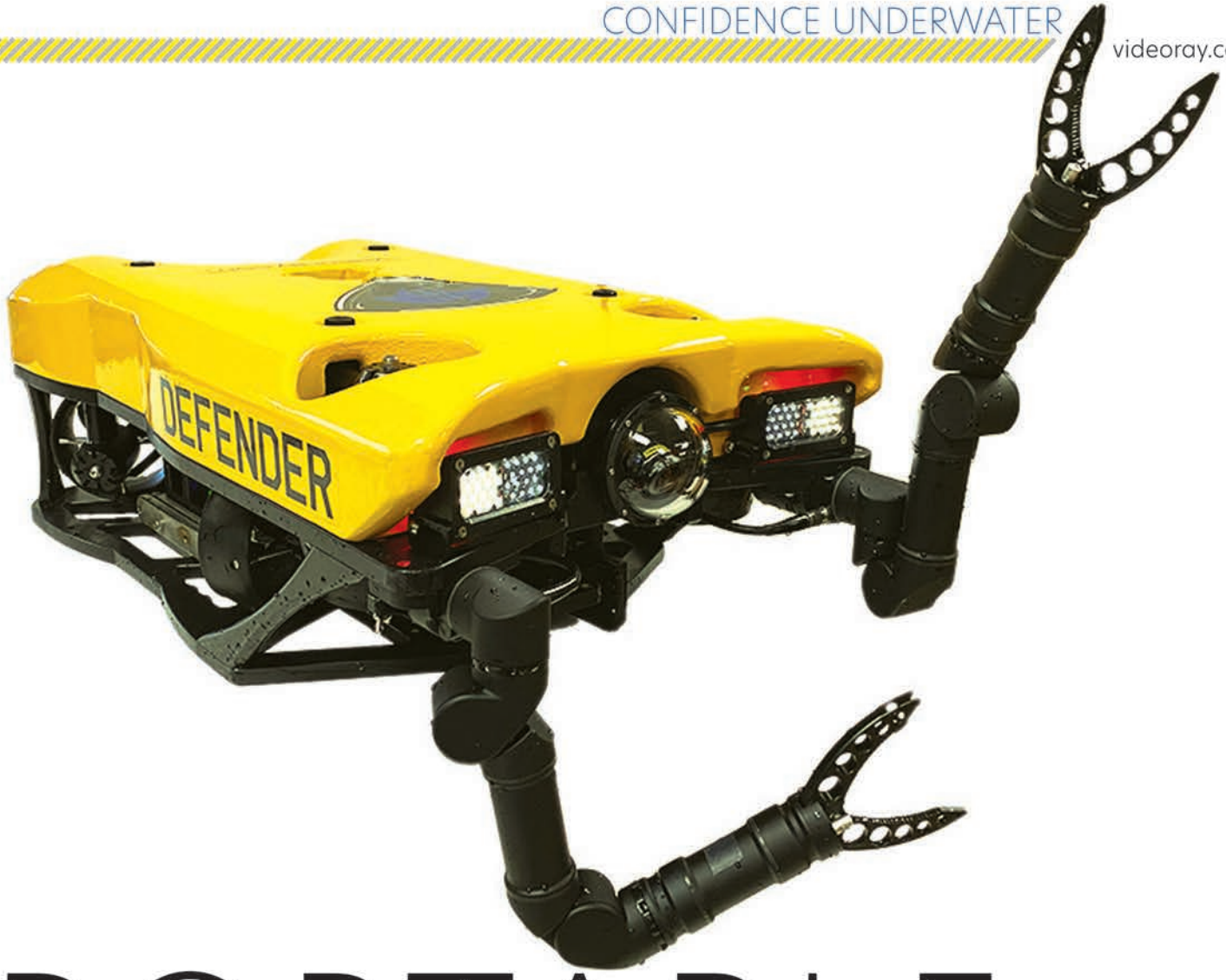
Inside Ocean Infinity's Growing Global Vehicle Fleet

RV Roger Revelle
Inside the $60m Refit

2021 & Beyond
More Autonomy, More Data, More Remote

Subsea Defense
U.S. Navy Doubles Down on UUVs

Volume 64 Number 1



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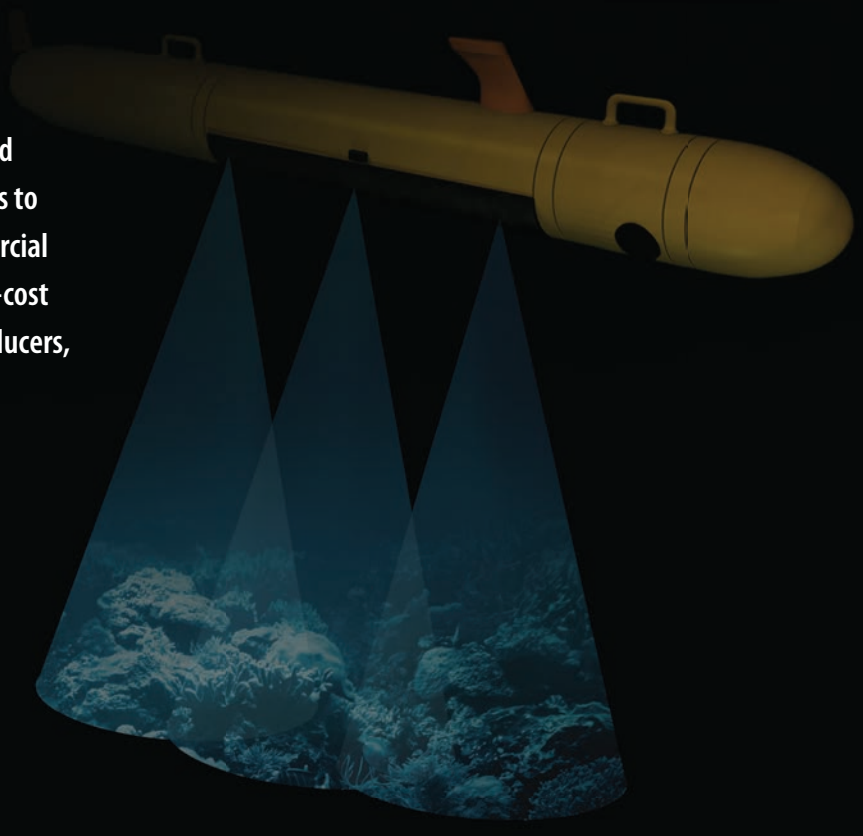

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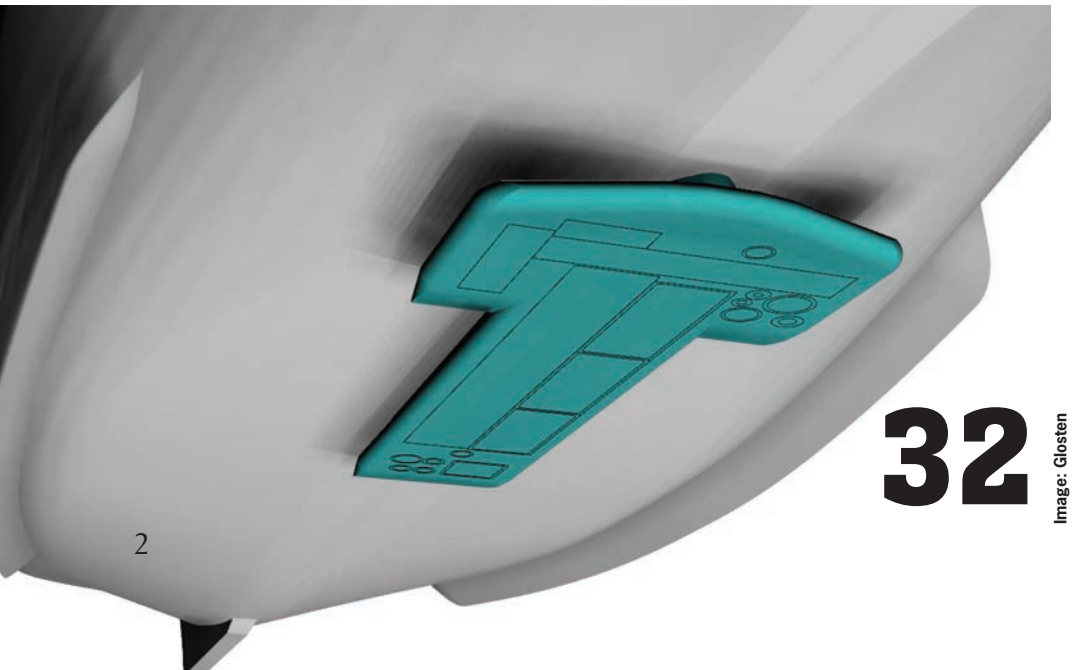
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Image: Glosten

On the Cover

The Research Vessel Roger Revelle received a $60m midlife refit.
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Editorial

As this is our 'Underwater Vehicle' annual, some might be surprised to see RV Roger Revelle – a surface, crewed ship – gracing the cover of this edition. While RV Roger Revelle does not necessarily fit the 'underwater' bill, it is a critical piece to the ocean discovery puzzle, offering a range, experience and capability to deliver a full suite of underwater vehicles and sensors in places that still today are too remote for uncrewed systems to work alone.

In interviewing **Bruce Appelgate**, Associate Director and Head of Ship Operations, Scripps Institution of Oceanography, for the feature, he said. "The utility of unmanned systems is that you can achieve a persistence at sea that's not possible with presence. Unmanned systems that we're deploying extend the ability of us to do our sensing at sea. It makes ships more useful. Maybe in 50 years it will be different, but things like going to the southern ocean and doing CTE profiles, and the kind of hydrography that the big ships do routinely, you just can't do it (with fully autonomous systems alone); you need too much power. Autonomy extends the utility of the service vessels. It makes us more efficient and gives us persistence."

The full story on this recently revitalized ship and its namesake starts on page 32.

2021 should prove a pivotal year for the evolution of all ocean vehicles, surface and subsurface, driven by the likes of Ocean Infinity which is launching the start of what will become a fleet of completely uncrewed ocean going vessels. These USVs will host and deploy other robotic systems, including remotely operated vehicles (ROVs) and AUVs, as well as towed systems and full ocean depth survey equipment. The first two in what's being called the Armada fleet will be ready for commercial operations in the North Sea in summer 2021. Finally, the defense market remains a primary driver for all matters subsea and autonomous, and the U.S. Navy, among others, is doubling down on its investment and efforts in this regard. Starting on page 40, Edward Lundquist explores how the U.S. Navy is broadening its use of unmanned underwater systems.

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Associate Publisher & Editor

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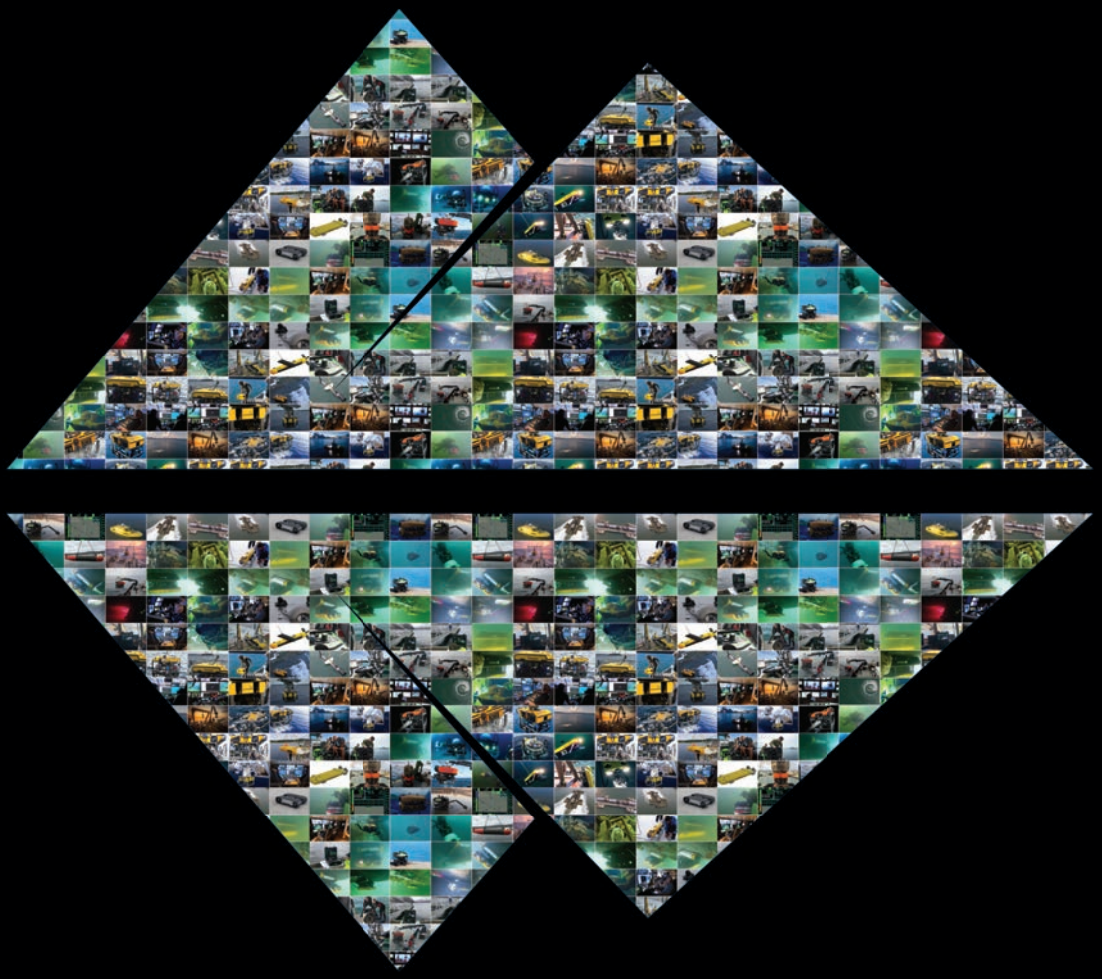

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"Quotable"

"Roger Revelle was a visionary who – back in 1946 – envisioned the Office of Naval Research as a world leader in sponsoring oceanographic basic research, and later foresaw the need for a new University of California in La Jolla that eventually grew around Scripps," said **Tom Drake**, director of the Ocean Battlespace and Expeditionary Access department at the Office of Naval Research. "He also suggested the likely trajectory of the Earth's climate, which we are now observing."

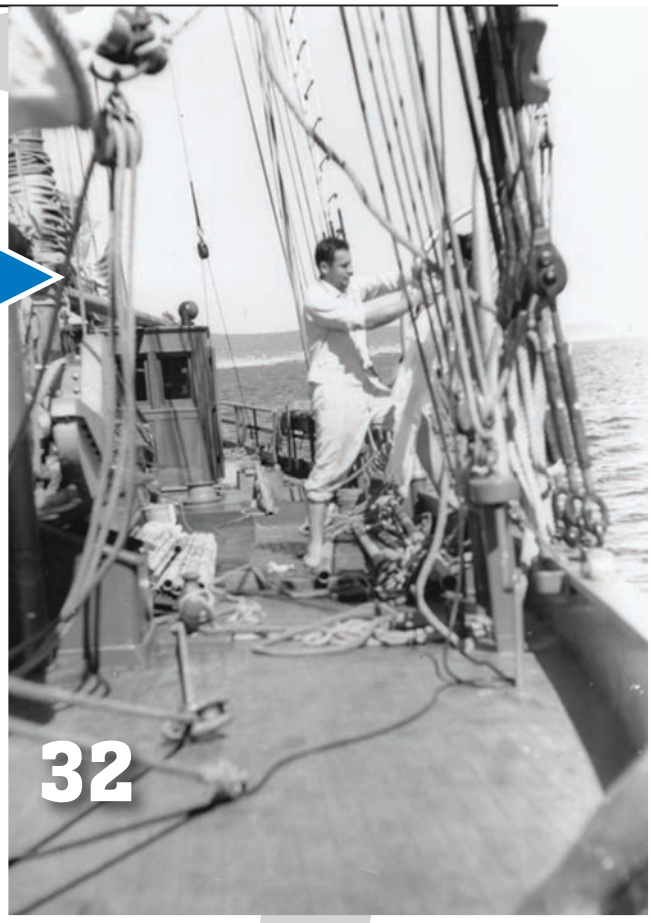

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Photo courtesy UC San Diego Library

"One of the limitations we observed in existing USVs was that you could only really deploy one type of sensor or go out for a week at a time ... In building Armada, we really tried to address that. The biggest change is scale. A 21 m vessel can carry multiple sensors, the right type of ROVs and the right type of sensors and winches that customers need."

Dan Hook,
Ocean Infinity

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Photo courtesy Ocean Infinity

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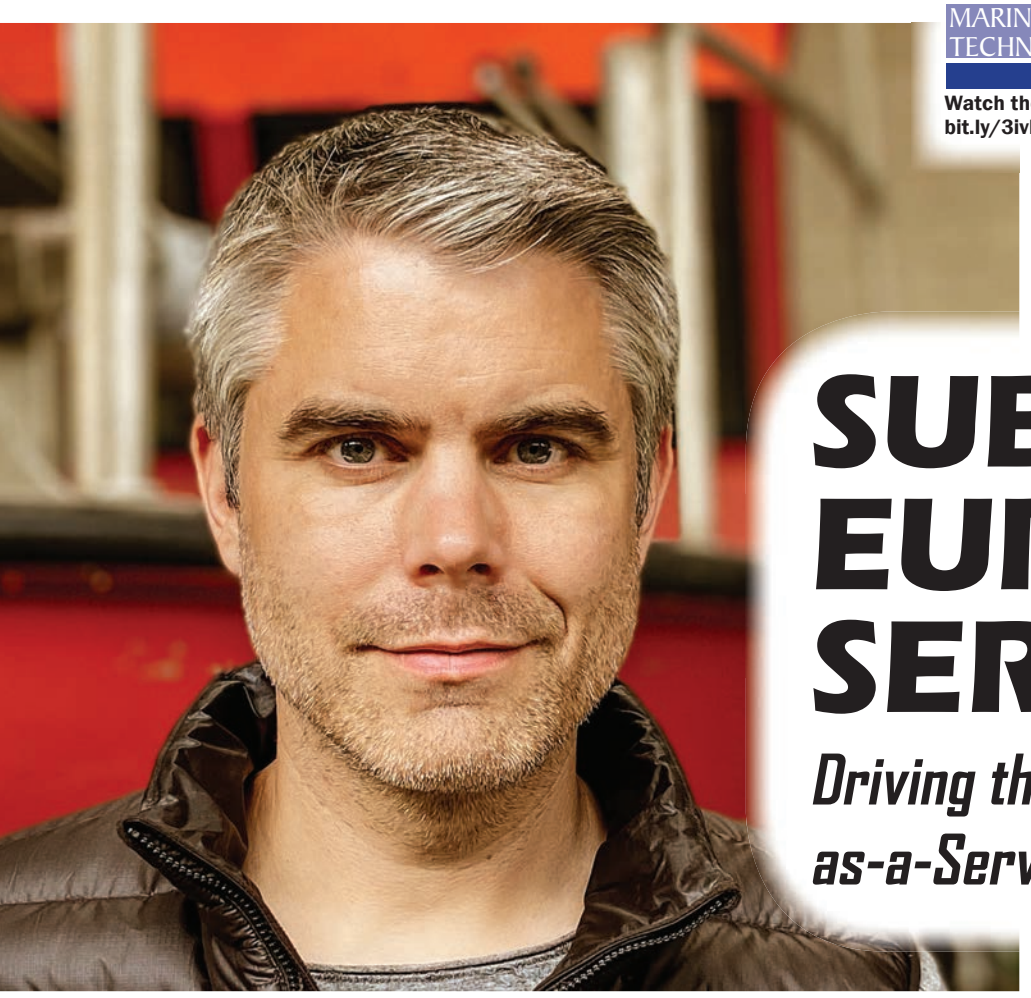

SUBSEA EUROPE SERVICES:

Driving the 'Survey System-as-a-Service' Business Model

*Subsea Europe Services was born during a pandemic, but **Soren Themann**, **founder and CEO,** is gearing up for a brisk business premised on true autonomy, AI and neural systems in 2021 and beyond.*

By Greg Trauthwein

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Subsea Europe Services

Soren, to start, can you give an overview, a 'by the numbers' account if you like of Subsea Europe Services today?

Subsea Europe Services is a young company, founded in January 2020, which was only a few weeks before COVID-19 started dominating our lives. The goal of Subsea Europe is to make it possible for every organization to collect and evaluate marine data professionally. During our first year in business we made a significant investment in the rental pool. We currently have more than 10 systems up to date. We've developed and also successfully implemented the integrated Hydrographic Survey System concept. And we've grown our field support capabilities so we have a total of five people, which I think is a great achievement under the COVID-19 dominated world.

I know everything today is viewed through a COVID-19 lens, and we will be getting back to that later, but when you look at your business today, what are the primary drivers?

Autonomy, both of the sensor systems but also autonomy of the platform carrying the sensor system, which from our perspective are two separate topics. In particular the autonomy of the sensor system requires the use of artificial intelligence moving forward, which we believe is the second important driver here. There will be no autonomous data processing and evaluation capabilities without AI, neural networks or supervised learning. This can be problematic because we have sufficient data available in the Maritime domain, but not sufficient proven interpretations of the data to train the network. That's a hard nut to crack for the future, but both autonomy and AI will enable new business models for us and lead to a disruption of existing value chains.

It is a fascinating 'push and pull.' As technology has evolved, it seems to a degree that hydrographic survey has become somewhat commoditized. How do you see it?

Well, especially in shallow water. With shallow water systems the technological differences between the different multibeam systems available on the market are rather small. So selecting a suitable system for the job has become more like a some kind of a passion statement rather than a fact-based decision. Now, this commoditization is in fact also enabling new business models for system integrators like us. So we believe we've standardized on an integrated hydrographic survey system that we believe meets the requirements of at least 90%, maybe 95% or for multibeam survey jobs in shallow water. So through this high level of standardization, we can keep the cost base low and still offer great technology with great technical support. And this then gives us the required leverage to offer our integrated systems. For example, on a subscription basis for customers who need a full-fledged system only a few times a year, but, of course, want the

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We've seen similar developments already in other industries. Look at the car rental industry: you don't rent a specific brand or model, rather you rent the class of car. So today you can even subscribe to a car rental and use it only when you need it, which leads to 'mobility-as-a-service' business models. We believe the next step in our evolution would be a 'survey system as a service,' which then leads to 'data-as-a-service' at some point, with customers only paying for the information, like a seabed map, instead of buying or renting a multibeam.

We cover autonomy relentlessly across our maritime, offshore energy, subsea and logistics brands. Can you drill down and discuss how autonomy is impacting the hydrographic survey sector?

We believe that real autonomy will be a game changer for the hydrographic sectors. There are several good examples of autonomous platforms available, but these are still automated platforms with certain aspects of autonomy. Real autonomy means I would give a system a task, like to do a multibeam survey in a specific area with a resolution of X and a point density of Y. Then the system conducts the whole survey takes all decisions autonomously and delivers the final product. To get to this point, we need to take autonomy of the platform and autonomy of the sensor system to the next level. So from our perspective, the roadmap to real autonomy will lead from automated platforms and sensor systems to autonomous platforms and sensor systems and then finally only to integrated autonomous survey systems.

A step in between will be remote services, which is something we're (and many others are) working on right now. So this is where automated systems are assisted, with an expert sitting in the offices far away from the action, for example. We see clear examples of this with Fugro's office assisted remote services, and in combination with semi-autonomous platforms also with Ocean Infinity's Armada, for example. This would mean that most hydrographers would spend more time assisting autonomous service systems from the (confines of their) warm office.

Subsea Europe Services

You hit on a lot of good points. In all of the sectors we serve I see this rapid evolution of technology, but on the other side of the coin, you have the cultural acceptance, or lack thereof. How do you see the evolution of the acceptance of this technology, allowing people to spend more time in the office and less time at sea?

When technology is evolving quicker than people, there's always a change process associated. It will still take years until we see a broad acceptance and use of remote assistant services and autonomy in all sectors of the industry. And some very specialized services may never be executed without an expert on site. But I believe the days of roughneck offshore surveyors fighting with technology and the elements are long gone. What we see today in the hydrographic surveying industry is more of a computer specialist than a daredevil. This new path could also result in a more healthy work-life balance, too.

You can't have a business discussion without discussing COVID-19, but the question in regards to your company is even more topical, as you were born just at the outset of COVID-19.

Discuss your outlook for 2021?

COVID-19 has had quite an impact on the industry overall. The nearly endless number of different local regulations regarding travel and quarantine made it very hard to plan and execute projects, gave a high-level of uncertainty, and led to delays and some cancellations. But after almost one year now we're in calmer waters and we'll execute our business case as planned. We're a little bit behind, but we hope to have positive results, and this means more investment for 2021. We are always searching for research projects around autonomy of survey systems and neuro networks for data interpretation. We're also expanding our services by adding post-processing services for multibeam data. simplifying marine data acquisition for our customers. There are exciting times to come.

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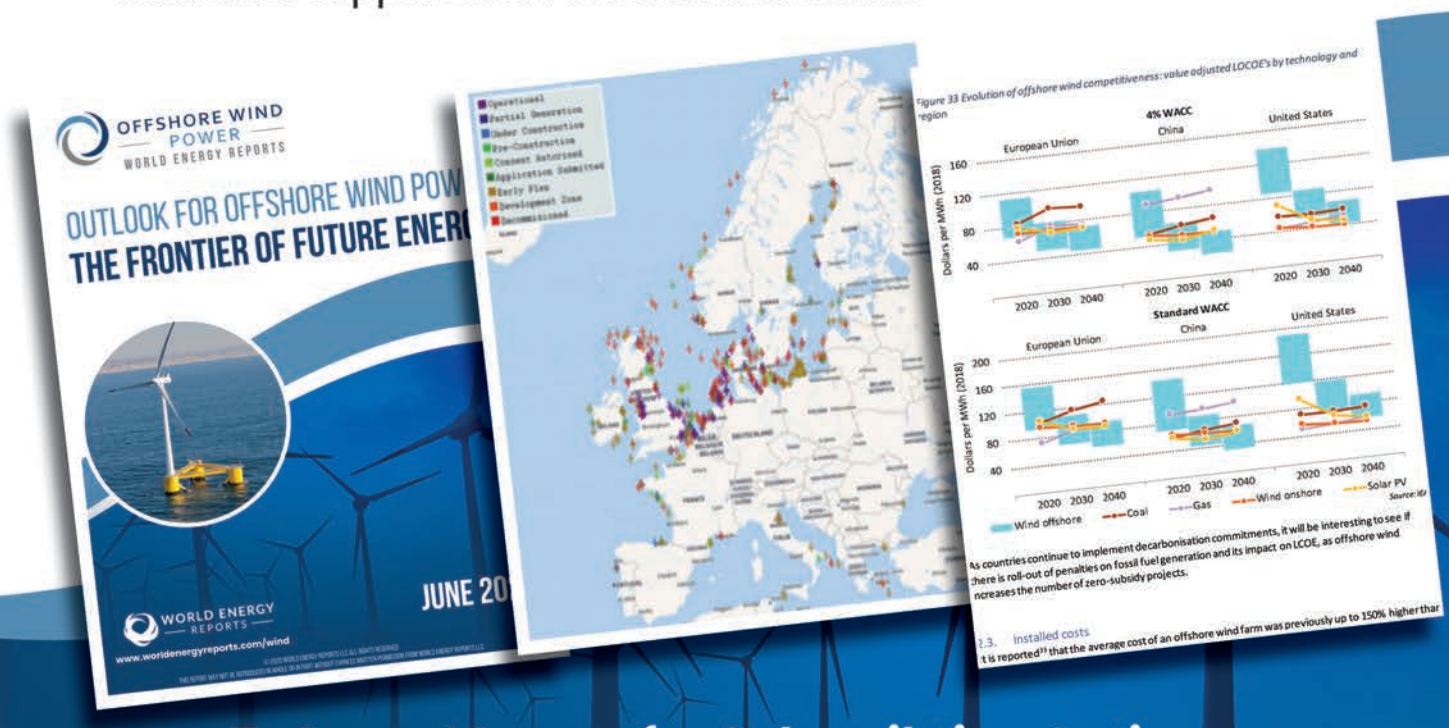

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5 MINUTES WITH **DAN SUMNER,** ORE CATAPULT

As part of our Market Planner focus, we spoke with **Dan Sumner**, *Project Development Manager, at the UK's Offshore Renewable Energy Catapult (ORE Catapult) about his views on trends in the offshore wind market.*

What is the overriding theme for the subsea industry in 2021?

It is well known that offshore wind is continuing its unprecedented growth across Europe, and the world. We have seen the levelized cost of energy decrease faster than originally forecasted, a fantastic success story, which can be primarily attributed to the development of larger capacity turbines and improving the economics of installation and operations per MW. The growth of farm capacity, again improving the economics, such as the effectiveness of the transmission network. In general, we are moving further away from shore, met ocean conditions on average will be more severe (higher mean winds, greater mean wave heights). Water depths will increase, beyond the 50/60m range which transitions them into what the industry experience as 'deep', seabed sediments become variable and an increased proximity to other offshore assets.

What do you expect to see more of in terms of technology?

As the environment becomes more extreme, we are seeing a trend towards more remote and autonomous technologies. Ways of working that remove humans from danger and provide reliable and repeatable data. We are seeing residency systems for subsea becoming viable, as well as a range of technology being controlled from the shore. IoT and continuous monitoring technologies enable more predictive maintenance.

What opportunities are there for new entrants?

There can be an application of machine Learning algorithms through all phases off the offshore wind lifecycle, from site assessment at the development phase, to image classification in the operations phase, to environmental monitoring at decommissioning. The scale of predicted growth of offshore wind should be an exciting prospect.

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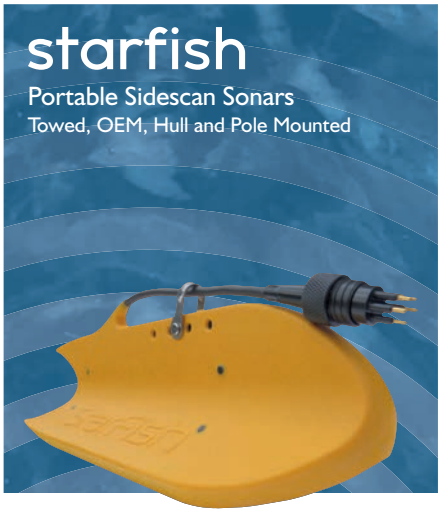

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BOSS

WHAT'S IN STORE FOR 2021?

IT'S ALL ABOUT "MORE" ... MORE REMOTE, MORE DATA & MORE AUTONOMY

Late 2018, before net zero targets had been agreed to by most western energy giants and nations, BP came out with a goal to reach 100% of subsea inspection by marine autonomous systems by 2025. It was a tangible goal then and it's one that might now be reached faster as remote and a more "digitally" oriented operations take hold with greater opportunities for new nimble players in the market. It's a goal being chased in offshore wind too.

By Elaine Maslin

Late 2018, before net zero targets had been agreed to by most western energy giants and nations, BP came out with a goal to reach 100% of subsea inspection by marine autonomous systems by 2025. It was a tangible goal then and it's one that might now be reached faster as remote and a more "digitally" oriented operations take hold with greater opportunities for new nimble players in the market. It's a goal being chase in offshore wind too.

Some of it's about emissions targets. Starting in 2019, the growing mass of pledges to net zero targets by nations, upstream companies and even suppliers has accelerated moves to do more remotely – lowering emissions (and, it's hoped also, costs). In offshore wind, it's also about the growing mass of turbines out there that present a significant operation and maintenance challenge. A global pandemic restricting travel has now accelerated some of that innovation. Remote operations a reality rather than a road map.

Refocus, reform – greener visions

Taking a step back, it's a tough, rapidly evolving environment for many, with depressed oil prices having impacted the oil and gas industry specifically, resulting in a wave of company restructuring. "Companies are busier than ever working out what to prepare for the future," says Bjørn Søgård, Segment Director for Subsea, DNV GL. Tier 1 contractors created through mergers just a few years ago are starting to be unravelled into more renewable versus traditional business (e.g. Aker Solutions spinning off its offshore wind and carbon capture segments) or demerging to distinguish upstream from midstream-downstream (e.g. TechnipFMC and its spinout Technip Energies), points

out Søgård, as CO2 starts to emerge as a balance sheet item and companies need a visible green profile. Operator strategies are focusing on emissions reduction, production and use of renewables alongside and oil and gas, but also power from shore, says Chris Pearson, the UK's National Subsea Centre director.

Expect more sensors, data, analytics

In the technology domain, the world is potentially equally as agile. Lee Wilson, who co-founded new company Honuworx at the start of 2020, says we now need to learn from the likes of Apple and Amazon and behave more like software companies, instead of sticking rigidly to a four-year technology roadmap and finding the world has changed at the end of it.

So what does that involve? Expect there to be more sensors, data and data analytics that will feed subsea robotics, automation and remote hubs and cyber-physical systems, says Pearson.

Some of that is already coming, not least around the use of unmanned systems (UxV). In 2019-2020, unmanned surface vessels (USVs), such as those from XOCEAN, were used for survey and data harvesting type operations. In 2021, USVs that can deploy ROVs and AUVs will enter the market, including the first of the 21m and 36m-long Armada fleet, being built by Ocean Infinity, and Fugro's SEA-KIT USVs; both of which will increase the scope of what can be done remotely. After the first vessels come out, more that can also deploy aerial drones will come – something which will be of use in the offshore wind industry for blade inspection – but also bigger and more capable ROVs, including work class, for inspection, repair and maintenance and even geotechnical work, says Karl Daly, director, IRM services Europe, at Fugro, speaking at the recent joint IMCA, SUT, Hydrographic Society in Scotland seminar. Instead of contracting a DP vessel, operators will be contracting for delivery of data, he says.

While initially there will have to be a human in the loop for all operations, from the growing number of remote operations centres popping up, the future will move to one person overseeing two or even three vessels, says Mike King, business development manager at Ocean Infinity, also speaking at the online event. The vessels and what they do will also become more and more autonomous, says Daly, although this will have to be done in tandem with the development of regulatory policy around uncrewed marine operations.

Subsea residency

Deploying an ROV with batteries and communications buoy (i.e. Oceaneering's E-ROV system) will continue, enabling un-vessel supervised campaigns, while moves towards subsea residency continue to creep forward. Saipem's Hydrone-R is set to be deployed at Equinor's Njord field offshore Norway some time in 2021. Saipem says Hydrone-R can spend up to 12 months underwater, without being brought back to surface. Hydrone-W, it's work class cousin, is due to go through testing in 2021. Eelume, the snake robot, is also due to be trialled at Åsgard, also in the Norwegian sector, while Oceaneering's Freedom vehicle is also set to be let loose in the wild, likely on pipeline inspection operations.

"Whether the systems are hosted subsea or on the surface, having 'eyes, 'ears' and even 'hands' on site remotely will help to increase asset uptime and potentially reduce the number of incidents through early identification," thinks Damian Ling, Geomatics Advisor at Chevron's Energy Technology Company (ETC), while USVs will increase how much shallow water inspection or host an AUV for deep water, without using crewed vessels, he says. "I see both methods or services as complimentary to achieving the same goal," he adds.

Increasing use of survey techniques adopted from terrestrial industries, such as photogrammetry, LiDAR, fiducial landmark navigation and automatic target recognition, will also help increase the efficiency of surveillance data collection and "enable autonomous inspection methods and provide data

Fugro

products from which we can have additional uses," says Ling (his views, not Chevon). Companies like Cathx Ocean, 2G Robotics (photogrammetry), 3D at Depth (LiDAR) and Forsea (landmark navigation) are examples here. But rather than coming back to base with a flood of data, edge processing, data analytics and miniaturised sensors will also help.

The same technologies and systems are set to benefit the offshore renewables industry, as it looks for ways to provide inspection and maintenance scope across its growing fleet of wind farms. "We are seeing residency systems for subsea becoming viable," says Dan Summer, Project Development Manager at the UK's Offshore Renewable Energy (ORE) Catapult. "IoT and continuous monitoring technologies enable more predictive maintenance, meaning less trips to site while remote technologies mean less people offshore."

Electrification

Some of the underlying technologies that enable remote operations and autonomy have become increasingly available over recent years, from terrestrial communications, including satellite and marine 4G networks, to underwater communications, including freespace optics, acoustics radio and hybrid systems, says Ling. Emerging low earth orbit satellites will further expand what's possible.

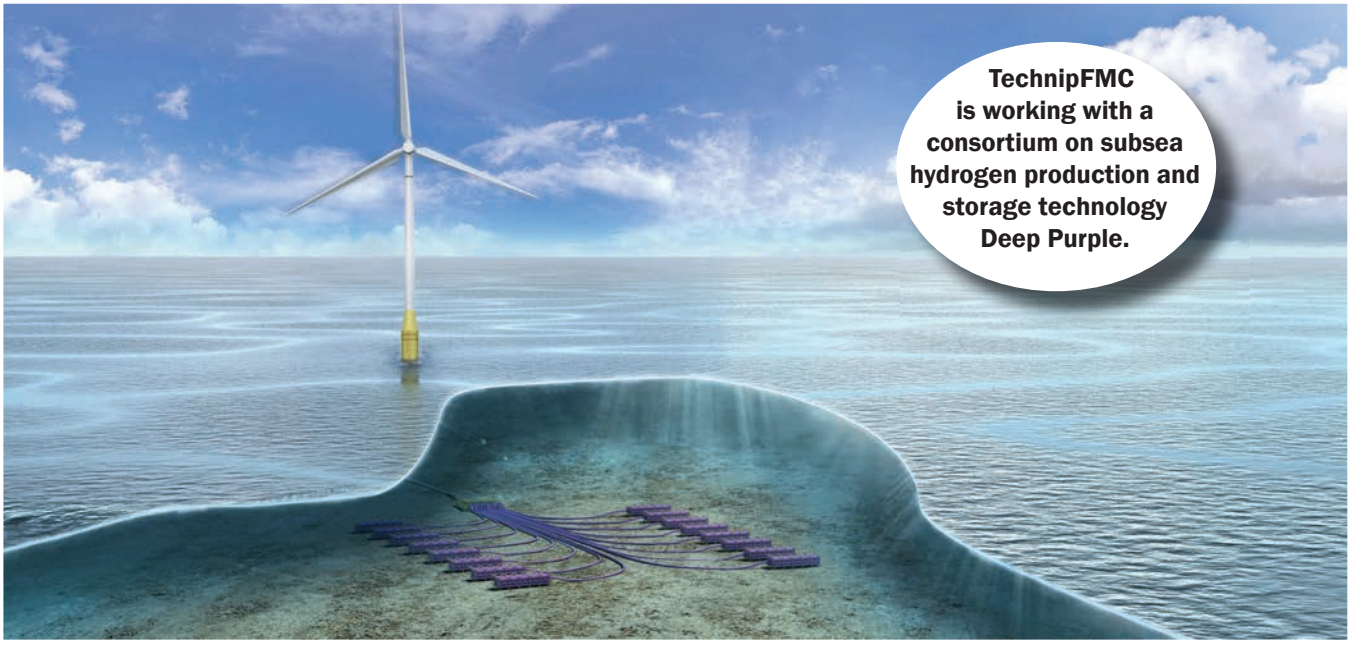
But another enabler may also finally come to market: subsea electrification. Subsea electrification could enable increased use of subsea processing, from pumping through to compression, enabling longer subsea tiebacks without the need for new topsides or significant modification to existing topsides, and also deeper water projects. It's been a long time coming. Subsea power distribution systems have been qualified by ABB and GE Oil & Gas, with Siemens following and TechnipFMC also developing a lower cost system for sub 6MW users, initially. Others are offering local power generation with options ranging from power generated on site using wave or tidal technology (Ocean Power Technologies, Mocean Energy), to fuel cells, such as Teledyne's subsea super charger, battery storage systems, including EC-OG's Halo energy storage system, and a combination of both, such as one being created by Columbia Power Technologies (C-Power).

"We see a clear trend towards a greater degree of electrification as the CAPEX/OPEX benefits have been demonstrated and the industry seeks to lower emissions," says Christina Johansen, Senior Vice President, Product Management, TechnipFMC, which has been developing its own subsea power distribution system and sees digitalisation and industrialisation as key directions of travel for the subsea industry.

The future is fluid

There's a lot going on – the future is fluid, says Ling. Incumbents are being forced to compete with new entrants. University spinouts and new start-ups have or are entering the market, think Seebyte and Hydromea). There's also room for players from other industries (e.g. Kawasaki) to disrupt the market with innovative technology.

Honuworx is one of those. It's developing solutions for the launch, recovery and remote operation of underwater vehicles that removes the requirement for large support vessels and complex lifting equipment. Wilson says the industry and market dynamics have changed structurally in the last year, with tiebacks more likely than big new greenfield projects (such as those that might attract a field resident system), and companies will need to be more agile. If they are, there's a lot to go after in the wide subsea ocean economy, he says, from food and energy production to mineral mining. There's just little certainty how that's going to look.



TechnipFMC

Tech in the Spotlight

Equinor's vision of a future carbon dioxide transport for storage UUV.

Equinor/Thomas Wolter/Pixabay

Blue Ocean Seismic Services' (BOSS) autonomous seismic nodes.

BOSS

> Swarm robotics

Blue Ocean Seismic Services is developing autonomous underwater vehicles that will operate as a self-repositioning autonomous underwater node to carry out seismic surveys. It's effectively a fleet of AUVs that will be able to take themselves, en-mass to pre-programmed sites on the seabed, stay there while a source vessel sails over, then move to the next site – saving the time it currently takes to manually place nodes using ROVs or via the node on a rope method. They could also identify and monitor carbon storage sites, says BOSS.

> Subsea hydrogen

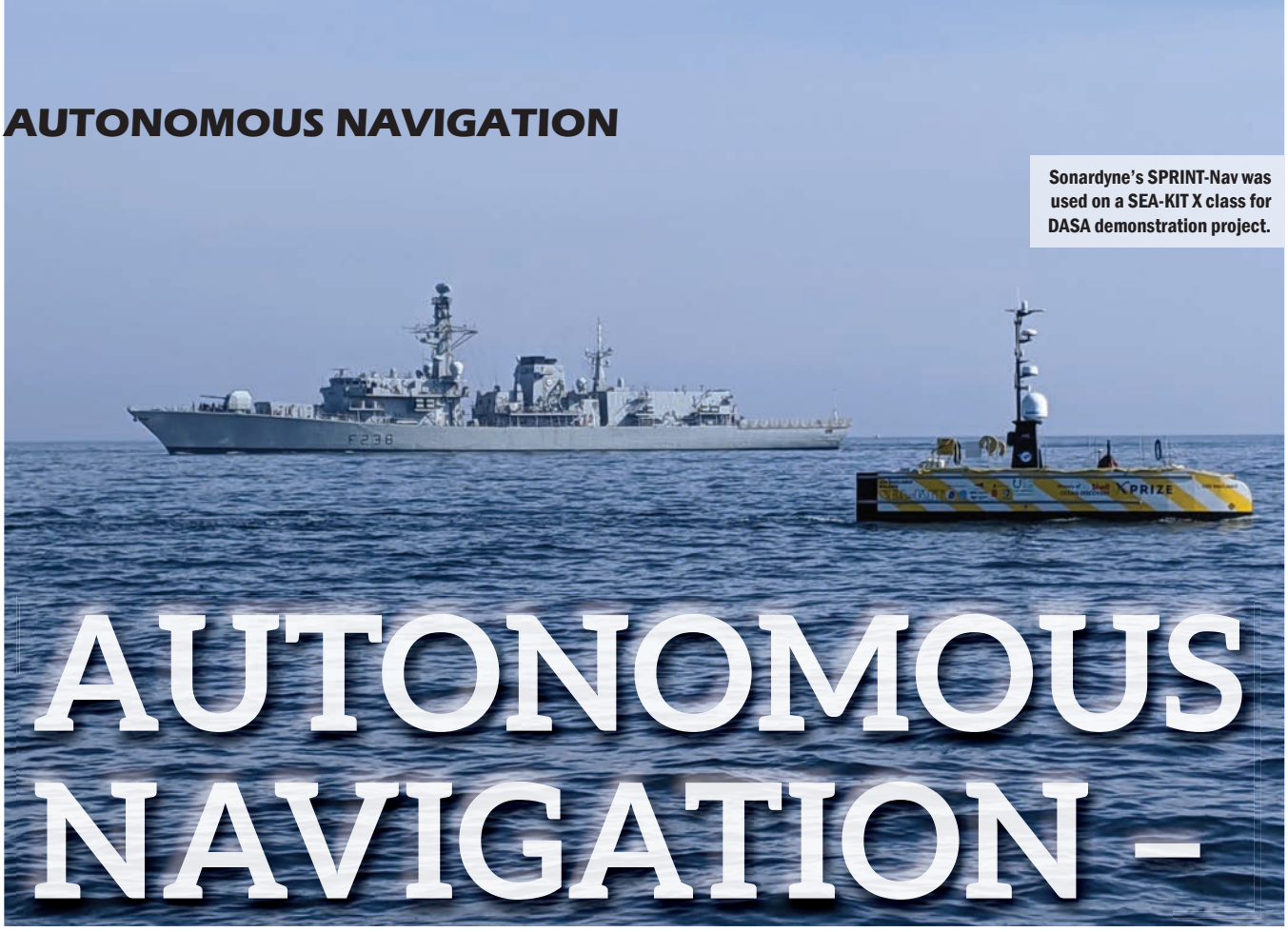
Hydrogen has shot up the energy agenda in the past 12 months and it's likely to be there for some time. TechnipFMC hasn't missed this and, as part of a consortium with Sintef, Energy Valley and the Ocean Hyway Cluster in Norway, it's developed Deep Purple, a wind-powered subsea hydrogen production and storage technology, complete with fuel cells to provide power when required. This could be used at offshore platforms, but also remote islands, for ship refuelling offshore and simply for hydrogen export.

> Underwater CO2 trucks

More of a mid-long-term vision is Equinor's vision to use a "large subsea drone" to transport CO2 to subsea injection sites, where it could also recharge, while offloading its cargo. The 135m-long "Subsea Shuttle" could also be used to transport gas and water, for reservoir injection, and offload oil, presumably meaning storage subsea can be skipped, instead pumping it direct into these huge vehicles, serviced by resident vehicles.

SAAB SEAEYE

SAAB TECHNOLOGIES SAAB



Sonardyne's SPRINT-Nav was used on a SEA-KIT X class for DASA demonstration project.

Sonardyne

AUTONOMOUS NAVIGATION – with or without GNSS

The era of autonomy is fast approaching, on and offshore, as are the suite of sensors available to support autonomous operations, including navigation in GNSS denied environments.

By Malik Chibah, Engineering Director, Sonardyne

Use of uncrewed surface vehicles (USVs) as operational tools in their own right is gaining increasing traction. From harbor patrol to offshore wind operations, USVs and autonomous shipping are seen as an opportunity to reduce cost, risk to humans and our carbon footprints.

But they don't come without challenges. Because they're unmanned and require control remotely, we are even more reliant on having accurate navigation systems onboard and currently that largely rests on Global Navigation Satellite Systems (GNSS).

As a primary navigation source, GNSS is well used, but there are conditions where purely relying on it could create some risks. This could be where line of sight to a GNSS constellation is lost while transiting under bridges or through busy harbours, or near significant structures, such as wind turbines, offshore platforms or port infrastructure. Some of these areas are where you most don't want to lose signal. Another risk that's less likely, but is still there, is jamming or spoofing where someone deliberately decides to disrupt GNSS signals.

These aren't new issues, not terrestrially at least. Self-driving or autonomous vehicles on our roads have been developing a mix of capabilities to ensure safe and accurate navigation for some time. They're using sensor suites which fuse a mix of camera, radar, onboard sensors and inertial navigation system (INS) technologies in order make sure that these vehicles

SPRINT-Nav was mounted to the underside of the SEA-KIT USV.

SEA-KIT

still know where they are. Use of an INS with multiple aiding inputs such as GNSS and Lidar allows the ability to better identify errors or outliers in the observation data; these observations can then be rejected providing more reliable and accurate navigation of the vehicle.

A similar approach is being taken for USVs in the offshore domain. Here, additional inertial and acoustic sensors are now being used to help underpin navigation, so that a vessel still knows where it is, with or without a GNSS signal. In certain cases, erroneous outlier GNSS positions can be identified and rejected. Some examples might include temporary loss of correction data or short term multipath or constellation obstruction from a nearby structure.

The approach for USVs is slightly different, but it's based on technologies we already have available to us today; i.e. hybrid guidance and navigation systems used for underwater vehicles. These technologies have been developed and used on systems such as remotely operated vehicles (ROVs) and autonomous/unmanned underwater vehicles (AUV/UUVs) that cannot use GNSS positioning for navigation, because the signals used do not travel well through water. This means that underwater systems require their own inertial and acoustic sensors to calculate their position.

A common approach is using a Doppler velocity log (DVLs), which measure a vehicle's speed in relation to the seabed it's travelling over. But a source of error in DVLs is that they do not compensate optimally for vehicle movement and often most, if not all, of their transducers need to receive a return from the seabed to compute a velocity. This means motion compensation is required, through the use of a separate orientation instrument. In addition, the DVL needs to be timed correctly with other instruments it will be working with and positioned correctly on the vehicle. Underwater vehicles also need to know their depth, so a pressure sensor also has to be integrated into this mix. It can get complicated, very quickly, and if each of these elements has even a small error, this will propagate and create system error that might no longer be suitable.

HYBRID NAVIGATION WITH SENSOR FUSION

A solution to this is a single instrument that combines, at very low level, the DVL and an inertial navigation system (INS). That's been achieved with SPRINT-Nav, which is what we call a hybrid acoustic-inertial navigation system, where an INS and acoustics (i.e. the DVL), and a highly accurate pressure sensor, are tightly integrated, physically and algorithmically, to create a single, high performance navigation solution.

SPRINT-Nav uses a SPRINT INS and Syrinx DVL. Because the single SPRINT-Nav instrument has an INS inside it, it optimally compensates for the motion of the DVL. It also needs fewer beams to navigate because individual beam observations are used by the INS and it then decides whether it's going to use or reject them, based on how accurate the beam data is. It can do all of that, because it already has an idea of its own motion and a mathematical model for what works and what doesn't, which a DVL on its own doesn't have.

The benefits of such a tightly coupled system are: individual

beam aiding, optimum motion compensation, perfect timing, not having to perform calibrations or work out offsets because it comes pre-calibrated in a single system and a generating higher performance than the sum of its individual parts.

The theory is good and the system is proven onboard ROV and AUV systems globally; from the most demanding survey ROV operations to long-range AUVs. But how easy is it to deploy on a USV?

DEFENSE DEMONSTRATOR

Actually very easy. Last year, through a UK Defense Science and Technology Laboratory (DSTL) and Defense and Security Accelerator (DASA) funded demonstration, we worked with USV manufacturer SEA-KIT to demonstrate SPRINT-Nav capability onboard a USV.

We installed the system on a gondola on the 12m-long SEA-KIT X class USV, and tested it against the local real-time kinematic (RTK) GNSS. It was sent on a number of different missions from our base in Plymouth to several miles offshore, covering different seabed types, sea states, altitudes and seabed gradients. We simulated a transit, survey lines and a transit back to a static mooring, similar to what might be expected on a survey operation, as shown in the top plot (Fig.1).

- 90km over 13 hours
- 0.5 and 70m water depth
- Over 2m swell and 20 degrees roll
- Shallow and deep gradient
- Narrow channels, strong tide/current
- Mud, rock, sand and shingle
- GNSS RTK reference comparison good to a few cm.

The bottom plot in Fig. 1 shows position difference between SPRINT-Nav, which had no external aiding, and the reference RTK GNSS. The overall error over a 35km run over a long time period was only 1.8m. That equates to 0.0051% of distance travelled, which is really unpreceded in terms of GNSS-denied navigation from a commercially available product. In reality, no USV mission would likely to be without a GNSS fix for this length of time, but it shows the accuracy that can be achieved in order to ride out and cross reference any GNSS issues.

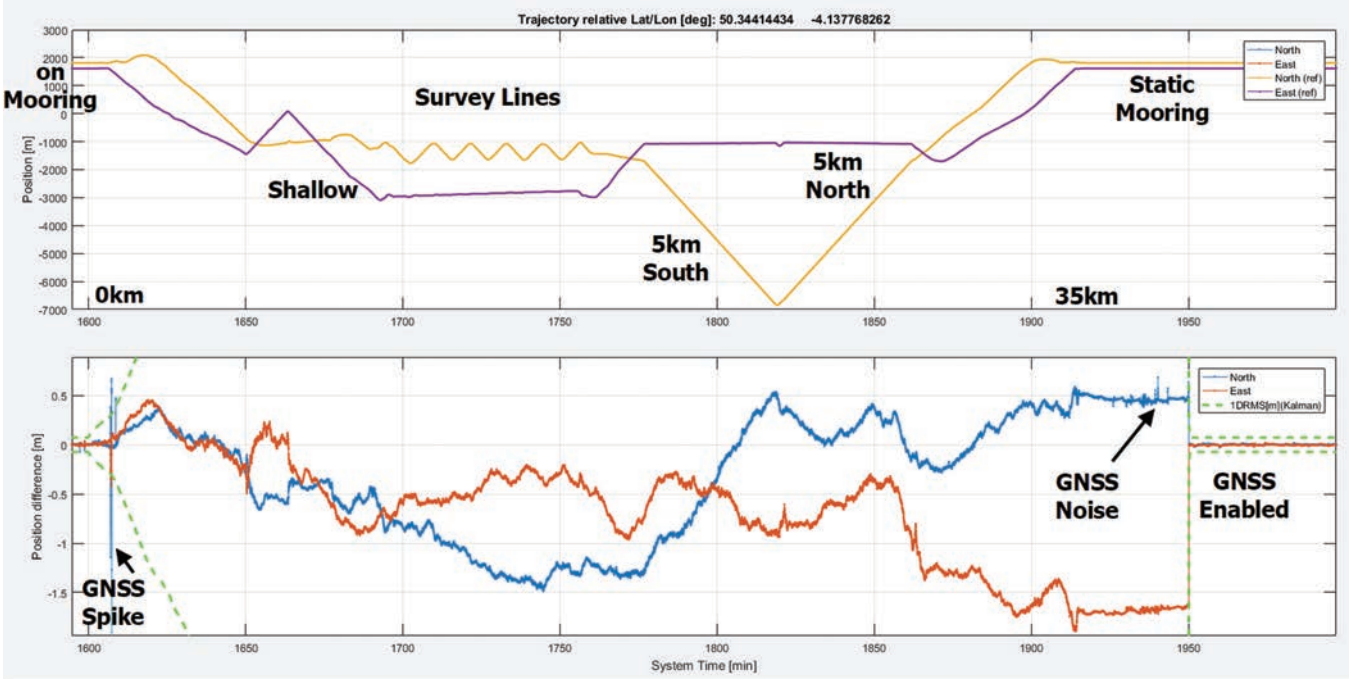
The demonstration also looked at static operations, i.e. station keeping. The vessel was station-keeping to within a 1m or so over a 16-hour period. At the end of the period, the error was within 1m, showing that the performance is also there for static applications.

In reality, a vessel may be trying to use this capability very close to seabed obstructions or a structure such as on offshore wind turbine. So we also demonstrated what happens if some of the DVL beams are obscured from reaching the seabed by the structure, the SPRINT-Nav was able to achieve high levels of accuracy even with multiple beams unavailable.

BUILDING IN ADCP CAPABILITY

Concurrent to developments towards supporting USV navigation, we've also built acoustic Doppler current profiler (ADCP) capability into SPRINT-Nav down to 80 m. This enables the collection of water column data at beam level, without disrupting the DVL's bottom tracking capability as the two modes can run in parallel. Again, because SPRINT-Nav has highly accurate knowledge of its motion and position it can automatically compensate the raw data to give a very accurate real-world

Fig. 1 SPRINT-Nav trails for USV navigation was pitched against local GNSS RTK.



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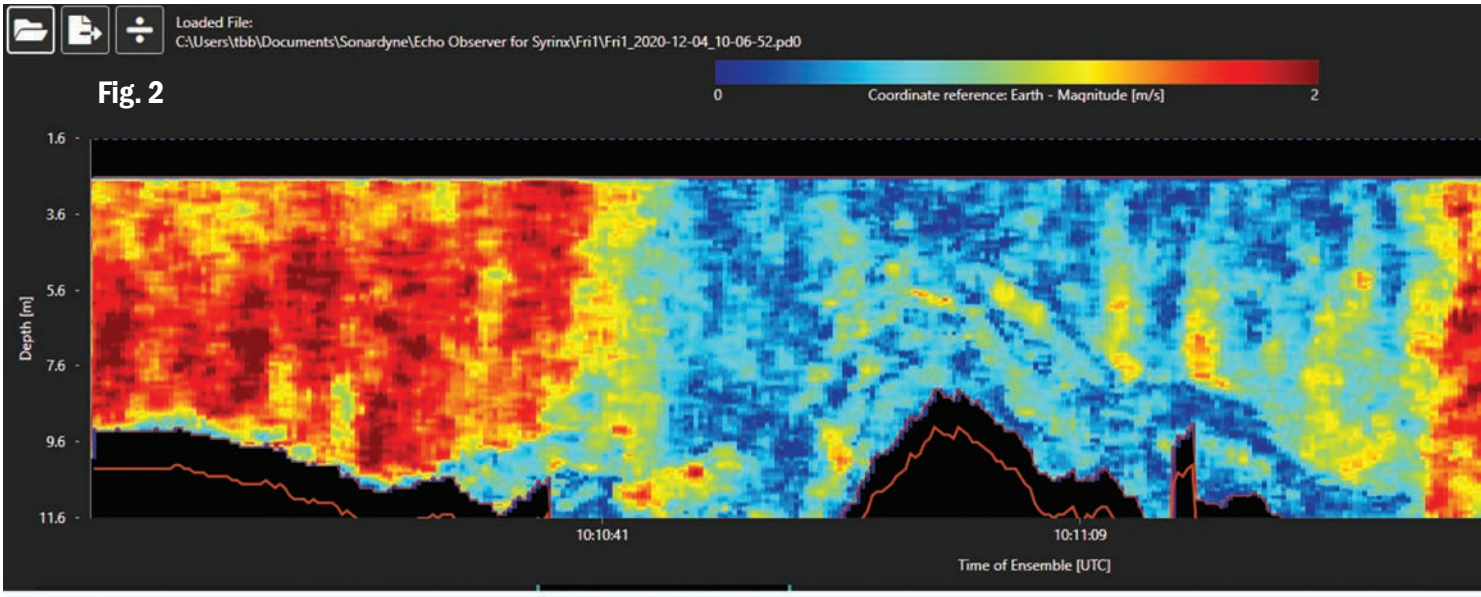
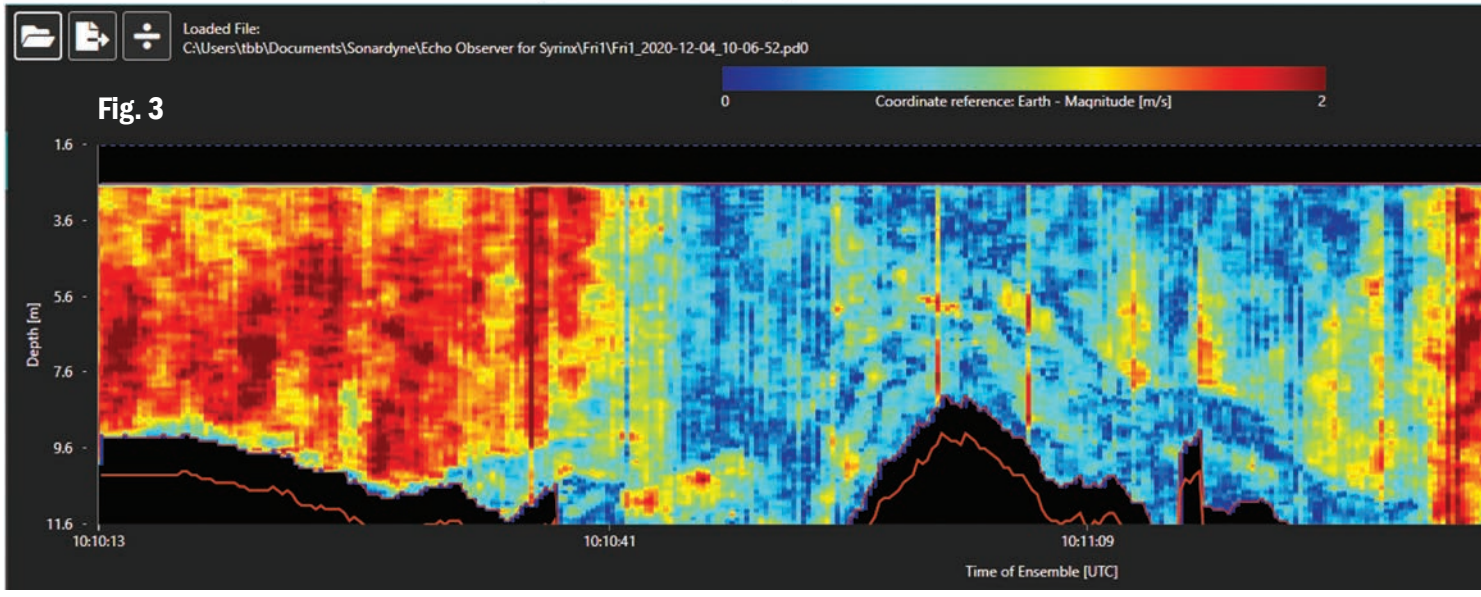
Ocean Infinity's Armada fleet first wave will come with SPRINT-Nav installed.

Ocean Infinity





Sonardyne

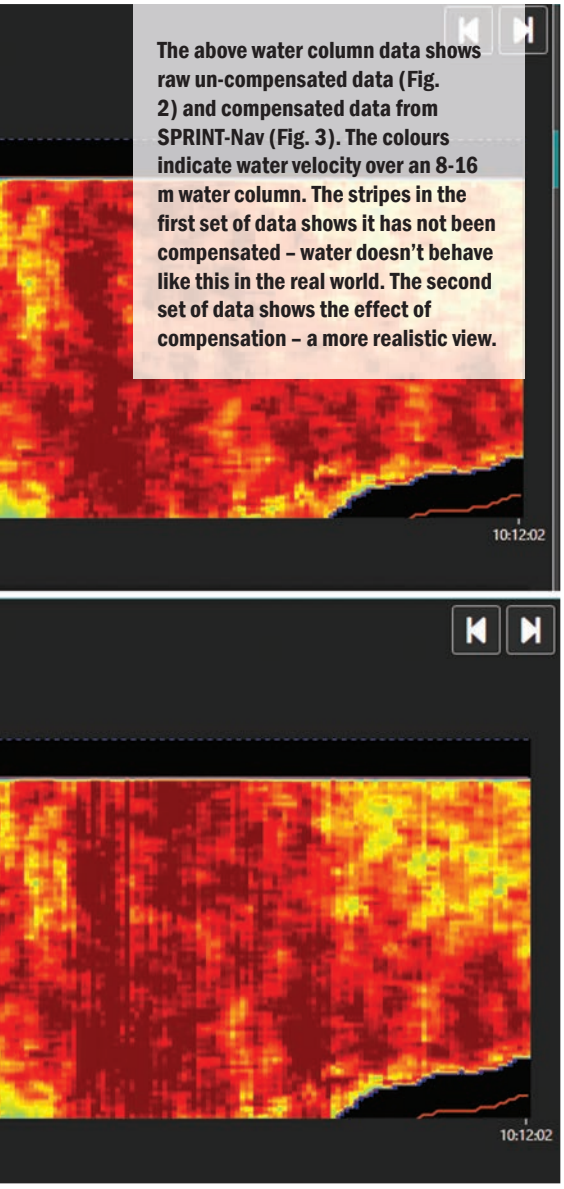
picture of the water column in terms of position and with vessel motion compensated for. This negates the need to integrate separate ADCP and motion sensor data and dramatically reduces the reliance of continuous and accurate GNSS data during dynamic water column data collection operations. In addition, if you are in deep water and don't have bottom lock, but you do have GNSS, the SPRINT inertial measurements can compensate for vessel motion in the ADCP data.

The combination of highly accurate navigation and the ability measure water current optimally without GNSS significantly reduces the risk of performing ROV and AUV deployments from USV host platforms.

A good example of this is the Armada fleet, being built by Ocean Infinity. The first wave of the fleet will host our Ranger 2 Ultra-Short BaseLine (USBL) positioning system and Marine Robotics pack, which will enable all-in-one tracking, communications and control capability for underwater payload robotics from the Armada vessels. In addition, the vessels will be fitted with SPRINT-Nav, to provide continuous, uninterrupted navigational aiding to underpin safe remote operations, even if GNSS service is impaired. The underwater vehicles deployed by these USVs will also have SPRINT-Nav systems and our Wideband Sub Mini 6+ tracking transponders that work using the same common hardware as Ranger 2.

CAPABILITY AT HIGHER ALTITUDES

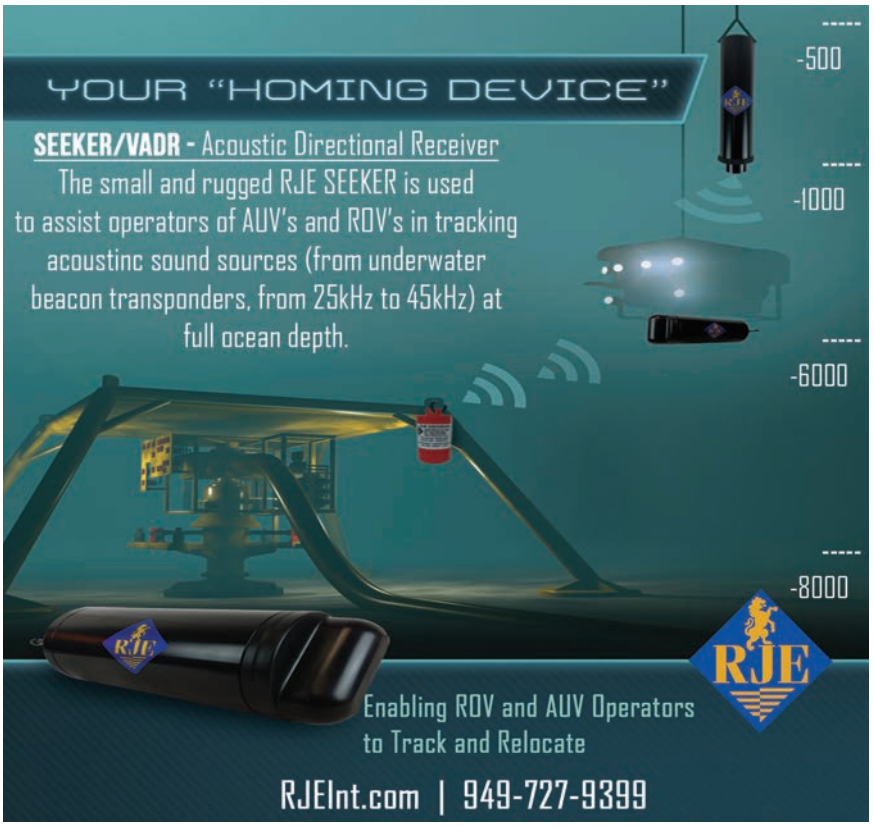
A further development we've initiated over the last year has been to create a higher altitude version of our Syrinx DVL. At launch SPRINT-Nav was only available with a 600 kHz Syrinx DVL. Now a 400kHz option is available which can achieve reliable bottom lock down to 220 m water depth (it's 175 m in the standard SPRINT-Nav) and ADCP functionality to 120 m.



The above water column data shows raw un-compensated data (Fig. 2) and compensated data from SPRINT-Nav (Fig. 3). The colours indicate water velocity over an 8-16 m water column. The stripes in the first set of data shows it has not been compensated – water doesn't behave like this in the real world. The second set of data shows the effect of compensation – a more realistic view.

Integrated into SPRINT-Nav, this extends the range to which USVs can go with this higher altitude bottom tracking capability.

In summary, USV operations are increasing. Integrating a USV with additional sensors that reduce their otherwise critical reliance on GNSS signals reduces operational risks, especially when operating close to infrastructure, holding station or while deploying or recovering another vehicle. Similarly, this data provides high accuracy for any mapping tasks the vehicle might undertake, to ensure that they are accurately compensating data or imagery, even if it's difficult to get an external position.



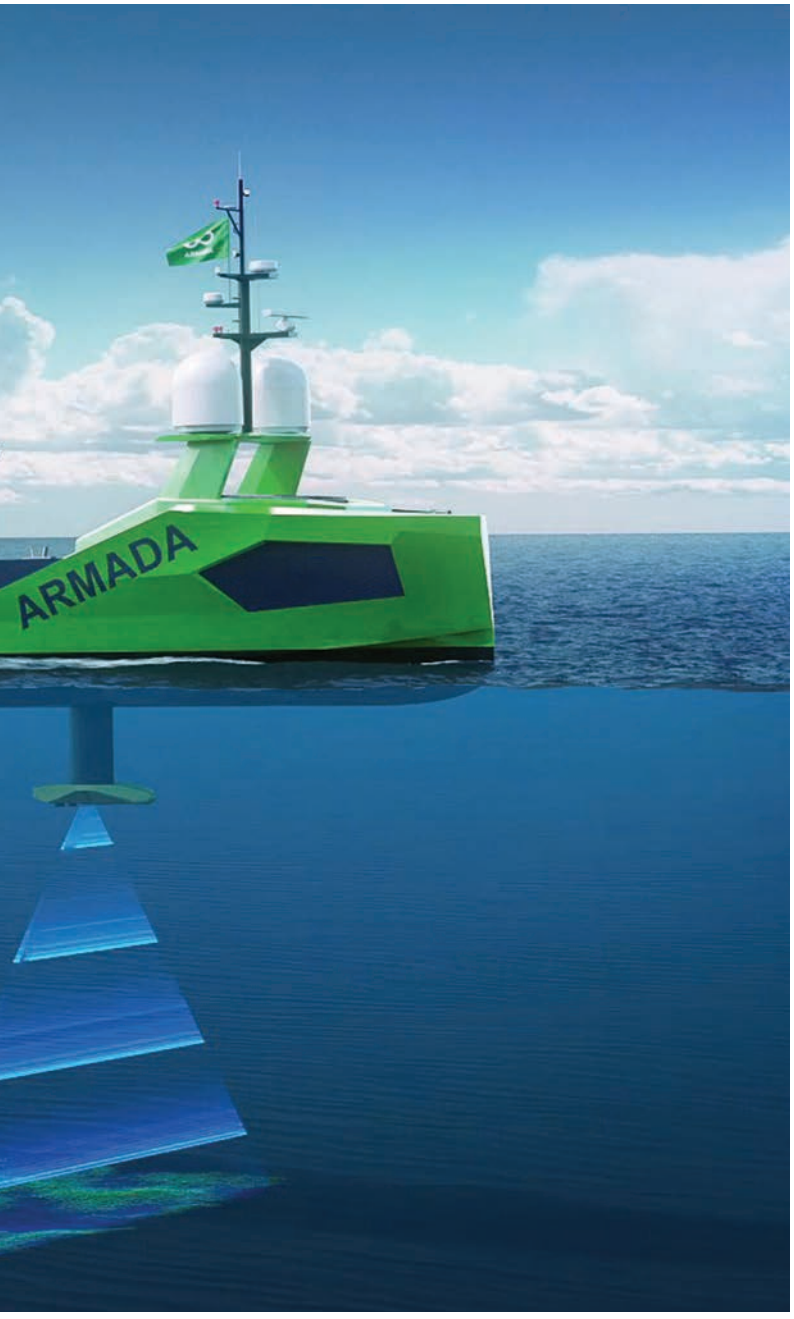
A GLOBAL ROBOT FLEET:

Inside Ocean Infinity's Armada Fleet

Back in 2017, Ocean Infinity made a novel move; deploying six autonomous underwater vehicles (AUVs), instead of just one, from a single vessel, vastly increasing the ground that could be covered in a single survey. Now the firm is taking the use of remote, robotic systems a significant step further.

By Elaine Maslin

All images courtesy of Ocean Infinity



As we enter 2021, US-UK based marine robotics firm Ocean Infinity is launching the start of what will become a fleet of completely uncrewed ocean going vessels, or USVs. They will host and deploy other robotic systems, including remotely operated vehicles (ROVs) and AUVs, as well as towed systems and full ocean depth survey equipment. The first two in what's being called the Armada fleet will be launched early next year ready for commercial operations in the North Sea in summer 2021 and an initial 17 are planned.

The company has brought some known experience onboard, including Dan Hook, who was behind the UK's ASV Ltd., an early developer of USVs now owned by L3Harris. What we realized, Hook says, is that small USV systems could only do so much so, while there was take up in the defense sector, for mine and submarine hunting, other sectors were slower to adopt such systems beyond inland, lake or coastal surveys.

"One of the limitations we observed in existing USVs was that you could only really deploy one type of sensor or go out for a week at a time," he says, which meant they could only do so much. "In building Armada, we really tried to address that. The biggest change is scale. A 21 m vessel can carry multiple sensors, the right type of ROVs and the right type of sensors and winches that customers need."

The initial vessels will come in at 21 m and 36 m long. All will come with a standard fit of permanently mounted survey equipment, mostly housed in a subsea gondola. This will include an inertial navigation system (with integrated acoustic Doppler current profiler/Doppler velocity log), single beam echo sounders, underway conductivity, temperature and depth (CTD), Ultra-Short BaseLine (USBL) positioning, and dual-head shallow-water multibeam echosounder and sub-bottom profiler.

Modular payloads will be added on top. Initially, that will be ROV focused, ranging from Saab Seaeye Leopards, recently ordered for the fleet, to Ocean Infinity's existing Schilling and Kystdesign hydraulic ROV systems designed for 3,500-4,000 m water depth. All of them will be deployed and recovered by an all-electric, automated vehicle-agnostic system being supplied by Kongsberg – so it'll be able to deploy different ROVs, as well as AUVs. The system will deploy vehicles via the vessel moon-pool, with release and capture of the ROV/AUV below the surface, away from the vessel hull to avoid potential vessel impacts and allow for higher sea-state launch and recovery.

Some vessels will be able to take two vehicles on board, to provide flexibility but also redundancy, says Michael King, business development manager at Ocean Infinity. "We're also going to be able to tow various hydrographic and geophysical sensors, towed side scan sonars, magnetometers," he says.

The firm has a wide range of potential work in its sight, from survey to UXO capability for the offshore wind market, 2D and 3D seismic, oceanographic and metocean data acquisition and geotechnical capability. It's already working on a full ocean depth deep water multibeam system for the larger vessels, targeted at the subsea cable market. The vessel's endurance will make long surveys easily feasible. At cruising speed it's expected the 21m vessel will be able to travel 3000 nm and the 36m vessel 5500nm. More vessels will come and inevitably they will be bigger again, as the firm eyes additional opportunities, such as logistics, in addition to the survey, ROV and AUV operations down to 6,000 m it will target first. They'll also be looking to add aerial drones in the future.

"We're looking at a wide spectrum of applications," says Hook, "everything from survey, collecting data, through inspection, logistics, defense and security and we've had a lot of enquiries in each, with a lot around data collection and inspec-

tion, especially from wind farm, offshore energy and cables – telecommunications and power."

It's also been revealed that the firm is working with Shell to be able to run multiclient seep hunting projects, using AUVs deployed from the USVs, which could then support work like carbon capture and storage site monitoring.

The hardware is one thing, but remotely operating uncrewed systems also relies on communications, to be able to control the systems, and data transfer – as much of their work and the management of it is about getting data. There are a few sides to that; managing it on the vessel, managing delivery of it and then managing it at a remote control center (ROC). The first has Ocean Infinity working with various data management providers and software companies to ensure data quality, with preprocessing offshore so not all raw data needs to be sent to shore. Cyber security comes into this and the company has employed experts, including an ex-US Air Force cyber expert, and has designed the vessels from the outset with cyber security in mind.

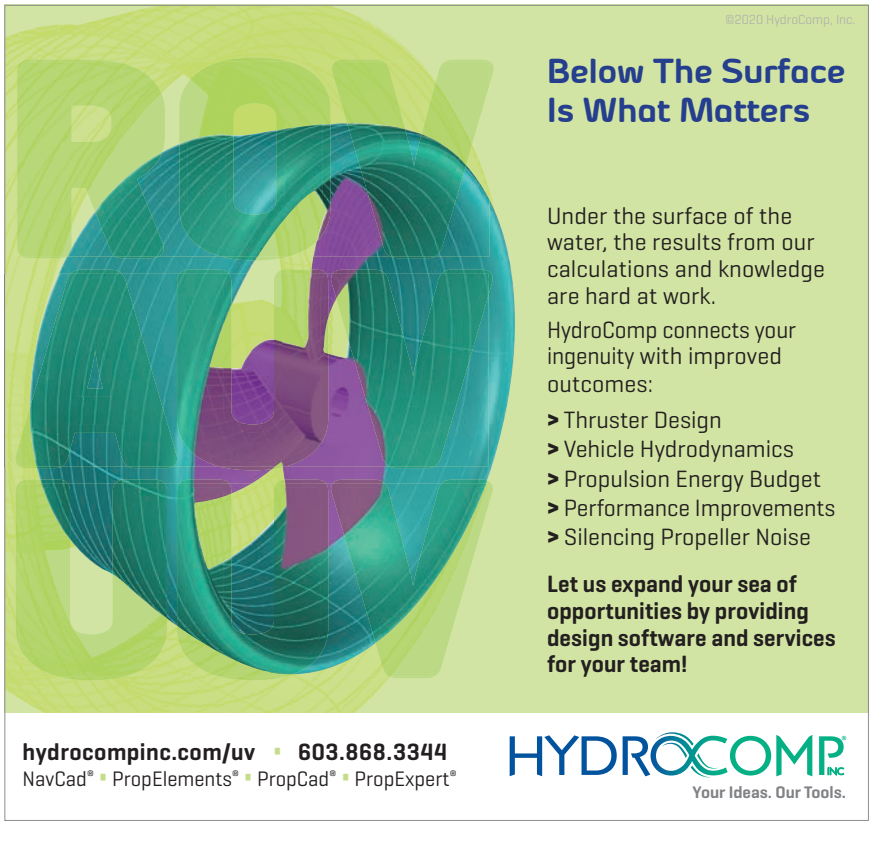
Then, to enable remote control, each vessel will have two large satellite domes, in addition to VSAT and 3-5G communications capability. "You can miniaturize everything you want in robotics these days; you can make tiny computers and tiny computers," says King, speaking at the joint Hydrographic Society, IMCA, SUT seminar. "But the one thing you can't miniaturize is a satellite dish and the truth is a larger satellite dish gives you more bandwidth. Because we have larger vessels than traditional USVs we can mount 2-3 large domes on each and that enables us to have larger bandwidth, in turn enabling us to have true command and control and data transfer in real time, bringing everything back to a ROC where a team of experts is sorting out the data management."

While autonomy is regularly talked about, today's vessels will not be autonomous, says King, each will have a mariner in control – "full human in the loop". But it's expected that autonomy will come. "In next few years we would expect our road map to take us to one mariner supervising two of these vessels or maybe even three," he says.

As these systems go out into the wild, a challenge could be physical security – what's to stop the vessels being attacked? This is new ground, says Hook. But, again, the vessels are being designed to prevent such an event. For a start, they've a mode to move and keep away from a threat automatically, then they're hard to board and the decks locked down, he says, and there's nothing to steal, or people to ransom, which has been a driver for past piracy events. Ocean Infinity is also looking at CCTV and an onboard PA system as well. But this will be a case of learning, as in any new business, and it's an area Hook says the company is keen to work with industry jointly on.

Another area that will develop is berthing. Unlike past USVs, these vessels will not be able to be put on a trailer and driven to a port for deployment. In some cases they'll be able to sail into a port or harbor themselves (under remote pilot control), where local suppliers could support refueling. In busier waters, a crewed pilot vessel would come out and escort the USV into port. The company will also have a field team, to go out and support berthing, says Hook.

Initially, operations will be in UK waters with work already lined up in wind farm, oil and gas and the subsea cable sectors in the first year, says Hook. These will be managed from a new operations center the company is building in Southampton. Ocean Infinity, which currently has offices in the UK and Austin, Texas, aims to open a third in Asia, and is also actively looking where else to deploy its fleet, from Australia to Taiwan and America.



The Covid pandemic has helped generate interest, says Hook. "When looking at risk planning for the future of their business, future pandemics is now on everyone's lists," he says. "The risk of moving crews around the world and on and off of ships means uncrewed operations have definitely come to the fore."

The initial British flagged DNV GL class fleet is being built at the Grovfjord Mek. Verksted (GMV) yard in Norway. But Hook says future vessels are likely to also be built elsewhere and the company is already in talks with yards in the US, where they would be Jones Act compliant. The vessels have a hybrid-electric propulsion system, with Volvo Penta DC gensets and Danfoss DC grid control system, with high battery capacity to enable more electric and even all-electric operations where possible. Hook says other cleaner fuel options could also be considered in the future, as options mature. Even with the hybrid system could save 90% emissions compared with a conventional 65m-long offshore vessel, at 644,182 kg CO2 versus 31,101 kg for an Armada vessel, based on trials assessing a typical 21-day offshore campaign, says King.

As the company is breaking new ground (or water) in this area, it's going in 'eyes wide open', says Hook, from the physical security to berthing and regulations. "We are working with as many different people as we can, the MCA, US Coast Guard and other international governance bodies towards safe operation of larger uncrewed vessels," adds King. "We're working with DNV GL as class society and we're particularly grateful for the support from IMO and MSC meetings." The company is also part of Maritime UK and IMCA working groups and other steering groups. But, "what we need to get across is regulations have to be fit for purpose, but they also have to serve the industry as well to allow for the advantages of systems to be utilized," says King.

Meanwhile, the company is staffing up. That means recruiting people, from master mariners to specialists in cyber awareness and remote engineering. It's offering new job opportunities says Hook. And it'll soon be a norm, he says. "Right now, it feels new and novel. But in 5-10 years this is going to feel very normal," he says.

Meet Armada

https://www.youtube.com/watch?v=l0ksWjlZ47o&feature=emb_logo

US-based seabed survey and ocean exploration company Ocean Infinity said it has launched a new marine technology and data company boasting the industry's largest fleet of unmanned surface vehicles (USV).

Armada, with a focus on combining technology and environmental sustainability, will initially add 15 bespoke designed marine robots to Ocean Infinity's current fleet of autonomous underwater vehicles (AUV).

Armada's fleet is currently under construction and is expected to be deployable by the end of 2020.

Each unmanned surface robot will serve a wide range of industries by being fully equipped to perform a multiplicity of offshore data acquisition and intervention operations down to a depth of 6,000 meters. These robot ships will be capable of remotely deploying a wide range of the latest sensors as well as AUVs and remotely operated underwater vehicles (ROV) for visual and acoustic data acquisition.

Armada's fleet requires neither people on board nor a host vessel nearby. Instead they will be controlled and operated by experienced mariners via satellite communications from state of the art onshore facilities in both Austin, Texas and Southampton, England.

The fleet approach produces up to 90% less CO2 than other conventional survey vessels, Ocean Infinity said.

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

Dan Hook, Managing Director for Armada, said, "We are very excited to be launching Armada, which perfectly complements the other service offerings in the Ocean Infinity Group. The pioneering technology makes our operations world-leading in terms of environmental sustainability and safety, while still achieving the very highest levels of data quality and value for our clients. With no requirement for a host vessel, we are breaking new ground in the area of subsea technology and data."

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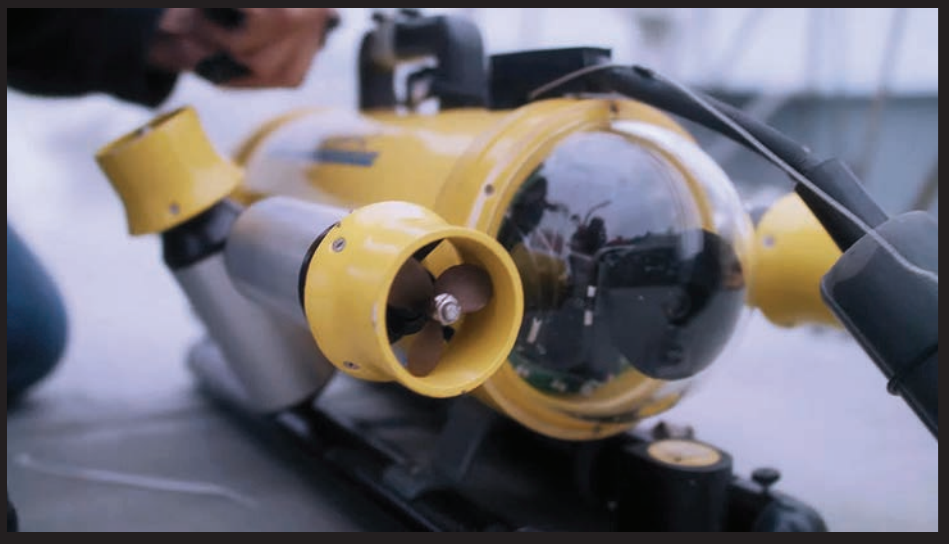

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RV Roger Revelle Gets

All images ©Scripps Institution of Oceanography

a $60m Mid-Life Refit

MTR dives inside the $60 million refit of RV Roger Revelle, a project which leverages a treasure trove of 'lessons learned' from recent refits in the academic research vessel fleet.

By Greg Trauthwein

Research Vessel (R/V) Roger Revelle

is back at work after a midlife refit involving upgrades from top to bottom, bow to stern. The ship is owned by the Office of Naval Research and has been operated by Scripps Institution of Oceanography at the University of California San Diego since 1996. It is one of the largest ships in the U.S. Academic Research Fleet, an important asset to U.S. oceanographic research due to its range, payload, duration, and ability to safely conduct scientific operations in remote areas around the globe.

"Roger Revelle isn't just revitalized, it is better than new," said Bruce Appelgate, associate director and head of ship operations at Scripps Oceanography. "The midlife refit was an opportunity to apply everything we've learned about the ship since 1996, in order to make a great research vessel even more effective."

The $60 million refit was supported by the Office of Naval Research (ONR), National Science Foundation (NSF), and UC San Diego, and highlights included:

- ***Repower:*** *The repowering involved replacing the six existing air-cooled generators and split electrical bus configuration (auxiliary and propulsion separate) with four new water-cooled generators and an integrated bus (auxiliary and propulsion together). This included replacing major switchboards and transformers, as well as the propulsion motors and drives.*
- ***BWMS:*** *An Optimarin ballast water management system to help stop the spread of invasive species.*
- ***Bowthuster:*** *The installation of a new retractable ZF bow thruster to improve performance, vibration and noise.*
- ***Cranes:*** *An overhaul and replacement of overboard handling systems, with new cranes, a refurbished A-frame and hydrographic boom.*
- ***Scientific Gear:*** *The addition of a scientific instrumentation gondola.*

Lessons Learned

Ship design, construction and operation technology has changed mightily since RV Roger Revelle was delivered nearly a quarter of a century ago, and the team tasked to design, outfit and update the ship sought to use 'lessons learned,' both from the operation of the ship itself as well as experience from recent refits of other research vessels in the U.S. Academic Research fleet. A big factor in many of the refit decisions, in fact, were the shared experiences from the refit of the Thomas G. Thompson, operated by the University of Washington. "One of the great advantages that we've got at Scripps is being part of the community of ship operators in academic research fleet," said Appelgate. "They shared everything with us, (including) their lessons learned."

One specific area was taking the decision to replace a noisy, inefficient bow thruster with a new retractable unit from ZF, a change which drops the bow thruster – and the related noise and vibration related to its operation – several feet beneath the hull, making living conditions on the ship more palatable and enhancing the collection of scientific data.

While Paul Mauricio, Port Engineer, and his team did extensive work to improve the efficiency and noise signature of the original bow thruster, including pulling, machining and fine-tuning the impeller on the water pumper, "It would max out at about 270 rpm, it would start to cavitate and it would shake the entire boat." As Appelgate and his scientific colleagues will attest, external noise and vibration at sea is not a friend of good science, particularly as research ships like the RV Roger Revelle use the bow thruster for many hours and days at a stretch to stay on station while equipment is in the water.

With the new retractable bow thruster from ZF, "once it's deployed, the noise is below the ship, not transmitted through the hull" said Mauricio. While the performance of the unit was critical, so too was being able to efficiently fit it into the ship, minimizing the level of modification work needed to get the new unit installed. "One of the driving factors to (which unit we picked) was the fact that it would fit in a retrofit without drastically modifying the entire bow," said Mauricio.

While noise and vibration is bad for science, it's equally bad for quality of life on any ship. "On Roger Revelle, up in the bow is where a bunch of our berthing quarters are located," said Appelgate. "Typically that's where the graduate students get put, so I was stuck up there (a few times). The reason you get 'stuck up there' is because it was noisy as heck because you were next to that (old) bow thruster. Even without cavitation, it was super loud. By installing the extendable bow thruster, it moves the source of noise farther away."

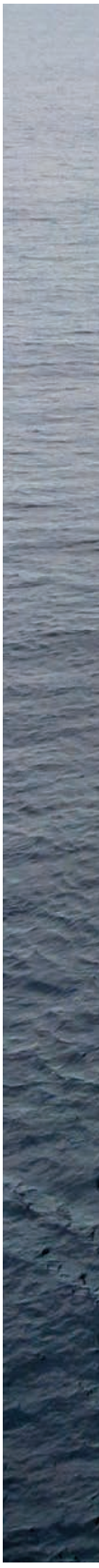
Better Science Minus the Bubbles

"I'm a geologist," said Appelgate. "Back when I was doing research, my interest was in sea floor mapping," and I sailed on the Roger Revelle as a scientist before I worked at Scripps. According to Appelgate, the configuration the ship's mapping sonars when built in 1996 was "the worst place you could possibly pick on the ship for your mapping sonars."

"Ships like Roger Revelle are very broad and not super long; so it pitches a lot," said Appelgate. "As it goes through the water pitching, it makes lots of bubbles and the bubbles sweep down along the hull. Bubble masking is something that we understand very well now, but not so much back in 1996. The place where all the transducers were (originally placed) were right in the place where bubbles would wash down and, basically, wipe out your sonar signals."

"In the period since then, there's been a lot of work done on how to mitigate that on a vessel without rebuilding the ship."

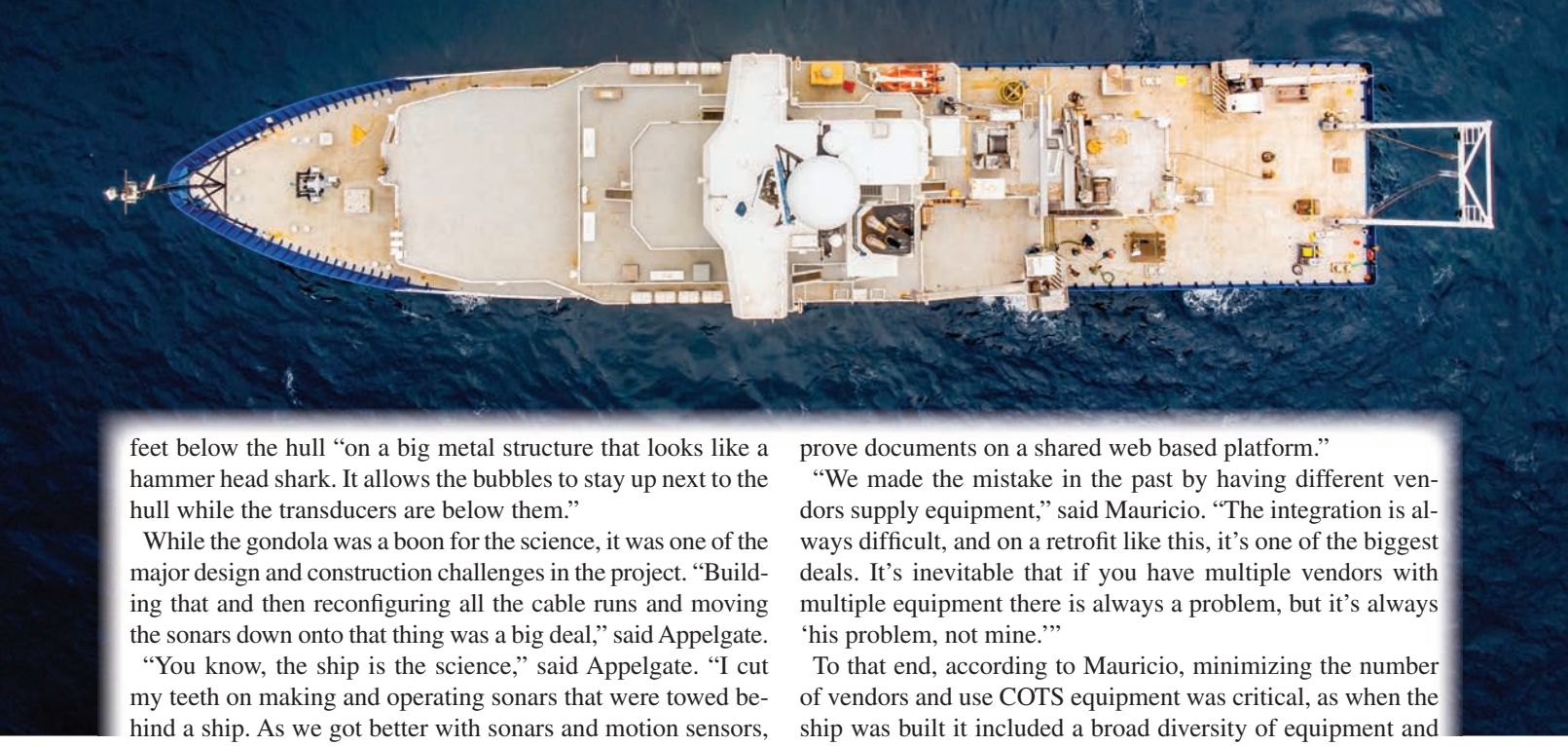
The answer was a gondola that puts the transducers a few



RV Roger Revelle Refit By the Numbers:

- Total Value: $60 million
- Shipyard contract value: $43.8 M
- Workers: 1,000 – including subcontractors and vendors.
- Duration: 14 months (April 15, 2019 – July 3, 2020).
- Cable installed: more than 21.75 miles of cable installed.
- Pipe: More than 3 miles of pipe installed.

All images ©Scripps Institution of Oceanography



feet below the hull "on a big metal structure that looks like a hammer head shark. It allows the bubbles to stay up next to the hull while the transducers are below them."

While the gondola was a boon for the science, it was one of the major design and construction challenges in the project. "Building that and then reconfiguring all the cable runs and moving the sonars down onto that thing was a big deal," said Appelgate.

"You know, the ship is the science," said Appelgate. "I cut my teeth on making and operating sonars that were towed behind a ship. As we got better with sonars and motion sensors, those evolved into multi beams. Then we put them onto the ship. Now, all of a sudden, the ship is your sensor. I think it's a valuable exercise to look at a ship holistically in that there's an instrument on the ship, let's say a multibeam, that's only as good as everything that it's attached to. Just like vibration, if you're transmitting a bunch of mechanical sound into your sonars, you're going to get junk. The ship is the instrument."

Cleaner Power

The original ship contract value was for $35 million to take care of specific ship systems – propulsion, controls, HVAC, piping, ballast water management – and steelwork to extend the life of the ship another 15 years or more, said Appelgate.

But "we knew that other issues on the ship needed to be addressed, or the primary users of the vessel just wouldn't be satisfied." That's where the upgrades to science systems came in, adding another $25 million to the project.

"The repower itself was intense," said Mauricio. "We gutted the entire engine room and we pulled about six miles of cable, and we replaced about six miles of cable. There was not a square foot of that ship that wasn't disturbed."

"We ended up going with Caterpillars for our main engines, two 3516's and two C32's, running them at 1800 rpm," said Mauricio. "We put 2100 KW generators on the 3516's and 940 KW generators on the C32's." He said while the addition of the scientific gondola increased fuel consumption by about 4%, the efficiency of the new machinery made it break even.

"The biggest challenge with this project is the integration of all new and existing systems," said Benton Strong, Vigor. "Nearly every major system was either replaced entirely or upgraded significantly, merging elements of new construction and ship repair into one cohesive project."

To streamline the flow of information among multiple parties, Vigor commissioned a custom document control system that allowed key partners to upload, review, comment and approve documents on a shared web based platform."

"We made the mistake in the past by having different vendors supply equipment," said Mauricio. "The integration is always difficult, and on a retrofit like this, it's one of the biggest deals. It's inevitable that if you have multiple vendors with multiple equipment there is always a problem, but it's always 'his problem, not mine.'"

To that end, according to Mauricio, minimizing the number of vendors and use COTS equipment was critical, as when the ship was built it included a broad diversity of equipment and manufacturers, which ultimately made the ship more difficult (and costly) to service.

"Our goal here was to simplify everything in common off-the-shelf equipment," and it was able to use experience building the RV Sally Ride five years ago to help in the process. "A lot of our choices were driven by that familiarity with vendors, our crew's familiarity with equipment," said Mauricio.

"We felt that if the crew is more interchangeable and you're familiar with equipment, we can keep our boats in better condition."

A point of focus too, for all machinery was to mitigate noise and vibration. "We have learned a lot about power management and efficiency," said Mauricio. "We incorporated all of that when we did the designs for the new propulsion systems. (Critical was keeping the vessel quiet as) Bruce's sonars, their data, relies on the vessel being extremely quiet as far as noise transmitted through the hulls."

To that end much time and effort was expended in the engineering phase to evaluate noise sources and devise means to mitigate. "Nothing makes direct contact with the hull; to make it acoustically quiet, so we don't interfere with the data sonars," said Mauricio.

In addition, Vigor partnered with Bruce S. Rosenblatt & Associates (BSR) to provide detailed engineering support of structural, mechanical and electrical systems. BSR used 3D modeling to develop detailed production level drawings suitable for material procurement and shop prefabrication. The 3D modeling process also helped identify design issues such as equipment and piping system clashes early in the design phase.

Autonomy versus Crewed Ships

While there is a decided move towards increased use of autonomous systems in the ocean study space, Appelgate contends that there are still many jobs – particularly those that

are far from shore and power intensive – that still demand a combination of crewed ships and autonomous systems.

"The utility of unmanned systems is that you can achieve a persistence at sea that's not possible with presence," said Bruce Appelgate.

"Unmanned systems that we're deploying extend the ability of us to do our sensing at sea. It makes ships more useful."

"Maybe in 50 years it will be different, but things like going to the southern ocean and doing CTE profiles, and the kind of hydrography that the big ships do routinely, you just can't do it (with fully autonomous systems alone); you need too much power. Autonomy extends the utility of the service vessels. It makes us more efficient and gives us persistence.

The Network

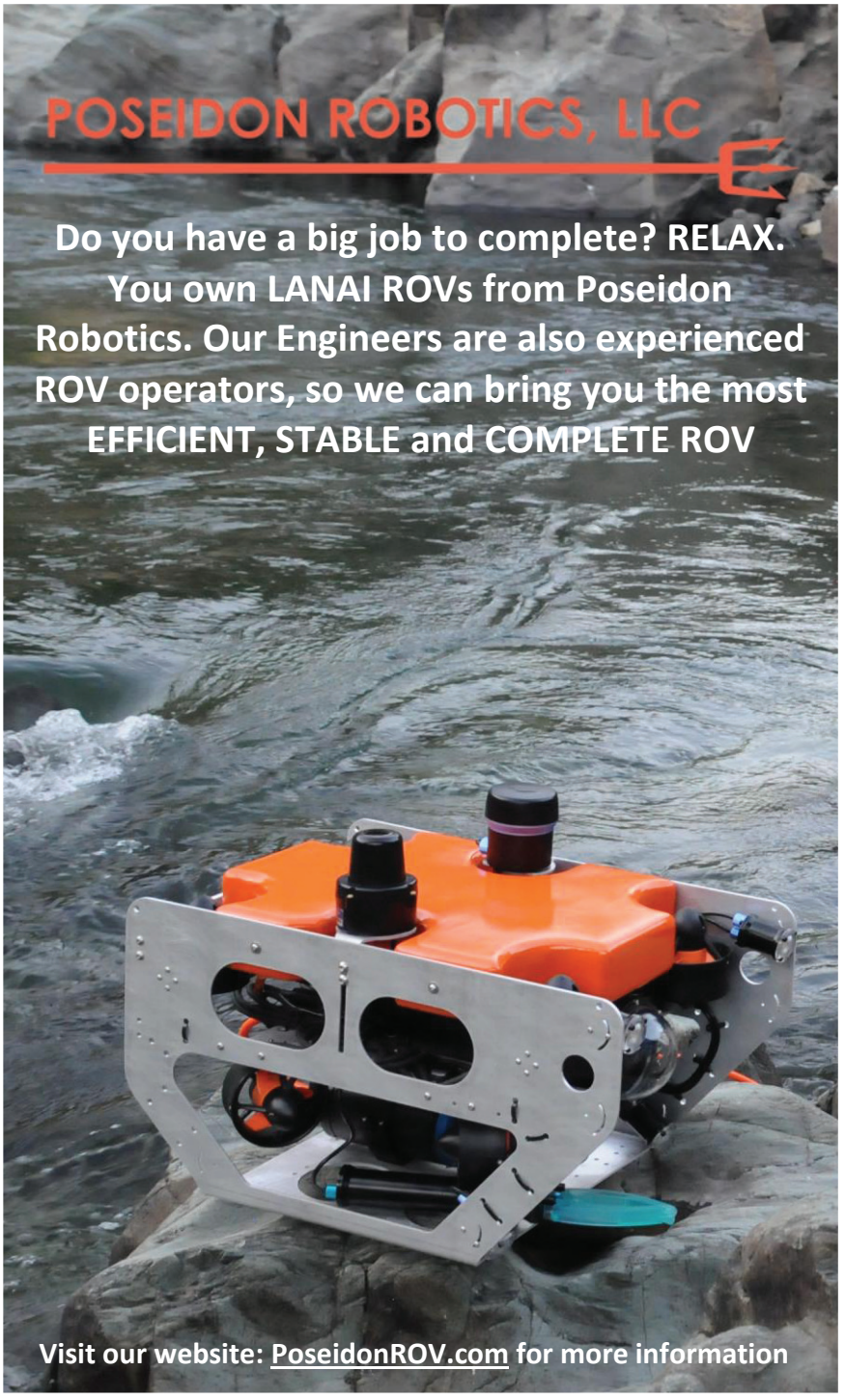
Upgraded network capabilities support the significant amount of data collected from these instruments. A new virtual desktop infrastructure (VDI) includes display consoles for all systems throughout the ship, reducing the workload for scientists and crew members alike who use these during their operations. New cyberinfrastructure and centralized computer management helps the ship's technicians maintain security and reliability of onboard computing and networking.

"Something that has totally been fast tracked in the last nine months is our ability to use SATCOMs; we have realized the potential of SATCOMs in the academic research fleet in a way that we knew was possible, but there really hadn't been the pressure to do it. In the midlife refit of Roger Revelle, Appelgate said "we completely rethought how we were going to do our cyber infrastructure on the ship."

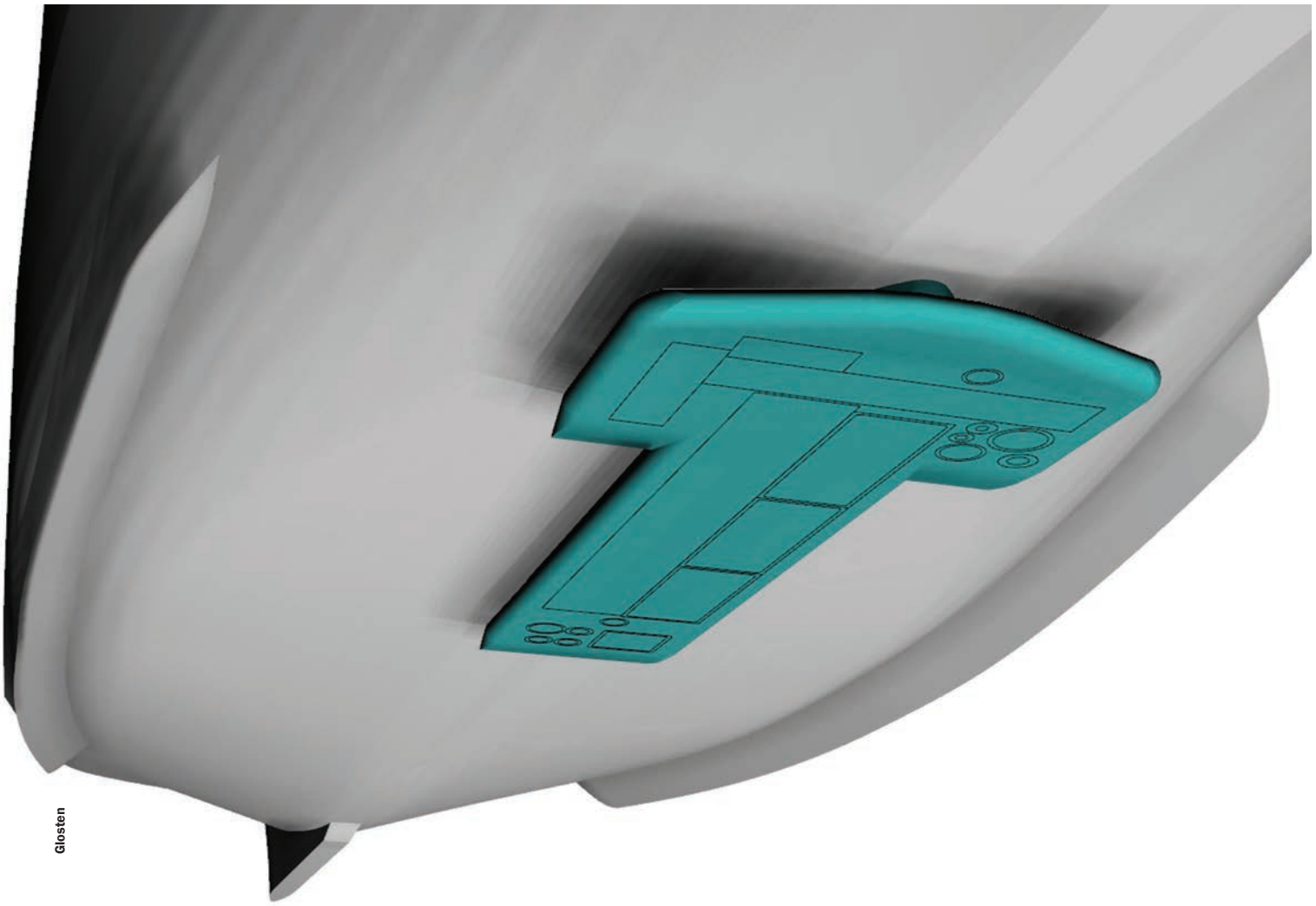
"What we did with Roger Revelle is we reimagined and reengineered how that infrastructure could be configured in order that we could make the most advantage of existing SATCOMs, and anticipating things like these low earth orbit systems that would be coming out soon that will allow even higher bandwidth at lower cost in a broader geographic area."

"We did a demonstration with Roger Revelle on sea trials, a test shot with a SATCOMs provider (where we) bumped up the internet connection on the ship to be equivalent to about what I experience at home.

All of the sudden we went from a situation where you could barely get an email out to streaming video and real-time sending undecimated data sets, big data sets back to shore to be analyzed in near real time and returned to the ship. We've demonstrated that it can work, and it really is going to be a game changer for how U.S. scientific community does work at sea in the short term."



The Gondola for the science transducers



Glosten

Instrument	Manufacturer	Model	Details	New or Moved
Multibeam	Kongsberg	EM124	Tx - 1 deg	New
Multibeam	Kongsberg	EM124	Rx - 2 deg	New
Multibeam	Kongsberg	EM712	Tx - 0.5 deg	New
Multibeam	Kongsberg	EM712	Rx - 1 deg	New
Depth sounder	Massa	TR-1073A	12 kHz	Moved
	Massa	TR-1073A	12 kHz	Moved
Scientific wide band echo sounder	SIMRAD	EK80	18 kHz	New
Scientific wide band echo sounder	SIMRAD	EK80	38 kHz	New
Scientific wide band echo sounder	SIMRAD	EK80	70 kHz	New
Scientific wide band echo sounder	SIMRAD	EK80	120 kHz	New
Scientific wide band echo sounder	SIMRAD	EK80	200kHz	New
ADCP	RDInstruments		75 kHz	Moved
ADCP	RDInstruments		150 kHz	Moved
Sub-Bottom	Massa	16 x TR-1075A	4 kHz	Moved
Ref Hydrophone				Moved
Ref Hydrophone				Moved
HDSS			50 kHz	Moved
HDSS			140 kHz	Moved

The HDSS is a system developed at Scripps – Hydrographic Doppler Sonar System. This had been located in wells aft of the transducers array, and was re-configured to fit in the gondola and the wells covered over.

The original multibeam and other acoustic sensors was a flush installation to minimize draft. Flush installations are more prone to bubbles sweeping down and over the transducers, reducing the effectiveness of the instruments. Various options were evaluated with CFD to help improve performance, with the selection to develop a gondola to move the transducers below the baseline and allow bubbles to pass between the hull and the gondola and not over the face of the transducers. The gondola is 38 ft. long, 16 ft. wide at the widest. Glosten developed a detailed structural design and nested plates for the construction of the gondola. It also developed the installation of the internal transceivers and conduit routing from the gondola to the transceivers.

Roger Revelle:
The Man, The Ship, The Mission

R/V Roger Revelle was put into service in 1996. It honors former Scripps Oceanography Director Roger Revelle who is widely regarded for not only establishing the institution as an internationally prominent science center, but for solidifying the decades-long relationship between Scripps Oceanography and the U.S. Navy. "Roger Revelle was a visionary who – back in 1946 – envisioned the Office of Naval Research as a world leader in sponsoring oceanographic basic research, and later foresaw the need for a new University of California in La Jolla that eventually grew around Scripps," said Tom Drake, director of the Ocean Battlespace and Expeditionary Access department at the Office of Naval Research. "He also suggested the likely trajectory of the Earth's climate, which we are now observing."

Revelle served as an oceanographer for the U.S. Navy during World War II and was instrumental in the founding of the Office of Naval Research. Revelle worked at Scripps Oceanography before and after the war and served as its director from 1950 to 1964. He was among the first to consider the implications of the accumulation of carbon dioxide in the atmosphere and absorption rates of the greenhouse gas by the ocean.

The first research expedition on the all-new R/V Roger Revelle got underway in early November, a mission led by UC Santa Barbara to retrieve ocean bottom seismometers measuring seismic activity and to collect rocks from seamounts and underwater volcanoes. "The ship went down to about the Cook Islands where we recovered ocean bottom seismometers," said Bruce Appelgate. "We retrieved 30 out of 30 of these ocean bottom seismometers, which is terrific as these things are worth half a million dollars each; the data on them are priceless. They had been up for a year and they were running out of batteries, so we had to go get them. It was a high priority cruise."

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Navy Deepens Commitment to Underwater Vehicles

The U.S. Navy uses unmanned and robotic underwater vehicles for a multitude of functions, including environmental sensing, mine hunting, and salvage. The Navy plans to evolve an unmanned systems operating concept that is platform agnostic and capable of operating in highly complex contested environments with minimal operator interaction.

By Edward Lundquist

Sailors assigned to Coastal Riverine Squadron 3 and the expeditionary mine countermeasure company of Explosive Ordnance Disposal Mobile Unit 5 retrieve a MK 18 Mod 2 unmanned underwater vehicle (UUV) during a transit through the Northern Mariana Islands in this August 2020 photo.

U.S. Navy / Mass Communication Specialist 2nd Class Cole C. Pielop

A surrogate Large Displacement Unmanned Undersea Vehicle (LDUUV) is submerged in the water in preparation for a test to demonstrate the capability of the Navy's Common Control System (CCS) at the Naval Undersea Warfare Center Keyport in Puget Sound, Wash. in December 2015.

US Navy

The most recent edition of the Navy's Unmanned Systems (UxS) Roadmap was issued in 2018, and a new version is expected in the near future. The 2018 document states that UxS will operate in every domain; always be an option; and be at their best when teamed with Sailors and Marines.

"UxS will strengthen naval power at, on, and from the sea by reducing operational risk and cost. UxS operating in the air, on the surface, under the sea, and on shore as a rapidly adaptable and interconnected network will provide access to areas denied to manned platforms, provide better situational awareness, increase capabilities with greater range and persistence, and enable faster decision making," the roadmap stated.

The document allowed as how there continue to be barriers, including policy, doctrine, force structure, acquisition, and technology development. Perhaps most of all, the Navy and Marine Corps must continue to work to build operator trust and confidence in unmanned systems in all domains.

The tri-service maritime strategy, Advantage at sea, issued jointly by the Navy, Marine Corps and Coast Guard and released in December 2020, calls for greater numbers of distributable capabilities over fewer exquisite platforms.

"We will design our future naval force to support distributed operating concepts that rely on lower signature, highly maneuverable forces. Naval forces will mix larger platforms with standoff capabilities and smaller, more-affordable platforms—including optionally manned or unmanned assets—that increase our offensive lethality and speed of maneuver," the document said. That includes unmanned systems.

According to the maritime strategy, as more Sailors and Marines use UxS, the importance of "the ability for them to act together coherently, effectively, and efficiently to achieve tactical, operational, and strategic objectives."

Size matters

The Navy classifies its UUVs in four size categories: extra-large, large, medium, and small. All but the largest are deployed from a host platform. The smaller categories can be delivered to the operating area and placed in the water by hand or from a boat, ship, helicopter or submarine to support a team afloat or ashore with environmental information or possible target location. Missions are measured in hours. The XLUUV category is usually deployed for a pier from where it can then transit to the operating area, and may augment some of the capabilities now performed by a manned platform. Missions are measured in weeks or months.

"Only XLUUV is explicitly intended for pier deployment only. LDUUV is the largest UUV planned for host submarine integration from large ocean interfaces. While LDUUV could be pier deployed, that is not the default concept of operations," said Capt. Pete Small, PMS 406 (Unmanned Maritime Systems), with PEO Unmanned and Small Combatants. "The Navy is cautious to not imply that unmanned vehicles will

replace manned submarines. They may take on missions done by manned platforms today, but are intended to augment, not replace, manned platforms."

Small

The Navy uses small UUVs, which are man-portable or launched from a ship, helicopter or submarine, for battlespace awareness and underwater reconnaissance, such as the HII Hydroid Mk18 Mod 1 Swordfish or the L3 Harris Iver.

The Navy is currently partnered with the Defense Innovation Unit (DIU) for the Next Generation Small-Class UUV (SUUV) program to replace the MK18 Mod 1. In 2019, DIU awarded prototype Other Transaction Agreements (OTAs) to both L3Harris for its Iver4 and HII Hydroid for its REMUS 300 to modify these commercial systems to meet the Navy's SUUV requirements.

Medium

Medium Unmanned Underwater Vehicles (MUUVs) are capable of persistent, autonomous, ocean sensing and data collection to support the Intelligence Preparation of the Operational Environment (IPOE) mission. They can be launched from a surface ship or submarine.

U.S. Naval Research Laboratory

Scientists from the U.S. Naval Research Laboratory's Ocean Sciences Division are optimizing the placement of ocean gliders and the usage of glider data to improve the Navy's ability to predict ocean conditions. The Navy maintains a large fleet of ocean gliders for environmental measurement. Ocean gliders are slow-moving, long-endurance, underwater vehicles that gather data as they travel through the ocean's interior using high-efficiency buoyancy engines.

In the medium category, the HII Hydroid MK 18 Mod 2 Kingfish is currently used by Naval Expeditionary Combat Command (NECC) forces for mine detection, localization, classification and identification, as well as environmental sensing. It is generally launched from a rigid-hull inflatable boat (RHIB) by a team of Navy expeditionary Sailors using a small handling system. The vehicle is recovered after a mission and the data is downloaded and sent ashore for analysis.

Huntington Ingalls Hydroid is building the Razorback AN/WSQ-43(V) 2 Littoral Battlespace Sensing Autonomous Undersea Vehicle (LBS-AUV), which is launched from submarines to gather environmental information.

The Navy released an RFP in April 2020 for a new MUUV system to provide surface-launched mine hunting capabilities or torpedo tube-launched battlespace-sensing capabilities, depending on the configuration.

"The MUUV will be a modular, open systems, and open architecture UUV. In the Razorback Torpedo Tube Launch & Recovery (TTL&R) configuration, it will provide submarine-based autonomous oceanographic sensing and data collection in support of intelligence preparation of the operational environment. In the Maritime Expeditionary MCM UUV (MEMUUV) system configuration, it will provide persis-

tent surface-launched and -recovered mine countermeasures (MCM)," the Navy said. "The notional MUUV will contain a common baseline vehicle architecture, including sensors and components, for the submarine and expeditionary configurations. Launch-and-recovery systems will reflect each configuration's unique requirements and missions."

The Navy would field the MCM variant first – supporting the expeditionary mine countermeasures teams who currently operate the Kingfish. The follow-on deliveries will support the submarine community's version.

The Knifefish UUV has a low-frequency broad band sonar to conduct volume, bottom, and buried minehunting capability for the LCS mine countermeasures (MCM) mission package (MP), and can also be deployed from and vessels of opportunity (VOO). Knifefish is built upon the General Dynamics Mission Systems Bluefin 21 vehicle.

According to Dr. Sam Taylor, PEO Unmanned and Small Combatants Senior Leader for Mine Warfare, Low frequency broadband (LFBB) is a description of the acoustic energy employed by the sonar to enable it to sense objects that might go undetected by other sonars. LFBB on Knifefish is used to find buried, bottom, and volume targets in highly cluttered environments. Knifefish is the only system used for buried minehunting.

"Knifefish is being built in blocks to incorporate new technology to increase performance in each block. Knifefish is part of the LCS mine countermeasures (MCM) mission package (MP) and is also being built so that it can be employed from other vessels of opportunity," said Taylor.

The development of Knifefish, both its sensing and processing, was a result of a successful collaboration within the Naval Research and Development Establishment (NRDE). "The NRDE spent years developing prototype sensors and algorithms that were tested in relevant environments to perfect the technology for transition to a program of record," Taylor said.

"Low-frequency broadband (LFBB) is our term for a technology area that we developed here at the Naval Research Laboratory (NRL) that exploits the structural acoustics involved with underwater sonar," said Dr. Brian Houston, Acoustics Division superintendent at NRL. "When you transmit sound,

Senior Chief Mineman Abraham Garcia (left) and Aerographer's Mate 1st Class Joshua Gaskill, members of the Knifefish Unmanned Undersea Vehicle (UUV) test team, man tending lines during crane operations as part of an operational test conducted by members from Operational Test and Evaluation Force (OPTEVFOR). Knifefish is a medium-class mine countermeasure UUV designed for deployment off the Littoral Combat Ship. OPTEVFOR is the Navy's sole test and evaluation organization for surface, air, and undersea warfare, along with various other programs which impact the Navy's overall mission.

U.S. Navy photo by Mass Communication Specialist 1st Class Brian M. Brooks/RELEASED

the acoustic return is very different depending on the physical object that is reflecting that acoustic energy. It might be a naturally occurring thing like a rock on the bottom, or something that's man-made, like a mine. In the water column, it might be a submarine versus a whale. What's in the acoustic return is very different for each of those targets. Sonar has traditionally helped us know where something is, how far a way it is, and sometimes provides an image. But in addition to bearing and range, we can now determine what it is."

Large

The Navy is evaluating two different Large Displacement Unmanned Underwater Vehicle (LDUUV) concepts.

An Innovative Naval Prototype LDUUV has been built by the Office of Naval Research. ONR's INP is being used to evaluate software, autonomy, command and control, and integration of various payloads.

Naval Undersea Warfare Center-Newport is the lead integrator for the Snakehead LDUUV, which will be used to conduct intelligence and preparation of the environment (IPOE), and intelligence, surveillance and reconnaissance (ISR) missions. The follow-on phase will look to give the system greater range. Potentially, additional payloads might include electronic warfare, mine warfare, mine countermeasures, anti-submarine warfare and anti-surface warfare.

The Navy released a request for proposals (RFP) on Dec. 23 for the design, development, and fabrication of Snakehead.

"With this solicitation, the government plans to competitively award a contract to a single vendor for fabrication of two prototype vehicles in fiscal year (FY) 2021," the RFP said. "Snakehead is a long-endurance, multi-mission UUV, deployed from submarine large open interfaces, with the capability to deploy reconfigurable payloads. It is the largest UUV intended for hosting and deployment from submarines, and has been designated a Maritime Accelerated Acquisition. The LDUUV will achieve full integration with Modernized Dry Deck Shelter and Payload Handling System-equipped submarines. Initial vehicles will be designed to support Intelligence Preparation of the Operating Environment (IPOE) missions. Future vehicle missions may include deployment of various payloads."

Extra Large

Orca is an autonomous extra-large unmanned undersea vehicle (XLUUV) for long-range undersea operational awareness and payload delivery. The modular, open architecture UUV has a sizeable and flexible payload section. It launched from a pier and has very long range. Orca can be used for a variety of warfare missions or provide logistics support. It can reach a destination and sit on the bottom to await instructions or conduct a mission on a schedule.

In 2017 the US Navy selected Boeing and Lockheed Martin for design contracts in the first phase of the XLUUV program. Later, the Navy awarded a contract to Boeing for the first four Orca XLUUVs in February 2019, and subsequently expanded the buy to five. The total contract price for five vehicles is $274M. The Navy plans to start buying two per year starting in 2023, according to a Congressional Research Service report from March 2020.

Boeing's Orca design is based on its Echo Voyager autonomous XLUUV. The 51-foot (expandable to 88 feet with the payload section) Echo Voyager has a range of 6,500 nautical miles and can perform several combat missions, including anti-submarine and anti-surface warfare.

Orca is launched and recovered at a safe port away from the area of operations and transit to the area where it will be working autonomously. It will be able to carry smaller UUVs as part of its payload. Assigning XLUUV to dangers or dull missions could allow a $3 billion Virginia-class attack submarine to be used for something more important.

One study conducted during Defense Secretary Mark Esper's tenure by the Cost Assessment and Program Evaluation office called for a force of as many as 50 XLUUVs.

CURV-21 is a 6,400-pound Remotely Operated Vehicle (ROV) that is designed to meet the US Navy's deep ocean salvage requirements down to a maximum depth of 20,000 feet of seawater. This vehicle is loaded with a host of new technologies and was built as a direct replacement for CURV-III but with a smaller overall system footprint.

Salvage

The Navy employs several different subsea systems for subsea salvage work, including tethered robotic systems and UUVs. They can be used from a variety of platforms, and are employed under the direction of the Navy's Supervisor of Salvage (SUPSALV).

The 6,400-pound CURV-21 ROV, built by Phoenix International, is the latest version in the series of CURV vehicles used by the Navy, can conduct salvage operations at depths up to 20,000 feet of seawater. It has more capability than CURV-III, its predecessor, but with a smaller overall system footprint.

DEEP DRONE 8000 is a 4,100-pound ROV has maximum depth of 8,000 feet and is equipped with manipulator arms and cutting tools. Different tools can be installed depending on the mission.

HYDROS is a 2,000-pound Remotely Operated Vehicle (ROV) that is designed to meet the Navy's shallow water, light weight, rapid deployable salvage requirements to a maximum depth of 5,000 feet anywhere in the world. It has pinger-detection, sonar, cameras, manipulator arms and a lifting capability and can be deployed from vessels of opportunity.

SUPSALV's Kongsberg Hugin 6000 AUV --called Trondheim--is equipped with a multibeam and synthetic aperture sonar, and is used for sonar searches, multibeam mapping, sub-bottom profiling, magnetic sensing, and high resolution still camera observation. The 23-foot AUV can operate in autonomous, supervised and trajectory modes. It has an endurance of 50-hours-plus and can dive to 20,000 feet. It can be deployed by any vessel of opportunity.

Gliders

The Naval Oceanography Enterprise provides warfighters with unique oceanographic products for operational and tactical decision making, and has been using underwater vehicles, including underwater buoyancy gliders, for many years. Gliders can be deployed from shore-based facilities as well as ships of opportunity, and operate in varying water depths down to 6,000 feet. Underwater gliders "fly" in the ocean by

Orca extra-large unmanned undersea vehicle will be used in mine countermeasures and anti-submarine warfare.

Boeing

changing buoyancy to alternately sink or rise to the surface. Using wings that create lift, and a rudder, the glider can move slowly along an assigned course.

The Navy's Littoral Battlespace Sensing-Glider (LBS-G) Program began as a program of record a decade ago with a contract for 150 gliders. The LBS-G gliders were manufactured by Teledyne Webb Research, with Teledyne Brown Engineering providing system integration and the University of Washington - Applied Physics Lab providing the Glider Operations Center software.

Gliders are able to collect data in a particular area of interest to the Navy for months at a time to help refine the ocean models that support operations in those regions Temperature and salinity affect water density, which directly impacts a submarine's buoyancy, or how sound travels underwater, or how storms form and intensify.

Today, a third of those gliders are deployed operationally around the world at any given time, controlled by pilots at the Naval Oceanographic Office (NAVO) Glider Operations Center located at Stennis Space Center, Mississippi. The pilots communicate with the glider with Iridium satellite links to collect oceanographic data such as water temperature, salinity, water clarity and depth, and provide positioning and course instructions.

Gliders can operate in remote locations for extended missions to collect data, or deployed in conjunction with major fleet exercises to give participants near-real-time data that provides accurate weather and ocean condition forecasts.

The National Oceanic and Atmospheric Administration uses gliders to monitor marine mammals and fish stocks, and collect data to better understand the dynamic air-sea interaction processes during tropical cyclones, and thus predict storm formation, track and intensity.

NOAA employs 21 gliders, including Slocum G3 oceanographic gliders, Kongsberg Seagliders and Oculus gliders, used for fisheries research, storm intensity measurement and atmospheric and oceanic data collection. The vast majority of the NOAA-associated gliders are owned or operated by the IOOS regional associations (a partnership of 17 federal agen-

MARINE TECHNOLOGY REPORTER

2021 Editorial Calendar

January 2021

Underwater Vehicle Annual

- Underwater Defense
- Manipulator Arms and Tools
- Autonomous Navigation GNSS MEMS
- Unmanned Vehicle Propulsion
- Hydrophones

Event Distribution:

Subsea Expo
February 23-25 Aberdeen, Scotland
Underwater Defense and Security
March 2-4 Southampton, UK
Ocean Business 2021
April 13-15 Southampton, UK

Digital Edition

MTR E-Magazine Edition:
Oceanographic

March 2021

Oceanographic Instrumentation & Sensors

- Offshore Energy: O&G and Renewables
- Fiber Optic Cables, Connectors & Slip Rings
- Buoyancy Technology
- Scientific Deck Machinery / LARS

Event Distribution:

OTC
May 3-6 Houston, TX
Oceans Europe
May 17-21 Porto, Portugal
Underwater Technology Conference
June 2021 Bergen, Norway

May 2021

Hydrographic Survey Sonar

- Comms, Telemetry & Data Processing Software
- USV Platforms
- Magnetometers & Streamers
- GPS, Gyro Compasses & MEMS Motion Tracking

Event Distribution:

Seawork:
Jun 15-17, Southampton, UK

Digital Edition

MTR E-Magazine Edition:
Hydrographic

July 2021

Autonomous Vehicle Operations

- Subsea Electrification & Residency
- ROV Technology: Work Class to Micro Systems
- Thruster Tech: Underwater Propulsion
- Underwater Tools & Manipulators
- Beacons, Flashers & Tracking Systems

Event Distribution:

Offshore Europe:
September 7-10 Aberdeen, Scotland
Oceans
September 20-23, San Diego

September 2021

MTR100: Focus on 100 Leading Companies, People and Innovations in the Subsea Space

- Interconnect: Underwater Cables & Connectors
- Offshore Inspection, Maintenance & Repair (IMR)
- Underwater Imaging: Lights, Cameras, Lasers & Multibeam Sonars

Event Distribution:

Europort:
Nov 2-5 Rotterdam, Netherlands

November 2021

Ocean Observation: Gliders, Buoys & Sub-Surface Networks

- Acoustic Doppler Sonar Technologies ADCPs and DVLs
- Instrumentation: Profilers, Samplers & Sediment Corers
- Fresh Water Monitoring & Sensors
- Seafloor Mapping
- Geospatial Software Systems for Hydrography

Digital Edition

MTR E-Magazine Edition:
Subsea Vehicles

Navy's around the world are adopting unmanned systems. Here an Australian Mine Warfare Team operates the Bluefin 9 Autonomous Underwater Vehicle (AUV) from a Mine Countermeasure Support Boat (MCMSB).

Royal Australian Navy photo

cies and 11 regions, comprised largely of academia, as well as industry partners) or the Navy, so their data is at times compiled, given a quality control check, and made available to the public and operational forecast models via the US IOOS Glider Data Assembly Center.

Liberdade class are autonomous underwater gliders developed by the Marine Physical Lab at Scripps Institution of Oceanography, and the Applied Physics Lab at the University of Washington for the US Navy Office of Naval Research, that can fly underwater for up to six months. They were developed as part of the US Navy's Persistent Littoral Undersea Surveillance Network (PlusNet) system of unmanned surveillance vehicles. Their blended wing bodies help achieve hydrodynamic efficiency. The Liberdade gliders are the largest known underwater gliders.

Gliders are extremely quiet, and come up to the surface and extend nothing more than a very small antenna for a very short time. This is advantageous for covert operations, or for detecting and tracking marine mammals.

The University of Washington's Applied Physics Laboratory and School of Oceanography uses a fleet of Seagliders to conduct long-duration collecting ocean conductivity-temperature-depth (CTD) data and sending it to shore in near-real time via satellite data telemetry. The Seaglider program is funded by the Office of Naval Research (ONR).

A glider can dive down towards the bottom as it collects data, and then slowly return to the surface to then send a satellite message about what it has observed.

Gliders can be deployed on a continuous basis in high-threat areas to give an up-to-date characterization of the underwater battlespace, for planners and decision makers.

Gliders can provide addition depth sounds to make nautical charts more accurate and complete. But they also gather data on water temperature, salinity, turbidity, currents and dissolved oxygen at different depts, all of which have an impact on how sound travels underwater, which in turn affects how submarines can be detected and tracked, or remain covert and avoid detection.

Understanding the physical properties of the water column help tactical officers best employ their sonar to find targets, and it helps to find how and where an adversary might exploit the conditions to remain undetected.

Vessels

Innovative new ships, boats & technologies to facilitate subsea work

NOAA Orders Pair of Oceanographic Ships

NOAA's effort to recapitalize its fleet of research ships took a major step forward with the U.S. Navy's award of a $178,082,877 contract to Thoma-Sea Marine Constructors LLC, Houma, La., for the detailed design and construction of two new oceanographic ships for the agency. NOAA is acquiring the vessels through an agreement with the Naval Sea Systems Command. The first ship, to be named Oceanographer, will be homeported in Honolulu. The second ship, to be named Discoverer, will be assigned a homeport at a future date. Both vessels will continue the legacies of their namesakes. The first Oceanographer served in the NOAA fleet from 1966 to 1996 and her sister ship, Discoverer, served from 1967 to 1996.

The new ships will support a wide variety of missions, ranging from general oceanographic research and exploration to marine life, climate and ocean ecosystem studies. These missions include shallow coastal, continental shelf, and worldwide ocean survey and data collection. Designed as single-hull ships, Oceanographer and Discoverer will be built to commercial standards. They will incorporate the latest technologies, including high-efficiency, environmentally friendly EPA Tier IV diesel engines, emissions controls for stack gases, new information technology tools for monitoring shipboard systems, and underwater scientific research and survey equipment. The ships will be equipped to launch work boats, perform maintenance on buoys and moorings, deploy scientific instruments to collect weather and water column data, and conduct seafloor mapping surveys. Each vessel will operate with a crew of 20 and will accommodate up to 28 scientists.

Meet VICTA, an Innovative Diver Delivery Unit

BAR Technologies won the deal to support SubSea Craft Ltd., in the design and build of VICTA – touted by the companies as 'the world's most advanced diver delivery unit.'

BAR Technologies has been integral to the shape and form of VICTA – designing and optimizing the hull and control system to enable its performance both on the surface and submerged: 40 knots and 250nm endurance on the surface, matched by an equally impressive underwater specification where four hours endurance can navigate two crew and six divers for 25nm.

BAR Technologies and SubSea Craft began collaborating on the VICTA development in 2018, progressing the build over the previous 14 months. The vessel is currently in 'finishing' where the carbon fiber hull is completed prior to receiving a synthetic, colored outer 'wrap'. This step provides VICTA's streamlined shape, reduces the acoustic signature and assures watertight integrity. Current activites are aimed to prepare VICTA for trials and testing in 2021. VICTA is primarily aimed at the defense market.

Damen finishes German Diving Bell Ship

Damen Shipyards Group has completed construction and outfitting of a diving bell ship for client FMSW Koblenz (Department Machinery Southwest)/ operator WSA Rhine (Waterways and Shipping Office) according to schedule.

Oceanographer & Discoverer will join NOAA's ship fleet, which includes NOAA Ship Ronald H. Brown.

Photo courtesy Wes Struble NOAA

Following its completion, the vessel has recently undertaken successful river trials. The vessel will succeed the existing Carl Straat, which has been performing her duties since 1963. The new diving bell ship will operate on the Rhine and its tributaries. It will provide dry conditions, in a pressurized atmosphere, in which personnel can work below the water. Her main scope of work will be the search and recovery of lost cargo and wreckage as well as inspection for construction projects. The vessel will also be capable of providing barrel anchors in gravelly and rocky areas in order to perform sampling activities.

University of Vermont Plans for New Research

Chartwell Marine was selected by the University of Vermont (UVM) to design a hybrid research vessel. The 19-m catamaran, designed in collaboration with BAE Systems, will be capable of low-emission, low-fuel-burn operations and is set for launch in April 2022. The build contract has been awarded to Derecktor Shipyards.

The hybrid design, which is powered by two Cummins QSB 6.7m 306hp diesel engines and two BAE AC traction motors, will provide the University with a new research and instruction platform to facilitate its advanced research operation. The hybrid propulsion method will enable all-electric operation for trips less than two hours in duration, which represents 60% of all current UVM voyages. This will provide a number of benefits – not only reduced engine maintenance costs, as its diesel power plants see usage fall by 55%, but also improved low-speed manoeuvrability, a quieter operating platform with less vibration for students, and also a less intrusive vessel for studying marine life.

This survey suite will be further bolstered by InterOcean Systems, in partnership with the Woods Hole Oceanographic Institute. Together, IOS & WHOI have developed a unique new winch system, which will enable UVM to operate more efficiently than ever before from both personnel and power perspectives. The winches are directly driven to reduce drivetrain losses and can be operated using a single wireless joystick. The new catamaran hull form that has been optimized via Computational Flow Dynamics modelling to minimize resistance at low speeds, accommodate battery storage, and ensure maximum stability.

The University envisions three main uses for the vessel: a mobile 'classroom' for undergraduate field trips; a platform for graduate students researching the Lake Champlain environment; and a way for engineering students to study the future of hybrid vessel design.

"Going to market for the next vessel tender enabled us to explore new opportunities in hybrid vessel design, with Chartwell Marine offering a number of operational benefits. UVM's Amplifying Our Impact strategic vision (go.uvm.edu/vision) underscores the University's prioritization of research and initiatives that strengthen healthy environments and healthy societies. Our partnerships with Chartwell Marine and Derecktor Shipyards support that vision. We look forward to 2022 when the ship will arrive at the Rubenstein Ecosystem Science Lab on Lake Champlain," said Patricia A. Prelock, Provost and Senior VP for the University of Vermont.

SubSea Craft is building VICTA – touted by the companies as 'the world's most advanced diver delivery unit.'

Photo courtesy BAR Technologies/SubSea Craft Ltd.

Elakha: Repowering a Valued Research Vessel

Ocean science is in high demand by scientists studying ocean acidification, wave energy, seabed composition, changing water temperatures, fish populations and dozens of other research projects. The Oregon State University (OSU) has a proud history in the field. The wide variety of research project require a variety of vessels.

One boat that has made large contributions to research is the 54 by 16.5-foot Elakha which was built in 2001 at Rozema Boat Works of Mount Vernon Washington. Showing design influences of a typical forward house west coast style fishing boat, the Elakha's after deck is set up for retrieving data from the ocean, although some fish research is also possible. Some of the most common types of work for the Elakha include dive operations, acoustic studies, glider deployment and recovery, box coring, profiler deployment and recovery, plankton and other tows, crab pot deployment and recovery and CTD casts.

As the boat approached its twentieth year of operation, the team at OSU had to consider the best mid-life upgrade. The existing 600 hp CAT 3176 had given good service and they considered a rebuild. Writing about the selection process, the Elakha's master, Captain Jeff Lawrence, describes the process:

"…As part of this evaluation we contacted Scott Graff at Curry Marine. In just a few short days Scott came up with a great package for our project that checked every box on our needs list. We decided to go with a new tier 3 Cummins QSM 11 610hp engine A ZF360A 2.44:1 marine gear and Glendinning ECS controls."

"On February 28, 2020 the R/V Elakha made her way up the Yaquina river to the Port of Toledo Boat Yard at Toledo Oregon to be hauled out and the re-power begun. After a week's time the old engine and gears were out, and we started to fit the new equipment to the boat. There was plenty of fabrication that had to be done before the new QSM11 engine and the ZF gears could be installed. With the skillful hands of the yard's mechanics, David Stoker and Ted Mandell, things came together nicely."

"After the new engine and gears were installed, new Racor's, fuel lines, raw water-cooling systems, muffler and exhaust all went in. In addition to these upgrades, new Glendinning ECS controls were installed as well during this time, as well as significant re-wiring from the engine to the engine brainbox, and up to the controls in the wheelhouse. With a good amount of assistance from Scott Hatfield from the shipyard, the Elakha crew removed all the old wiring for the CAT engine and ran new wiring for the Cummins engine.

"Along with this new wiring, the Elakha received some dash control upgrades as well in the form of a more modern engine monitoring system with a more comprehensive assortment of readouts and information for the main engine. After everything the installations were complete The Elakha happily splashed back into the Yaquina river and we arranged for a test run.

Damen completes work on German Diving Bell Ship. The new diving bell ship will operate on the Rhine and its tributaries.

Photo: Damen

The Curry Marine mechanics, Scout Hockema, Scott Houck and Matt Orr arrived at the yard and we fired up the new engine. As expected, it fired right up and ran smooth. With a few minor adjustments we were ready for sea trials. Our plan was to run down to Newport and back the next day. Sea trials went remarkably well, the vessel performance was excellent and significantly surpassed our expectations. With a newly repowered vessel, significant upgrades and COVID-19 mitigation procedures firmly in place, we were ready to go back to work just in time to kick off the busy summer season. For the past six months we have stayed busy even within the mitigating parameters of the ongoing pandemic, and the new restrictive operational practices we have developed to keep all users and crew safe. The new engine and gears are running smother, quieter, cleaner and more fuel efficient than ever before. The new Cummins engine provides our operations with more available power and speed, while also increasing fuel economy.

Elakha, an Oregon State University RV built in 2001 at Rozema Boat Works, recently received a repower.

Photo: Oregon State University

The University of Vermont selected Chartwell Marine, BAE Systems and Derecktor Shipyard to deliver its new RV.

Photo courtesy Chartwell Marine

Offshore Power: Paving the Way for True Autonomy

With the advent of autonomy on and under the water, part of the value proposition is the ability to stay at sea, on station, to exponentially increase efficiencies. Have the ability to repower at sea is central to this effort, as an increasing number of companies work to solve the inherent technical and logistic problems.

Columbia Power Technologies (C-Power) is commencing a six-month sea trial to test and validate its SeaRAY autonomous offshore power system (AOPS), in partnership with a pair of powerhouses: the U.S. Department of Energy (DOE) and the U.S. Navy

Initially conceived during a U.S. Department of Defense project, the SeaRAY AOPS is designed to provide in-situ power, energy storage, and real-time data and communications support that is intended to advance the marine economy toward a future of autonomous, connected and resident technologies. It is designed to support unmanned offshore activities, including subsea vehicles, sensor packages, and operating equipment.

"The ocean is a power desert," said Reenst Lesemann, CEO of C-Power. "Providing reliable power and real-time data communications through an AOPS is critical to unlock the full potential of the marine economy. The SeaRAY delivers these capabilities and enables a future of cheaper, safer, cleaner, more connected offshore operations."

The sea trials will begin later this year at the Navy's Wave Energy Testing Site (WETS), located off Marine Corps Base Hawaii on the island of Oahu, Hawaii.

The SeaRAY AOPS at WETS is a moored configuration consisting of a surface wave energy converter; a single, combined mooring, data, communications and power cable; and a seafloor base unit that provides 100 kWh of energy storage for payload operation. The SeaRAY, which will support several payloads during the deployment, has been developed under a $3.2 million DOE-sponsored research and development program.

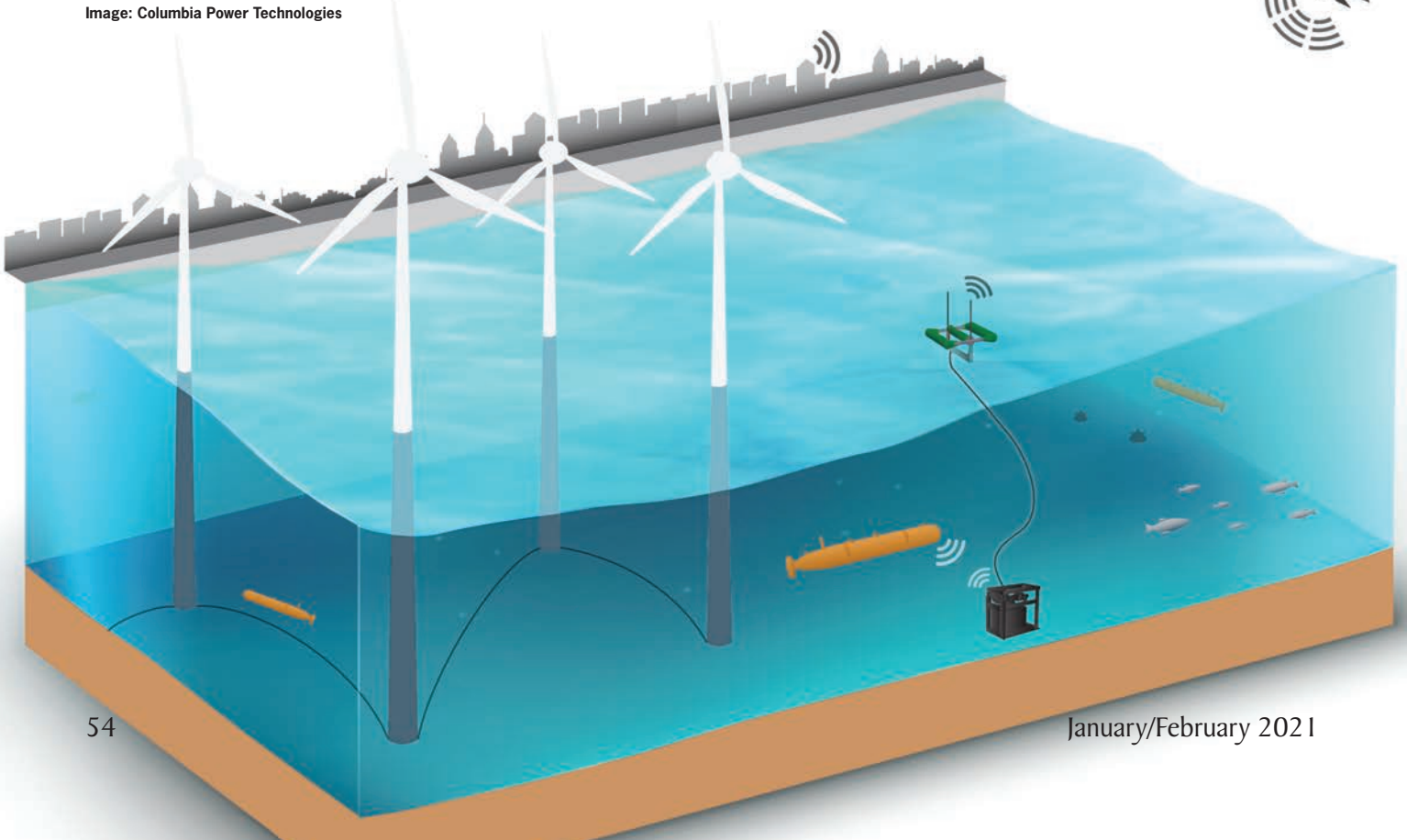
The SeaRAY AOPS is designed to be scalable to capacities from tens of watts to tens of KW. The AOPS is designed to survive the expected conditions of a 100-year storm off the Oregon coast and is easily transported worldwide in two standard ocean containers. It will be deployed at WETS with a small, lightly-crewed vessel.

C-Power's technology partners for the sea trials include EC-OG, RigNet, EOM Offshore and Saab Group.

The SeaRAY's seafloor base unit will be provided by EC-OG. EC-OG's 100-kWh Halo lithium-ion battery energy storage system is designed for the harsh subsea environment and will be fully integrated with the AOPS, providing the payload interfaces for power, data and communications.

Following completion of the WETS sea trials, C-Power expects to complete commercial launch of the SeaRAY in 2021.

Image: Columbia Power Technologies



Acoustic Tech to Prep for America's Cup

INEOS TEAM UK needed accurate measurements of speed through water while training for the America's Cup in waters with complex current flows. Nortek tech helped out.

INEOS TEAM UK was formed to challenge for the 36th America's Cup, to be held in New Zealand in 2021. They will compete in their new AC75 yacht named Britannia, a foiling monohull that flies over water on T-foils at speeds up to or exceeding 50 knots.

The team represent the Royal Yacht Squadron, one of the most prestigious yacht clubs in the world, and are based out of Portsmouth on the south coast of Britain, using the Solent as their training waters.

"The Solent's reputation as a venue for sailboat racing is well-known. Its strong tides and complex geography and wind patterns make it an interesting and fun place to race," said Mark Chisnell, INEOS TEAM UK's Technology Coordinator. "Unfortunately, these conditions can make it a tricky venue for testing America's Cup yachts, as satnav cannot be relied on for accurate performance information because it only measures motion relative to the seabed. The complex and ever-changing tidal current flows of the Solent add an unknown vector into the data that makes it difficult to accurately measure the yacht's true speed."

The solution: Mount a tailor-made Doppler speed log from Nortek inside the bulbs of each of Britannia's T-shaped foils.

Photos: Nortek

Measuring speed through water

The tide can flow at speeds in excess of four knots in some areas of the Solent, and if not measured correctly could potentially introduce a significant error in the test data.

The team needed to measure velocity through water very accurately, which led them to Nortek and its Doppler Velocity Logs (DVLs) for subsea navigation. These sensors use an acoustic Doppler measurement to estimate velocity relative to the water column.

"We knew that the Nortek DVL had been used successfully in ocean racing, involving high-performance monohulls that could reach 30 knots. So while the DVL was intended for the slow speed and high accuracy demands of subsea navigation, there was evidence that the sensor might cope with the speeds of the AC75," said Chisnell.

The solution was to mount a tailor-made Doppler speed log from Nortek inside the bulbs of each of Britannia's T-shaped foils, with a flooded chamber sealing the space and forming a smooth interface with the external face of the bulb. This provides accurate speed through water measurements without affecting performance.

"We recessed the speed log into the bulb, which was flooded. It was then covered with a piece of acoustically neutral plastic, a polycarbonate plate. This achieved the two goals of an unbroken (or measurable) acoustic path from the transducer into the water column, while maintaining a very smooth and efficient underside to the bulb," said Chisnell.

New Products

Innovative new products, technologies and concepts

Forum XT500 Trenching System

Forum Energy Technologies has secured an order to supply specialist subsea equipment for a cable maintenance project in South East Asia.

The contract will see the company deploy a Perry XT500 trenching system and Dynacon Launch and Recovery System as well as associated surface power and control installations. The equipment will be used to support telecommunication contracts in South East Asia and the Indian Ocean.

The 500-hp XT500 trenching system has a 3,000m depth rating and three meter ROV burial capability on the ocean floor. The vehicle will be manufactured at Forum's facility at Kirkbymoorside, Yorkshire and installed onboard the client's vessel in early 2021. As part of the workscope, Forum will also deliver operational and maintenance training for the client's personnel and provide support during the first mobilisation onboard the vessel, including sea trials.

Forum

The XT500 trenching system is designed to meet the demanding trenching requirements of both strong soils and deep flowline burial protection over long stretches. Capable of operating in free-fly, skid-based trenching and survey modes, the system is designed for demanding applications, providing a robust solution even in the world's harshest environments.

Valeport Debuts new SWiFT CTD Profiler

The new SWiFT CTD is the next generation of Valeport's SWiFT profiler range and is designed to deliver enhanced accuracy and versatility for CTD measurements. The SWiFT CTD profiler provides survey-grade sensor technology coupled with the convenience of Bluetooth connectivity, rechargeable battery and an integral GPS module to geo-locate each profile.

The SWiFT CTD features a new fast response temperature probe and operates down to 500m as standard, delivering directly measured Conductivity, Temperature and Depth. In addition to the directly measured CTD, computed Salinity, Density and Sound Velocity is calculated using the UNESCO international standard algorithm and the Chen and Millero equation. Data can be downloaded wirelessly, and uses Valeport's new Ocean software for iOS, Android and PC platforms.

Valeport

The new SWiFT CTD makes any problematic battery changes a thing of the past and delivers fully automated data transfer with no user input required. It also features Valeport's signature SWiFT magnetic switch ring. The switch ring is easy to operate even with cold hands, it simply turns through 90 degrees and reassuringly clicks into position.

The end cap features user-friendly LED status indications for GPS, battery and communications.

New Products

Innovative new products, technologies and concepts

Saab Seaeye for Swedish Survey

Peab Marin chose a Saab Seaeye Falcon as a multi-functional resource in support of the company's marine survey, salvage and civil construction operations. The Swedish marine services company says the Falcon will secure a safer working environment for its divers and will be an "excellent tool" for surveying.

Importantly for Peab Marin's wide range of construction and maintenance work the Falcon's quick and easy deployment with ready systems change and expandable systems options, make it a highly adaptable resource.

Diver safety is paramount and in hazardous circumstances the Falcon can be deployed to work underwater endlessly and tirelessly.

Robert Hedin at Peab describes the important role the Falcon will play in diver safety.

"Some work can offer serious risk for a commercial diver, especially Delta-P situations when the differential pressure between two water columns attempts to equalize, creating tremendous pressure/suction.

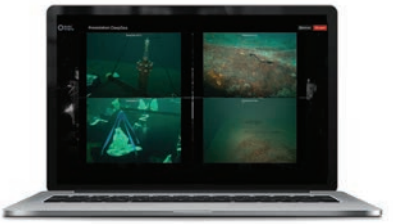
It's a hazard that cannot be downplayed, as in some cases it's just impossible to reduce the suction in case of emergency. In situations like this, we prefer to send down the Falcon to either completely replace the diver's work or in order to make a proper safety assessment. It really helps us to create a safer work environment for our commercial divers.

This has been exclusive to the offshore industry for a long time, and we're really glad to see the same application moving into the civil inshore industry in Sweden."

With Swedish waters notorious for low visibility, typically 0.5m and less, and working in a wide variety of water states from open seas to waterway locks, fitting a Bluetooth multibeam sonar to the Falcon was essential, says Robert Hedin: "It is a must-have for operating an ROV in our underwater environment."

With Peab Marin pilots typically working in challenging conditions, their pilots welcome the precise control, agility and stability of the Falcon when faced with complex environments in turbulent waters and strong currents.

SaabSeaeye



SubC Imaging

SubC Imaging

SubC Imaging released its new Offshore Real-Time Video Streaming Solution. The low-latency video streaming solution enables live streaming of subsea video from ROV, and other subsea systems, allowing decision-makers real-time operation of remote assets from anywhere in the world.

The cloud-based service has been in development since 2018 but is of particular interest today as many offshore operations have been affected by COVID-19.

Arctic Rays Manta

Arctic Rays, LLC released Manta HD, a small HD-IP or HD-SDI underwater camera. The Onvif profile S compliant Manta HD camera is capable of a resolution of 1920 x 1080 at 30 fps (1080p30 full HD), features a 30x optical zoom and on-board recording to an SD card. An additional connector is offered to provide power and control for an external pan & tilt or light. The compact design measures 82.6mm (3.25in) diameter by 198mm (7.8in) long with connector and weighs 1.21 kg (2.67 lbs) in air and .34 kg (.75 lbs) in seawater. Housed in a 6061-T6 AHC aluminum housing with acrylic lens, it is rated to 1,000 meters (3,300 feet).

SubC Imaging

New Products

Innovative new products, technologies and concepts

OSIL Piston Corers Go Global

The range of piston coring systems available from UK based manufacturer Ocean Scientific International Ltd (OSIL) has proven popular in recent months, with a notable increase in sales, shipments and enquiries, particularly for smaller systems under 10m in length.

OSIL

The Piston Corers operate in a very similar manner to traditional gravity coring systems, with the exception of the piston itself, which acts as a plug on the coring barrel array once the corer has been fully deployed into the sediment that, together with the core catcher, holds the sample more securely inside the core liner than in a regular gravity corer system and prevents sediment slump. The piston also reduces internal friction within the core liner and prevents clumping of the sample. This ensures that the OSIL Piston Corer systems deliver a more well-defined sediment sample to the operator.

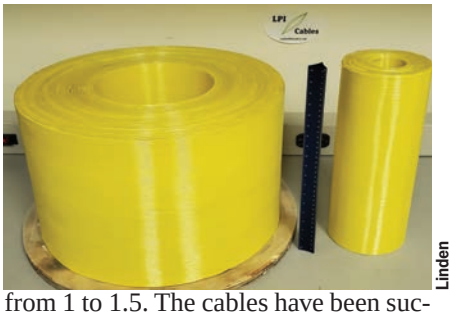
Airmar CM510L Transducer

Airmar Technology introduce the CM510L Cavity Mount Transducer, a 3 kW Chirp-ready transducer with low frequency (25-50 kHz) Chirp capabilities. Suited for commercial fishing applications where bottom discrimination and target resolution of bottom-fish species are critical to success, the CM510L includes the popular 28 kHz, 38 kHz and 50 kHz fishing frequencies, plus all other frequencies in the band. The CM510L operates in Chirp mode or on discrete frequencies, and includes a fast-response water temperature sensor. It also includes Airmar's patented Xducer ID technology, which enables the transducer to transmit important data about itself automatically to the connected echosounder.

Airmar

Linden Buoyant Optical Cables

Linden's patented BSTFOC are thin, rugged, buoyant optical cables that can float on the surface, remain neutrally buoyant at depth or have controlled density to sink at pre-determined rates. These cables can be manufactured in lengths >40 km with no splices. Linden has used BSTFOC to manufacture 30 km precision wound, inside-payout packs. The cables have been tested to hydrostatic pressure of 4 kpsi, have an OD in the range of 0.9 to 1.1 mm and 50 lbf tensile strength. SG can be tailored from 1 to 1.5. The cables have been successfully terminated with LC, SC, FC, ST, Greene-Tweed and Fischer connectors. Applications include ROVs.



Linden

RTSYS

SEMA MK-II

Within the framework of a contract notified by the DGA (French Directorate General of Armaments), RTSYS is carrying on innovations initiated in 2011 regarding ASW training targets. As a result, two new training targets SEMA-MKII were delivered to the French Navy in September 2020, bringing to six the number of units on duty within this Navy. Two other training targets are planned to be delivered in early 2021.

These new SEMA MK-II targets strengthen crews training capabilities in Anti-Submarine Warfare (ASW) by offering acoustic signature simulation of a submarine, and respond to latest-generation LFA1 sonars and homing torpedo heads, putting crew at the heart of operational scenarios by surprising it with kinematic escapes.

More compact than the Mark I, SEMA MK-II weighs 33 kilograms and measures 2.13 meters long. SEMA MK-II can navigate down to 300 meters depth during 10 hours at four knots (1.5 hours at 15 knots) thanks to its secured battery, high-capacity and easily rechargeable on board. Navigation skills combined with GPS repositioning also offer optimal and increased surface localization conditions at the end of the mission. Various improvements have been qualified on this new standard such as safety of use, safety in transport and on board, data security, UHF surface localization module, and more.

New Products

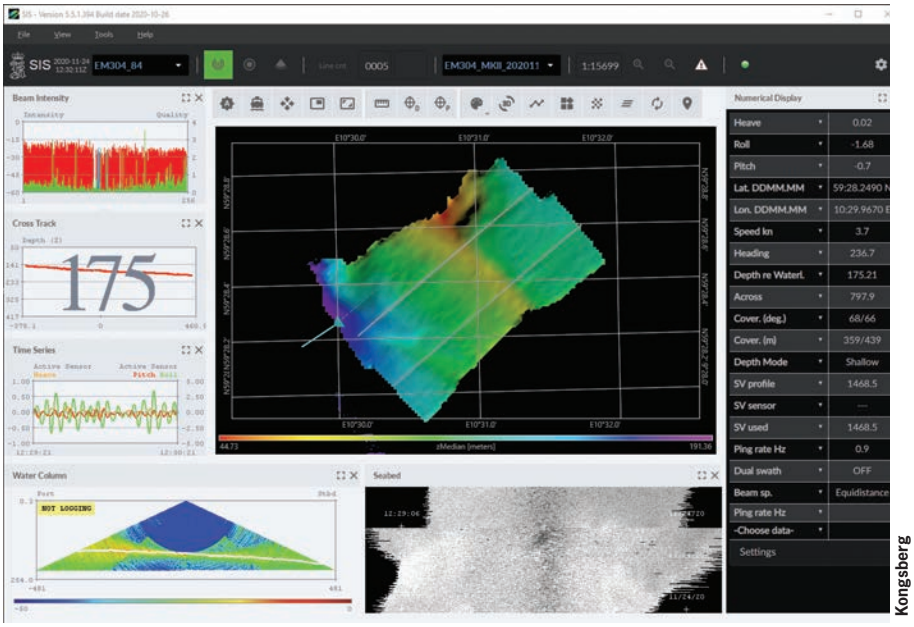
Innovative new products, technologies and concepts

Kongsberg EM 304 MKII Multibeam Echo Sounder

Kongsberg Maritime launched the EM 304 MKII, the newest addition to its portfolio of deep-water multibeam echo sounders.

Underpinned by a new KONGSBERG-designed wideband transmitter working in the 20-32kHz band with a nominal frequency of 26kHz, the new mapping system significantly improves upon the performance of the MKI model, boosting range from a previous maximum of 8,000m to full ocean depth, and increasing swath performance by up to 75%.

In addition, the EM 304 MKII delivers 0.3° x 0.5° resolution. Meanwhile, the system's modular construction and flexible transducer design make installation easy and enable it to be adapted to fit almost any size of vessel.



Kongsberg

The EM 304 MKII is compatible with a Kongsberg-developed datagram format. This supports several innovative features such as extended backscatter calibration, and more features are already in development. The new format is supported by Kognifai, Kongsberg's open digital ecosystem, which provides operators with the potential to transform their survey operations via digitalization as well as hosting all major post-processing software on the market.

EvoLogics Launches Integrated USBL Buoy

EvoLogics announced a new USBL buoy, a fully integrated solution based on the company's S2C USBL devices.

The buoy comprises a USBL transceiver with a built-in battery, mounted to a floating unit with an on-board PC, GNSS receiver with dual antennas, and a Wi-Fi access point. The design concept of the system derives from fishing floats that remain highly stable even in rough seas thanks to their long stems and minimal cross-section near the surface.

This allows the elongated buoy to remain stable in harsh conditions, and when deployed close to a vessel hull or pier walls, where the waves are taller.

This integrated system eliminates the need to use external GNSS receivers for geo-referenced positioning of underwater targets. Dual GNSS antennas

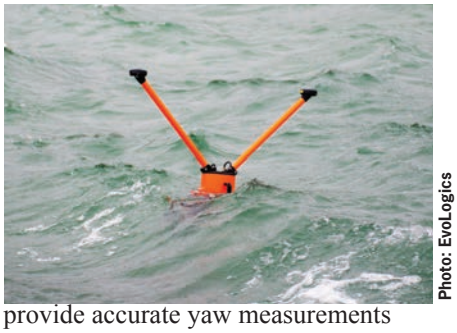


Photo: EvoLogics

provide accurate yaw measurements without be-ing affected by magnetic interferences. The optional RTK increases precision and accuracy. Moreover, as both sensors are part of the same hardware assembly, it is not necessary to calibrate the relative position of the USBL and the GNSS receiver.

The on-board PC runs the pre-installed SiNAPS, EvoLogics positioning software. The user can access USBL positioning data by connecting to the Wi-Fi access point of the buoy and opening the web-based SiNAPS interface. SiNAPS allows to operate the system and visualize the loca-tion of the buoy and target transponders. Furthermore, positioning data can be streamed as NMEA strings and input into other applications that can process this information in real-time.

The buoyant body of the unit is made of carbon and glass fiber composites, making it lighter, more compact and robust than conventional designs with foam-based floatation collars.

The system packs up into a single case and can be easily transported, assembled and deployed by a single operator.

Launched in December 2020, the buoy is available with all models of the EvoLogics S2C USBL range.

Who's News?

Latest People & Company News

Teledyne Marine

Webb Honored by WHOI

Valeport

Valeport Promotes Frankland

Ashtead

Ashtead Appoints Stewart CFO

Webb Honored by WHOI

Douglas C. Webb, founder of Teledyne Webb Research, was named Oceanographer Emeritus at the Woods Hole Oceanographic Institution. This peer appointed honorary position has been bestowed upon Webb in recognition of his contributions to WHOI and to oceanographic science and engineering. Webb is a gifted engineer and inventor whose pioneering work can be credited for fundamentally changing the way in which scientists are now able to observe the interior of the oceans. From his graduate work at Manchester University, where he demonstrated the first prototype transistorized computer, Doug brought individual transistor technology with him to WHOI where he developed accurate timing for acoustically tracking langrangian floats (integrated circuits were not yet available). Throughout his career, Doug has been an early adopter of enabling technologies (i.e. silicon chips, ceramic transducers, satellite communications, GPS, etc.), and continually brought those technologies to bear to solve a set of problems that helped resolve ocean dynamics. Doug recognized early on that one of the key hurdles facing the oceanographic community and data collection was the ocean's grand scale and the limited size of the research fleet. He set out to develop and create a toolbox of long-endurance remote sensing platforms that would provide scientists with a better look into the world's vastly under-sampled oceans. His innovative work includes low-frequency acoustic sound sources used for water mass tracking, long range navigation, and tomography (SOFAR, RAFOS, Tonpilz), Vertical Current Meters (VCMs) to measure water chimney convection, profiling floats (ALACE and APEX) that evolved into the ARGO program, and the genesis of ocean gliders (Slocum). The sound sources are still in use today for a variety of applications. The VCMs morphed into the floats with the added capability of electromagnetic probes (EM-APEX) for water velocity measurements that are now air deployed from C-130 planes. Over the last 20 years of the Argo program, the floats have made over 2 million ocean profiles.

The Slocum gliders, capable of crossing ocean basins with well over a year of endurance, are routinely being used to measure and monitor many facets of the ocean including biogeochemical properties, whale and penguin movements, and facilitating hurricane intensity predictions.

Greensea

Gill Joins Greensea

Miguel Silva, CorPower

Valeport Promotes Frankland

Valeport promoted Guy Frankland to Head of Marketing, as it targets market leadership in the environmental sensors sector. The internal appointment of Frankland, former marketing manager, marks the latest step in the strategic growth plans for Valeport.

Ashtead Appoints Stewart CFO

Ashtead Technology appointed **Ingrid Stewart** a chief financial officer (CFO) and five managers for newly created roles across its international team. The new Aberdeenshire based managerial hires across Ashtead Technology include **Lili Hughes**, as group QHSE manager, **Stephen Booth** as decommissioning BD manager and asset integrity project manager **Michael Gibson**. In addition, **Mark Vela** has joined as US operations manager in Houston, and **Dan Davies** has taken up his new role as NDT market manager within the company's inspection solutions team in Bedfordshire, England.

Gill Joins Greensea

Greensea hired Karnveer Gill, Junior Robotics Engineer, to help advance OPENSEA's software tools and applications. Karnveer received his electrical engineering Bachelor of Science degree from San Francisco State University where he worked as a mechatronics teaching assistant as well as a research assistant in the Control for Automation and Rehabilitation Robotics Lab.

CorPower Bags Portugal License

CorPower Ocean is set to unleash a wave energy project in the Atlantic Ocean after securing a 10-year license. The TUPEM license - awarded by the national Directorate-General for Natural Resources (DGRM) - provides a 'Permit for the Private Use of the Maritime Space' up to 12 miles off the coast of Aguçadoura in northern Portugal. CorPower Ocean Country Manager Miguel Silva said the permit unlocks the demonstration phase of the firm's flagship HiWave-5 project.

MacArtney Promotes Middleton

MacArtney Group appointed a new Managing Director for its UK operations. Phil Middleton joined the group late last year where he will be heading up MacArtney's UK operations based out of Aberdeen.

MacArtney Promotes Sharma

MacArtney Underwater Technology appointed Saurabh Sharma as Regional Sales Manager, reinforcing its sales activities in the Middle East and India.

NORBIT Prize Goes to Gibbons

NORBIT UK chose to sponsor an academic prize for a high achieving student at UCL (www.ucl.ac.uk). This year's winner is James Gibbons, who has a background in Earth Science and an active interest in structural, physical and chemical properties of the subsurface. The Geospatial Science and Hydrographic Surveying course expanded his knowledge of these disciplines whilst also allowing him to "gain significant insight into the uncertainties associated with the digital expression of 3D positional data on and below the Earth's Surface and their significance in Marine Engineering."

Cyprus Subsea, SES Collaborate

Subsea Europe Services GmbH and Cyprus Subsea Consulting and Services entered a new strategic cooperation to share knowledge and services designed to simplify the acquisition of high-quality marine data for clients across Europe. The agreement was signed January 1, 2021, and is the foundation for matching the extensive autonomous and long-term water column survey experience of Cyprus Subsea and Subsea Europe Service's seafloor surveying expertise to provide a harmonized Hydrography and Oceanography portfolio from a single, Europe-wide source.

MacArtney

MacArtney Promotes Middleton

MacArtney

MacArtney Promotes Sharma

Norbit

NORBIT Prize Goes to Gibbons

Who's News?

Latest People & Company News

Sonardyne for AUV

Dive Technologies has chosen a complete suite of Sonardyne technologies for navigation, tracking and control of its large displacement DIVE-LD autonomous underwater vehicle (AUV) programme. The DIVE-LD AUV is being developed to meet a wide range of long-endurance mission requirements, across the commercial, research and defence sectors. For the full story visit: **bit.ly/2Y2ybM3**

Sonardyne

Sonardyne for Dive Technologies's AUV.

HII Acquires Autonomy Business

Huntington Ingalls Industries acquired the autonomy business of Spatial Integrated Systems Inc. (SIS) which has proven unmanned surface vessel (USV) solutions. SIS's unmanned systems solutions — including multi-vehicle collaborative autonomy, sensor fusion and perception — have been fielded for more than 6,000 hours on 23 vessel types.

HII

HII Acquires Autonomy Business.

Williams Succeeds Cobis @ Klein

MIND Technology, Inc. announced that Michael A. Williams has been named General Manager at its Klein unit located in Salem, NH, following the retirement of Frank Cobis.

USN SURTASS Program Support

When the U.S. Navy needed to ensure the recovery of the AN/UQQ-2 Surveillance Towed Sensor System (SURTASS) in case of loss at sea, it reached out to RJE International. The SURTASS system is a passive surveillance system that consists of long acoustic arrays towed by the T-AGOS class naval ships. In support the Navy's ASW mission, SURTASS provides long-range detection, tracking and classification of both diesel and nuclear powered submarines. To ensure the recovery of these arrays, the U.S. Navy has selected RJE International's ATT-400 underwater acoustic transponder for subsea relocation in case of loss.

RJE/USN

USN SURTASS Program Support.

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