ROV PLANET

22

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ISSUE Q1 / 2020

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My name is Richie Enzmann, and allow me to welcome you all to the latest issue of ROV Planet!

Dear Reader,

Entering the new decade, we are kicking off 2020 with the beginning of the show season. Excellent events are in the pipeline this quarter: Subsea Expo, Underwater Intervention, Oceanology, and the OCEANS conference. In this issue we take a look at the success of OCEANS Seattle and preview what Oceanology has to offer for ROV & AUV professionals.

The year has brought another series of new underwater vehicle development. Aleron Subsea are showcasing their new MultiROV. Historically, the company have been refurbishing used and second hand ROV systems. Now they are looking to become a new ROV manufacturer with a proprietary design of their own, building on their vast experience. We wish them good luck and success in this endeavour!

Another reoccurring theme is automation and intelligent subsea operations. We have caught up with Roberto Di Silvestro, Head of Saipem-Sonsub, and Giovanni Massari, Project Manager at Saipem-Sonsub, for an interview to learn more about Hydrone, a new range of automated underwater vehicles that they have been working on. In relation to the intelligent subsea ops, you can also read about the subsea digital twin from Abyssal and their recent case study with BP.

Finally, our friends at Digital Edge subsea have announced the version 5 of their Edge DVR system with enhanced functions and additional capabilities.

Best regards,
Richie Enzmann

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Front Page Cover Photo: Courtesy of iXblue
Poster Photo: Courtesy of Saipem

EVENTS CALENDAR 2020

For more information about all events visit WWW.ROVPLANET.COM

FEBRUARY

UNDERWATER INTERVENTION
New Orleans, LA, USA (5-7 February 2020)

SUBSEA EXPO
Aberdeen, Scotland, UK (11-13 February 2020)

MARCH

OCEANOLOGY INTERNATIONAL
London, England, UK (17-19 March, 2020)

APRIL

MTS TECHSURGE
Fort Pierce, FL, USA (1-2 April, 2020)

OCEANS 2020
Singapore (6-9 April, 2020)

MCEDD
London, England, UK (21-23 April, 2020)

MAY

OFFSHORE TECHNOLOGY CONFERENCE (OTC)
Houston, TX, USA (4-7 May, 2020)

DEEP SEA MINING SUMMIT 2020
London, England, UK (13-14 May, 2020)

UNMANNED MARITIME SYSTEMS TECHNOLOGY
London, England, UK (13-14 May, 2020)

UNDERSEA DEFENCE TECHNOLOGY (UDT)
Rotterdam, The Netherlands (26-28 May, 2020)

JUNE

IOSTIA BLUETECH EXPO
Washington, DC, USA (10-11 June, 2020)

AUGUST

ONS 2020
Stavanger, Norway (31 Aug – 3 Sept 2020)

SEPTEMBER

WINDENERGY
Hamburg, Germany (22-25 September 2020)

TELEDYNE MARINE USERS CONFERENCE
Halifax, Canada (29-30 September 2020)

OCTOBER

OCEANS 2020
Biloxi, MI, USA (19-22 October 2020)

EURONAVAL 2020
Paris, France (20-23 October 2019)

OFFSHORE ENERGY
Amsterdam, The Netherlands (26-28 October 2020)

NOVEMBER

ADIPEC
Abu Dhabi (9-12 November 2020)

OSEA2020
Singapore (24-26 November 2020)

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Courtesy of iXblue

DRIX AN EFFICIENCY MULTIPLIER AGAINST TRADITIONAL METHODS

After successful trials conducted for Total in the Caspian Sea in 2018, DriX was once again chosen to bring agile, disruptive and innovative services to the Energy sector. Since its launch, iXblue's Unmanned Surface Vessel (USV) has indeed proven to be a real game changer and has gathered the interest of major actors operating in the Energy and Geosciences industries.

Drebbel, provider of offshore inspection, construction and trenching services for the Oil and Gas industry, and survey contractor Sulmara Subsea, having identified DriX as a lever for innovative competitiveness, approached iXblue in April 2019. The request? Evaluating DriX as an alternate to ROV-based pre-lay surveys in the shallow waters of the Gulf of Mexico.

One of the most important offshore petroleum production regions in the world, the Gulf of Mexico covers a surface area of 1,550,000 km2 with an average depth of roughly 1,615 m. The more localized area off the coast of Mexico, where DriX operated, however possesses much more shallow water oil production in the range of 100 m. This specific area, that has undergone a major O&G commercial boom in the past few years, with many new platforms being installed, has now become the theatre of important subsea operations, pipeline coupling being needed to connect the various installed platforms and take production to shore.

Seeking to conduct more efficient and cost-effective operations, offshore companies are now looking at new disruptive ways to gain more efficiency for their surveys and the positioning of their subsea assets.

"Sulmara Subsea is very innovative company that is seeking to bring disruptive innovations to their clients," explains Olivier Cervantes, Vice-President Marine Services at iXblue. "They believed in DriX potential from the very start and reached out to us as soon as they received Drebbel's request for pre-lay survey operations in such a challenging region of the world."

Pipeline route survey's prior to installation campaigns being required to define the subsea topography, its hazards, debris, as well as the soil characteristics prior to trenching operations, ROVs equipped with Multibeam Echosounders and Sub-bottom Profilers, are traditionally used to acquire all the necessary data to create a comprehensive cartography of the

seabed, including a Digital Terrain Model (DTM) that will give all bathymetric information and a seismic profile showing the soil composition to around 50 m depth under the seabed.

"For this particular mission, the end client was requiring a DTM with a 25cm resolution," Olivier continues. "One of the challenges was to make sure we reached this resolution from the surface in 80 m of water depths and at a high speed (6 knt). The use of a surface vessel, that can conduct operations at a much faster rate than a ROV, was of particular interest for Sulmara Subsea and Drebbel."

A more efficient and cost-effective solution compared to traditional ROVs which operate at 1 knt and require more people and logistics, it was decided that DriX would be sent to Mexico where it subsequently surveyed 90 kilometers of pipeline route at up to 6 knt in the shallow waters off the coast of Mexico.

For the first phase of the project dedicated to the pre-laid survey, a multibeam Echosounder with a specific set-up was installed within DriX gondola, two meters below the surface of the sea. The USV performed the survey operation at speeds reaching up to 6 knots and successfully provided images within the required 25 cm resolution.

"Using DriX during over several months on our project in Mexico was a real game changer. Its efficiency was second to none and enabled us to drastically reduce vessel time," explains Kevin McBarron, CEO at Sulmara Subsea. "Within 24 hours, DriX proved to be able to provide high resolution imaging 4 times faster than traditional data acquisition by ROV in up to 100m water depths. Thanks to the efficiency delivered by the iXblue USV we were able to gain much more efficiency as compared to using traditional methods and we expect to improve on this on next year's campaign. DriX is truly a new and disruptive technology that really moved the needle for our customer and fits very well with Sulmara's approach to delivering innovative solutions for our clients. We look forwards to further collaboration with iXblue in the near future."

This first phase of the pipe laying operations completed and other production sites having already undergone the trenching operations, DriX then performed the last phase of the project: the as-laid survey. Still equipped with a Multibeam Echosounder, DriX successfully surveyed the pipelines and concrete mattresses already laid on the seabed to record their position and physical condition.

"Overall, this 7-month mission was another success. DriX not only proved to be the perfect tool to save precious vessel time by conducting surveys much faster than traditional assets, it also provided incredible data resolution at shallow water depths, no compromise being needed between efficiency and quality. It was also proven that DriX offered a carbon footprint 10 times lower than a traditional vessel. This all makes the overall operation a great success for us" Olivier adds. "And, in order to further increase DriX operational efficiency for a new upcoming mission in Mexico, we are now in the process of integrating our Echoes sub-bottom profiler into DriX gondola, along with its current multi-beam Echosounder. Both sensors will thus be able to be used simultaneously during the survey, exponentially increasing our USV efficiency. Beside seabed mapping applications such as pre/post lay surveys, DriX will furthermore be conducting subsea positioning operations in the near future, widening the scope of its missions. We are very thankful for Sulmara and Drebbel's confidence in our USV that has for sure increased DriX reliability and efficiency in the Offshore environment and will allow us to be able to offer even more capabilities in 2020."


Courtesy of iXblue

After successfully completing the required phases of the project and bringing highly sought-after efficiency to the operation, DriX will thus return to the Gulf of Mexico's waters in early 2020. With a bright future ahead of iXblue's new USV in the Offshore Energy sector, 2019 will have finished proving that DriX is a disruptive force that is to be reckoned with and that brings agility and innovation to a market that is actively looking to reinvent itself.

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PIXELS TO DESK

(Courtesy of Rovco)

Rovco's SubSLAM X2 subsea camera system has been producing outstanding results for some time now. Our robust housing, capable of depths up to 1000m, contains a pair of large 4K sensors mated with precision lenses and a large amount of computing power. We use these to generate ultra-high-definition video and, in real-time, dense 3D point clouds which are colour-correct and automatically scaled.

We can now make this same data available to any desk in the world, live, while the ROV is still subsea. By transmitting video images and the point cloud over a low bandwidth link to a cloud server, we can deliver them to any device immediately, allowing defects and anomalies to be investigated right away. This is a major step towards delivering supervised remote autonomy, reducing cost and risk whilst increasing quality.

AN EXAMPLE

Let's take a look at how this worked during a recent demonstration: The docks at the Offshore Energy Catapult at Blyth near Newcastle offer a pretty typical environment for nearshore inspection work – shallow water and subsea visibility rarely exceeding a metre. We launched our SubSLAM X2 camera into the dock, carried by an inspection class ROV.

On the "seabed" we had placed a cable connector. Because the dock can be drained, we know a lot about this asset; exactly how big it is, what colour it is and the various knocks and bumps it's sustained over the years. We've also modelled it various times before, with previous SubSLAM editions, and completed a comparative study using a terrestrial laser scanner. On this occasion, we modelled the asset again to test improvements in our camera system and wanted to share the results with the team back at the office in Bristol, 300 miles away. Rather than getting on the phone and verbally describing the model we decided to use SubSLAM Live to put the model right on their screens. To connect, they simply had to log into our cloud-based Intelligent Data Platform, and immediately they could see the camera image, the model so far, and the position of the ROV as it manoeuvred.

The model is built live on-screen, allowing both teams to check the expected quality improvements while having the capability to measure sizes, angles and so forth, from any camera position thanks to the Platform's 3D model viewer. During the inspection, some areas of the top surface of the asset where still left to be surveyed. Rather than leaving it undone, the team were able to send a simple message to the pilot. Five minutes later they had the complete model they were looking for.

Not only were we sharing the model with our colleagues in the office, but our CEO was out on the road, and was able to log into our Intelligent Data Platform using his phone, keeping up with progress also in full, live 3D.

Finally, we were able to save the model and finish the survey. Without SubSLAM Live we might have needed to review the data offline and go back into the water, this saved us hours of work.

BANDWIDTH

This capability requires an internet connection both at the ROV end and at any machine that wishes to access Rovco's Intelligent Data Platform. We've measured the bandwidth required, and for a typical system, the bandwidth requirement sits comfortably below 200Kb/s, averaging around 120Kb/s. Latency, when running over the domestic mobile phone network, is less than a second.

We're able to achieve these remarkable figures not only by compressing the data but by also taking advantage of its internal structure. Because we have a deep understanding of what the data means, in terms of camera poses, points and pixels, we can make better decisions about how to shrink

it down. Repetition of data is avoided and pose graph updates are reduced to the minimum size. The result is an optimal combination of information: odometry information is updated most frequently, therefore, the ROV's movement can be tracked, with point cloud data and images following.

AUTONOMY

The real benefit comes when combining live 3D modelling with autonomy. Because we're able to send detailed 3D models to the desk and there are ROVs that are capable of station holding and relative movement, supervised autonomy becomes possible.

As the ROV moves from position to position in response to the supervisors' commands, a point cloud model is being built. Along with input from other sensors, an occupancy map is constructed. This map describes where obstacles are known to be, where is empty space, and where there are unexplored areas. This forms the basis of the ROV's worldview.

Unlike a traditional pilot, commands from the supervisor don't need to be second-to-second as this level of control is taken care of by the ROV's software: a combination of position sensing and the occupancy map means it will not perform perilous operations between supervisor commands. Intelligence in the ROV's software acts as a real-time safeguard.

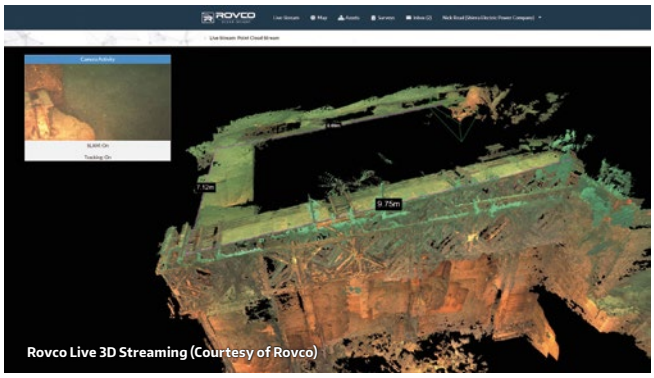
Rovco has recently demonstrated software which, based on the data collected, calculates where the ROV should move to next and sends that command back to the vehicle. These suggestions are calculated and weighted according to the current position and trajectory of the ROV, as well as a kinematic model. The cost, in terms of energy used, time taken, and tracking ability can all be considered.

Although we are clearly moving towards using machine intelligence to guide the ROV to achieve the best survey, supervised autonomy means that the control loop is closed with a human supervisor remaining in that loop.

ARTIFICIAL INTELLIGENCE

Images and models are not the only things that can be sent over low bandwidth links to an onshore operator. Rovco's camera system includes the ability to run advanced AI models in real-time alongside the state-of-the-art 3D modelling capability. We've recently revealed our improved model which includes the latest processors, giving us a 20x boost in performance for AI applications.

Because these AI models exist on the edge, ie on the ROV itself (at the point of data collection), they are co-located with the high definition video streams being captured. Although the video itself consists of hundreds of megabytes of data per second, the result of AI analysis is much, much smaller. It is not possible with today's technology to stream 4K video from an ROV to the cloud, or a remote desktop. However, a machine learning model, such as an anode depletion detector, for example, produces only a few dozen bytes.



Rovco Live 3D Streaming (Courtesy of Rovco)


Project Management from the Office (Courtesy of Rovco)

This information can be provided to an onshore operator who would be able to take appropriate action. In a world of supervised autonomy, we can amend the ROV's mission to take a closer look or simply carry on, assured that the data is securely and automatically logged.

The limits of what AI on the edge can do for the subsea industry have yet to be discovered. At Rovco, we're continually building new models which produce extraordinary results. Being able to deploy these in a remotely supervised situation will completely change the face of ROV surveys.

ABOUT ROVCO

Since its inception in 2015 Rovco has been growing quickly. We secured £10m of future contract revenue over the last 12 months, completing projects around the globe, and we've recently brought in £5m of private equity to help fuel us further. Behind our growth is a world-class team of experts in ROV operations, computer vision, machine learning, autonomy and web technology.

This potent mix of technologies allows us to deploy techniques not previously used in the subsea sector. The result is a step-change in the quality of data that we can deliver live and direct from an intelligent perception system. We have deployed across multiple sectors: renewables, oil and gas and others with outstanding results.

Our trajectory is towards putting machine intelligence into subsea inspections with the goal of producing fully autonomous systems. There are many new components in such systems, and it may take some time for the inherently conservative subsea industry to adopt them. In the meantime, we are realising benefits as steps along the way. Live 3D models on the desktop is just one of the many exciting technologies that we're bringing to market over the next few years.

Jupiter AIM

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Zetechtics announce the new Jupiter AIM Subsea Multichannel Shock & Vibration Acquisition System

Shock and vibration are significant threats to subsea systems, particularly for extended or permanent deployments where inspections are sporadic or impossible. The recent drive for permanently deployed complex subsea systems highlights the need for comprehensive monitoring of their operational state.

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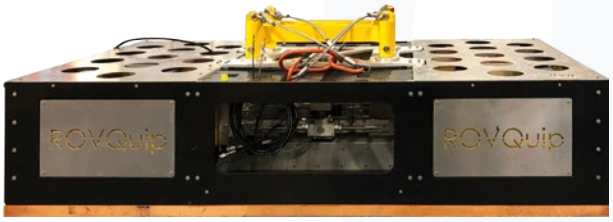

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THE MULTIROV
BRIDGING THE GAP

Subsea Expo 2020 brings the launch of a new generation in Remotely operated vehicle capability: Aleron Subsea's new MultiROV system a Multi-Purpose, reconfigurable Work Class ROV.

The MultiROV is an evolution of the work Aleron Subsea have been doing over the past few years with WROV system upgrades and the development of both the AUXROV and TRACKROV. This represents a shift in the type of operations being performed offshore and the need for specialist systems to perform tasks that current market WROV's have struggled to do. This consists of working in changeable, high inshore currents that cause operator's frustration as they pay to wait on the weather, ultra-shallow water operations where larger vessels can't operate, and carrying large tools with payloads up to 30Te which standard ROV frames can't handle.

Mobilising specialist ROV systems for short duration tasks isn't cost effective. Specialist systems also have limitations and don't have the buoyancy or freedom of a standard ROV to swim up close to structures.

BUT ALERON HAS A SOLUTION FOR THIS: THE MULTIROV

The MultiROV is a 300HP dual subsea HPU Work Class ROV that can be reconfigured to do all of the above. This means lower risk and cost mobilising and demobilising. The system will come with an enhanced thruster configuration option allowing it to hold station in head-on currents over 4 knots.

The MultiROV will also have a modular frame so that we can adapt from a free swimming ROV to a heavy-duty tooling ROV operating large grabs, mattress frames, or mass flow excavators. The ethos of the system is to deliver a 'swiss army knife' ROV that – once mobilised – will tick all boxes of ROV operations, in both shallow water and deep-waters.

The type of ROV operations MultiROV is targeting cannot currently be performed by Electric Workclass ROV systems, operating large grabs, mass flow excavators, shear tools, BOP intervention packages, etc.: all tools that as of today need large volumes of hydraulic fluid and pressure.

As befits a system designed for the 2020's and beyond, MultiROV operates on environmentally considerate oil (Panolin) and the system has advanced diagnostics, so operators of the MultiROV will be able to perform predictive maintenance. Since the system is network based there is future options for remote piloting.

The MultiROV will be available for sale or rental in 2020 and will come with various specification options and launch and recovery methods to bridge the gap in what is available on the market today. If you require more information, please contact Aleron Subsea: info@aleron-group.com

Courtesy of Aleron Subsea

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SAAB SEAEYE

NAVIGATING UNDERWATER AUTONOMY

By Ioseba Tena, Global Business Manager - Robotics, and
Rolf Christensen, INS Manager, Sonardyne International Ltd.

Change in the offshore oil and gas industry is often quite slow, including in the subsea domain. Remotely operated vehicles (ROVs), as a prime example, have largely taken the same form for a number of decades. However, change is now coming.

Equinor's Njord A facility, soon to be home to a Hydrone-R resident system. (Photo from Equinor/Thomas Soia)

While we'll still need work class ROVs for some time, there's a lot of new technology entering this space. It's supported by, and is in support of, increasing levels of automation; doing things smarter, creating digital twins or future oilfields.

These moves have not appeared out of the blue. There has been a lot of background work in this space for many years, from the development of electric ROVs to the systems that control them. But, it's the last 12 to 18 months that have finally seen contracts for the new type of subsea model, resident ROV systems. First, IKM Subsea installed its tethered Merlin UCV Resident ROV in a subsea garage beneath Equinor's Snorre B platform, a system which can be operated from shore.

Then, in October last year [2019], Equinor awarded a contract to Saipem for a Hydrone-R resident vehicle to operate on the Njord field, from early this year, and a Hydrone-W (W for work class) from 2021.

A decision on using yet another subsea resident system, with multiple underwater intervention drone (UID, as Equinor calls them) docking stations, was expected to be awarded on the Snorre Expansion Project, again by Equinor, in November. This is just the start.

MARKET DRIVERS

Driving these moves are market requirements – reducing cost, emissions and HSE exposure and increasing efficiency and digitalisation – while access to technology is making them possible. Key technologies now available include 4G networks across entire basins, such as the UK and Norwegian sectors and shallow water Gulf of Mexico, to enable remote control from shore where infrastructure isn't available.

Below the waterline, more and more ROVs, as well as hybrid vehicles, are now electric, and electric tooling is being designed too, making remote control and feedback easier.

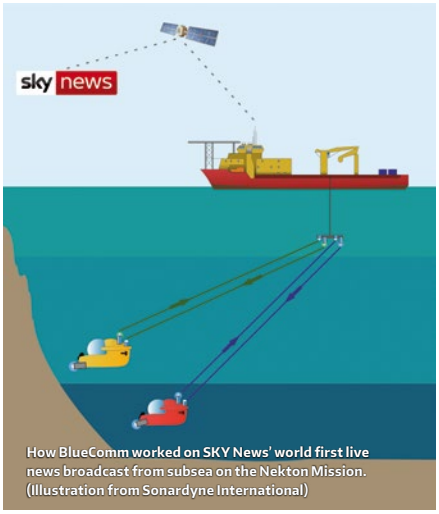
With electric systems, the ability to tap into the local infrastructure for power becomes possible to enable remote operation over long periods – or even temporary battery-supported deployments when infrastructure or nearby renewable energy sources aren't available. The sensors these vehicles need in order to gather data have also evolved, so much so that there's now actually a challenge in some areas around how to handle all the data they gather.

It also provides live HD video feed to allow onshore operators to control, in real-time, operations on the other side of the globe, with comfort and confidence.

Part of this challenge is already solved, using commercially available and proven through-water high bandwidth communications links, so that vast amounts of data can be transferred quickly, and operators can have live high definition video and control capability during critical intervention operations. Underwater navigation technologies have also evolved, with ever more precise, yet compact, systems established in the market.

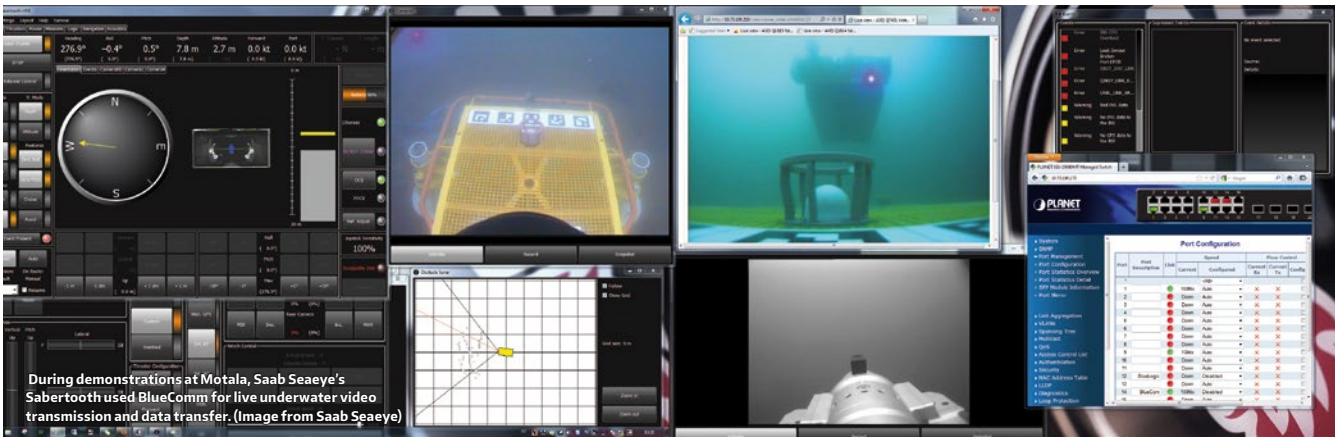
TECHNICAL ENABLERS

Sonardyne have been a leading proponent and enabler in this space, providing those critical links, in many cases ahead of the curve. And we're confident there's more to come. As an example, we brought BlueComm to the market, a proven through-water free space optical modem that can both transfer large volumes of data (up to 10Mbps over 150m), solving at least some of the data challenge. It also provides live HD video feed to allow onshore operators to control, in real-time, operations on the other side of the globe, with comfort and confidence. It's already been used to transfer data wirelessly between seafloor sensors and underwater vehicles in ocean science. Last year, BlueComm was used to transmit live footage from underwater vehicles to a surface vessel, which then relayed the video live to people's homes in the first ever underwater televised broadcasts – including the world's first presidential address from underwater. It's also been used to upload large data files from autonomous under water vehicles (AUVs) to unmanned surface vessels (USVs).

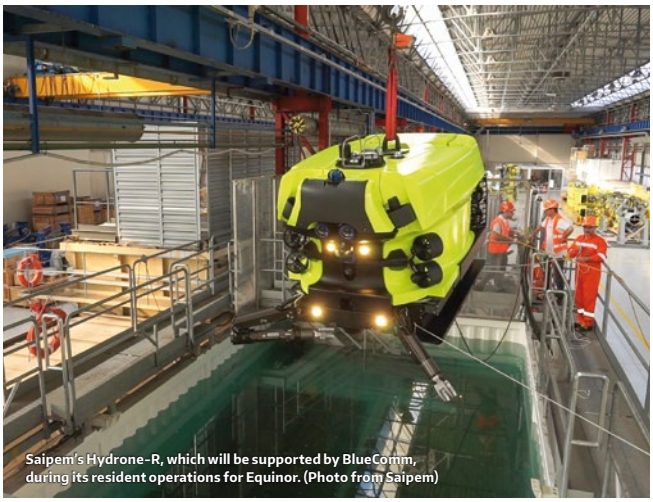


How BlueComm worked on SKY News' world first live news broadcast from subsea on the Nekton Mission. (Illustration from Sonardyne International)

SKY News' Anna Botting broadcast live from underwater in a submersible using BlueComm. (Photo from Sonardyne International)



During demonstrations at Motala, Saab Seaeye's Sabertooth used BlueComm for live underwater video transmission and data transfer. (Image from Saab Seaeye)



Saipem's Hydrone-R, which will be supported by BlueComm, during its resident operations for Equinor. (Photo from Saipem)

Saab Seaeye's Sabertooth, with BlueComm onboard, after trials at Motala in Sweden. (Photo from Saab Seaeye)

Returning to resident vehicles, last summer, we were delighted to demonstrate BlueComm in action at Saab Seaeye's demonstration day in Motala, Sweden, where live docking, control and data download from their Sabertooth AUV onto an Equinor subsea docking station (SDS) was supported by BlueComm. This year, we'll be looking forward to supporting Saipem when it deploys its Hydrone-R at Njord, complete with a pair of BlueComms for live control and video feed.

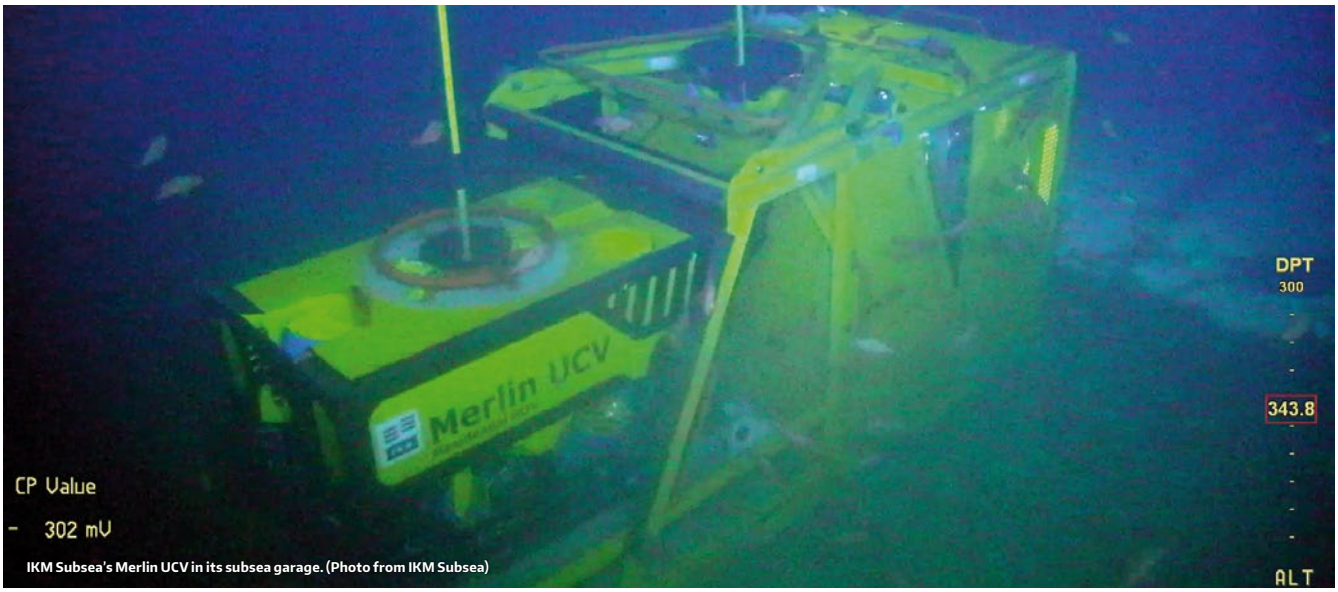
NAVIGATION

Another example of already proven and well-established enabling technology is SPRINT-Nav, which combines our SPRINT INS sensor, Syrinx DVL (Doppler velocity log) and high accuracy intelligent pressure sensor in a single housing. It has set a new standard in acoustic-inertial hybrid navigation in one of the smallest combined instruments on the market. It's a market leader and has even outperformed our expectations (achieving 0.02% drift on distance travelled), so much so that, last year, based on a huge data set that we've built up since the first SPRINT-Nav went out to work, we revised our specifications for it.

It's supporting demanding underwater vehicle operations, such as Cellula Robotic's Solus-LR, a vehicle designed for long-distance, port-to-port operations, and the National Oceanographic Centre's A2KUI AUV, which will have a SPRINT-Nav 700 to aid its under-ice missions. You don't get much more demanding than that.

SPRINT-Nav is also supporting new breed of vehicles, including fast and autonomous pipeline inspection vehicles and resident robotic systems, including Oceaneering's Freedom AUV and IKM Subsea's Merlin UCV R-ROV. We were delighted to see SPRINT-Nav in operation on the Freedom prototype at Tau, near Stavanger, Norway, in autumn last year when Oceaneering demonstrated its automated docking capability onto Equinor's SDS.

Sonardyne's SPRINT-Nav hybrid underwater navigation instrument. (Photo from Sonardyne International)



IKM Subsea's Merlin UCV in its subsea garage. (Photo from IKM Subsea)

The demonstrations at Motala and Tau are helping to show the capability of these systems and what's already possible with the technology we already have today. That contracts are now being awarded shows that there's confidence in these systems and that there's a future for them.

FIELD-WIDE NETWORKS

We believe that there's still room to run, however. First, there are other tools available to underwater vehicles, in all their forms. To further enhance their localization in the subsea environment, vehicles can use acoustic aiding from sparse LBL nodes. With sparse LBL, vehicles can operate for longer without reducing their positioning accuracy.

This technique is already well established in the ocean science and offshore sectors for mobile mapping operations, where the sparse LBL array acts as a reference and aids INS positioning for more accurate survey data. In 2014 and 2015, oceanographic research centre Monterey Bay Aquarium Research Institute (MBARI), in California, used ROV mobile mapping techniques, supported by Sonardyne, and achieved angular accuracy below 0.5°. The level of accuracy achieved means that this is a frequently used technique.

A sparse LBL array, using our 6G acoustic Compatts and Wideband 2 signal architecture, can also be used to wirelessly transmit data over thousands of meters, which means AUVs can also use these beacons to update their navigation computer and transfer status information. Then, when they're close to a docking station or a structure with which they have to interact or download high-bandwidth data from, BlueComm can kick in. It's all there and available today.

GOING REMOTE

The next step, for remote locations, where there's maybe not a hard wire to a nearby facility, which itself is hardwired to shore, data buoys or USVs can be used as communications gateways, enabling live communication and control. This could be to an ROV or AUV system deployed on or off a tether from the USV, which can be tracked and controlled using our family of USBL systems.

We're already working with a number of clients to make these concepts happen and demonstrated what's possible in the 2018 in the UK-supported Autonomous Surface and Subsurface Survey System (ASSSS) project, led by ASV, now part of L3Harris Technologies Inc. This saw an NOC ALR transfer data acoustically through Loch Ness's deep and murky water, using our AvTrak 6G combined transponder, transceiver and telemetry instrument, and our Wideband 2 signal architecture, to a C-Worker 5 USV, equipped with our Ranger 2 Gyro USBL system, which then transmitted the signals to shore.

This project also saw the ALR transfer high-bandwidth data to the C-Worker, using BlueComm. AvTrak can also support AUV-to-AUV communication, enabling cooperative operations – a function which is already being used in the defence and ocean science sectors and is easily transferable to oil and gas and offshore renewables activities.

With BlueComm, sparse LBL and AvTraks, a complete communication and navigation network is enabled subsea, permanently within green field projects or on an ad hoc basis in a brown field. It's a system any contractor arriving in field to perform any inspection, maintenance or repair operations can have access to. It can support and enhance the operator's digital models of their oilfield infrastructure. It enables the subsea digital twin, the underwater internet of things – whatever you might want to call it.

LOOKING TO THE FUTURE

So, the market drivers are there for advanced underwater systems. The technologies are there and are being used today. What's next? We believe there's more to come and we're already working on new solutions that will open up some of the capabilities we've explained above to an increasing number of underwater vehicles. We look forward to telling you more about that another day. As they say, watch this space.

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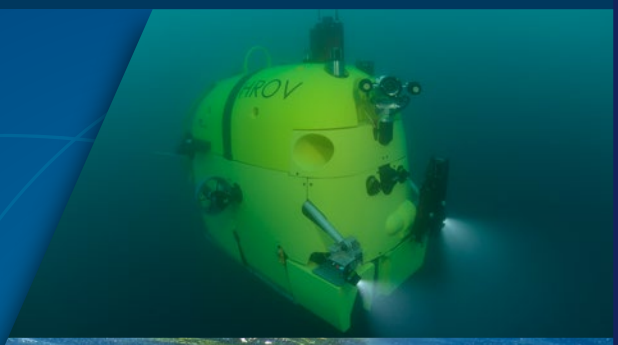

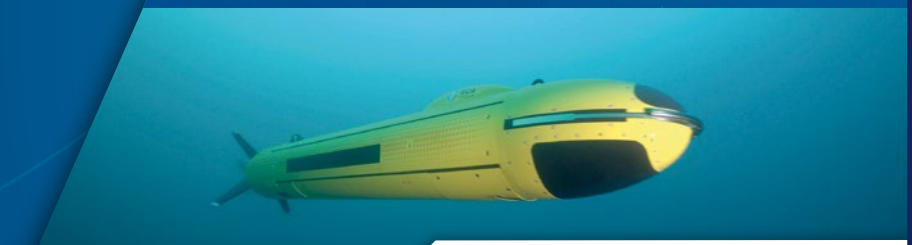

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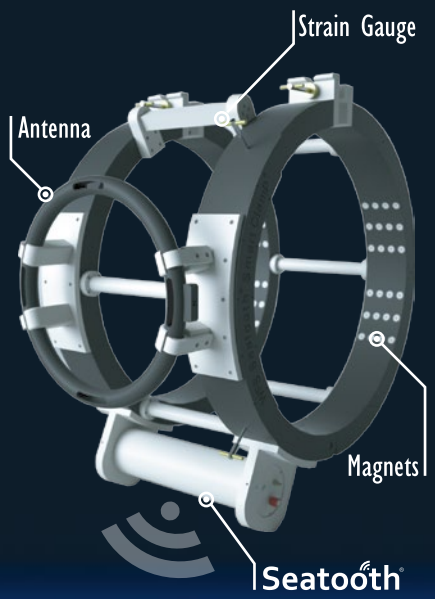

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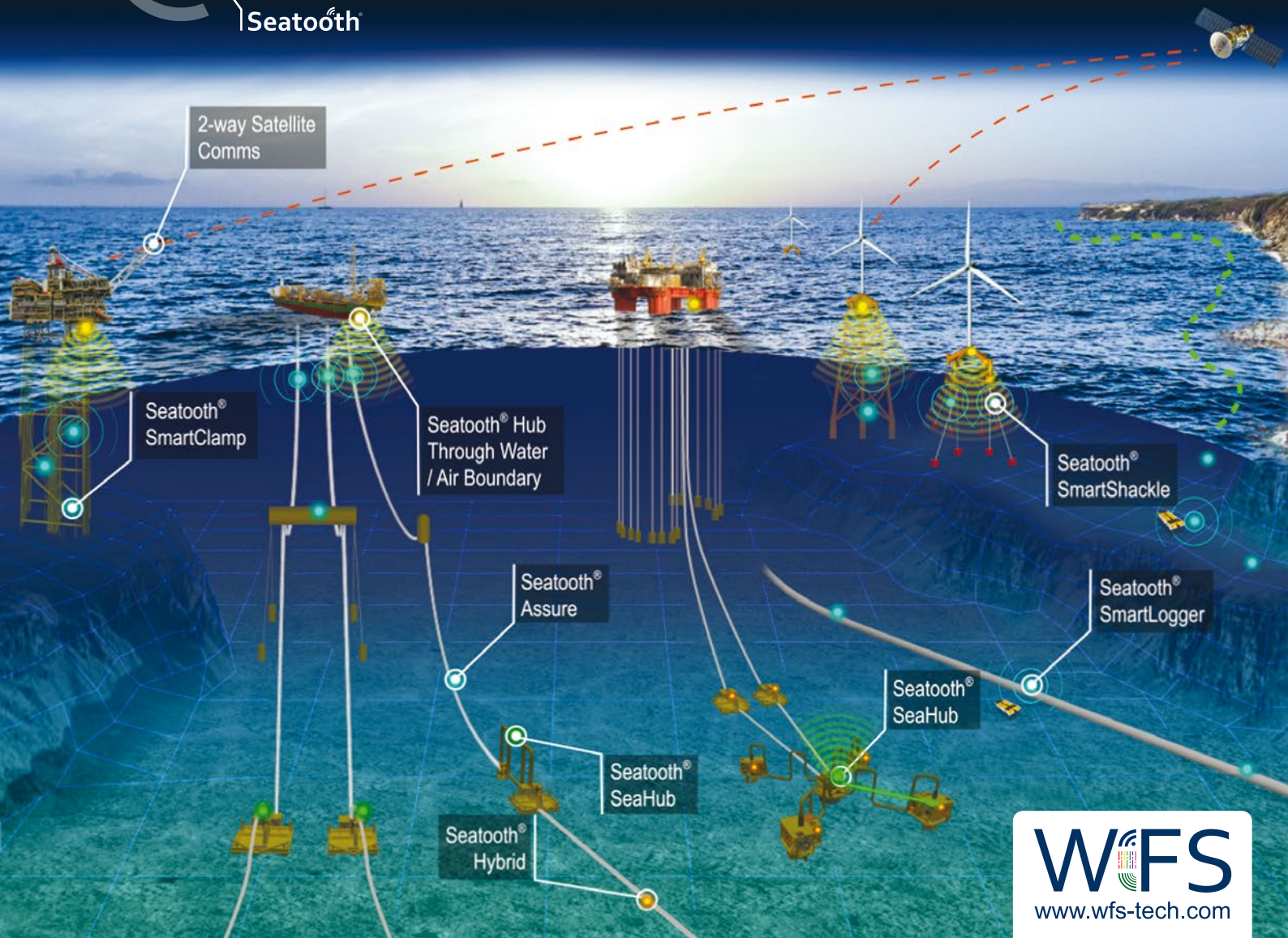

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THE FUTURE OF REMOTE SUBSEA OPS USING THE DIGITAL TWIN

ABYSSAL'S TECHNOLOGY AND OPERATIONAL TOOLS – THE IDEAL SOLUTION FOR UNMANNED OPERATIONS

Abyssal is a company that's been leveraging the best tools, practices, and employees to deliver state of the art scalable software products and technology. The team's expertise includes a wide scope of technologies and applications – ranging from 3D visualisation, digitalisation, physics simulation to machine learning and artificial intelligence – and have been successfully delivering projects over the past 8 years.

The current portfolio of products was developed in close collaboration with the industry and are focused on providing safety and efficiency throughout the entire project lifecycle. The core product offering of the company – the abyssal cloud, offshore, and simulator – deliver the most complete subsea digital twin solution available on the market.

Abyssal has developed a platform, that incorporates a 3D visualisation engine and a survey grade Geographic Information System (GIS) and is able to acquire, process, and integrate data in real-time from multiple sources. Abyssal's methodology relies on an innovative approach of integrating all relevant data that results from offshore operations, and is time-stamped, and geospatially referenced in a 3D platform.

Courtesy of Abyssal

The platform is capable of digitally integrating both historical and real-time data from various systems with different formats, to be stored, contextualised, and correlated in order to provide a robust knowledge-management system for any stakeholder at every stage of a project.

The scalability of the Abyssal platform has enabled the company to quickly develop fit-for-purpose digital tools to support planning, risk management, monitoring, command and control, and remote operations, all within the same ecosystem. Clients and partners can get easy access to the portfolio of products through the Abyssal Cloud, a web-based application and managed cloud platform with integrated data services. It allows users to create, manage, and share digital assets throughout the entire project.

FOR DESIGN AND ENGINEERING:

This solution inherits the platform capabilities and thus is able to integrate data from different sources – GIS, bathymetry, 3D models, imagery, point clouds, documentation systems, asset integrity systems, metocean data – into a single platform. This provides engineers and project managers with fully contextualised information of the subsea field environment. It also allows engineers to collaboratively perform design reviews, risk assessments, design procedures, and a range of other features on the entire virtual scenario.

FOR INSTALLATION AND OPERATIONS:

Cloud and satellite communication technology allow operational teams to track and manage offshore operations from any location in the world. It provides an evergreen view of fields and a complete picture of offshore operations in real-time.

A key component of the Subsea Digital Twin is the Abyssal Simulator. This operational tool is also built on top of the Abyssal platform, enabling it to make use of the same data generated by the different tools. It also allows users to correlate GIS, 3D models, material density, and environmental specific conditions to create multiple virtual scenarios.

Courtesy of Abyssal

The company's precision approach for the simulator translates into enhanced applications for training, system integration testing, hardware in the loop and synthetic data generation for machine learning.

By allowing engineers to design and plan operational procedures in the 3D virtual environment, instead of running an offshore campaign, the Abyssal Simulator is saving several vessel days, and reducing risk, cost, and their carbon footprint.

The device layer (IoT component) of the Abyssal Platform is the Abyssal Offshore that closes the loop to create the full Subsea Digital Twin. Connected directly to the ROV control room, the Abyssal Offshore is a real-time management tool for offshore operations with data processing capabilities. Based on 3D visualisation, GIS, and Augmented Reality technology, it provides users with a live 3D overview of the operation's environment, increasing their overall visibility and spatial awareness, improving safety and efficiency in navigation, and eliminating any downtime due to low visibility.

Abyssal 3D and augmented reality features coupled with the Abyssal Cloud and Simulator provide the complete digital toolbox to support multi-site, multi-UIDs and ASVs teleoperation with a full functional traffic and data management system.

Abyssal's approach to offshore operations relies on providing easy-to-use tools to create digital assets, as well as generating new knowledge that will provide a continuous improvement for future field design and operations.

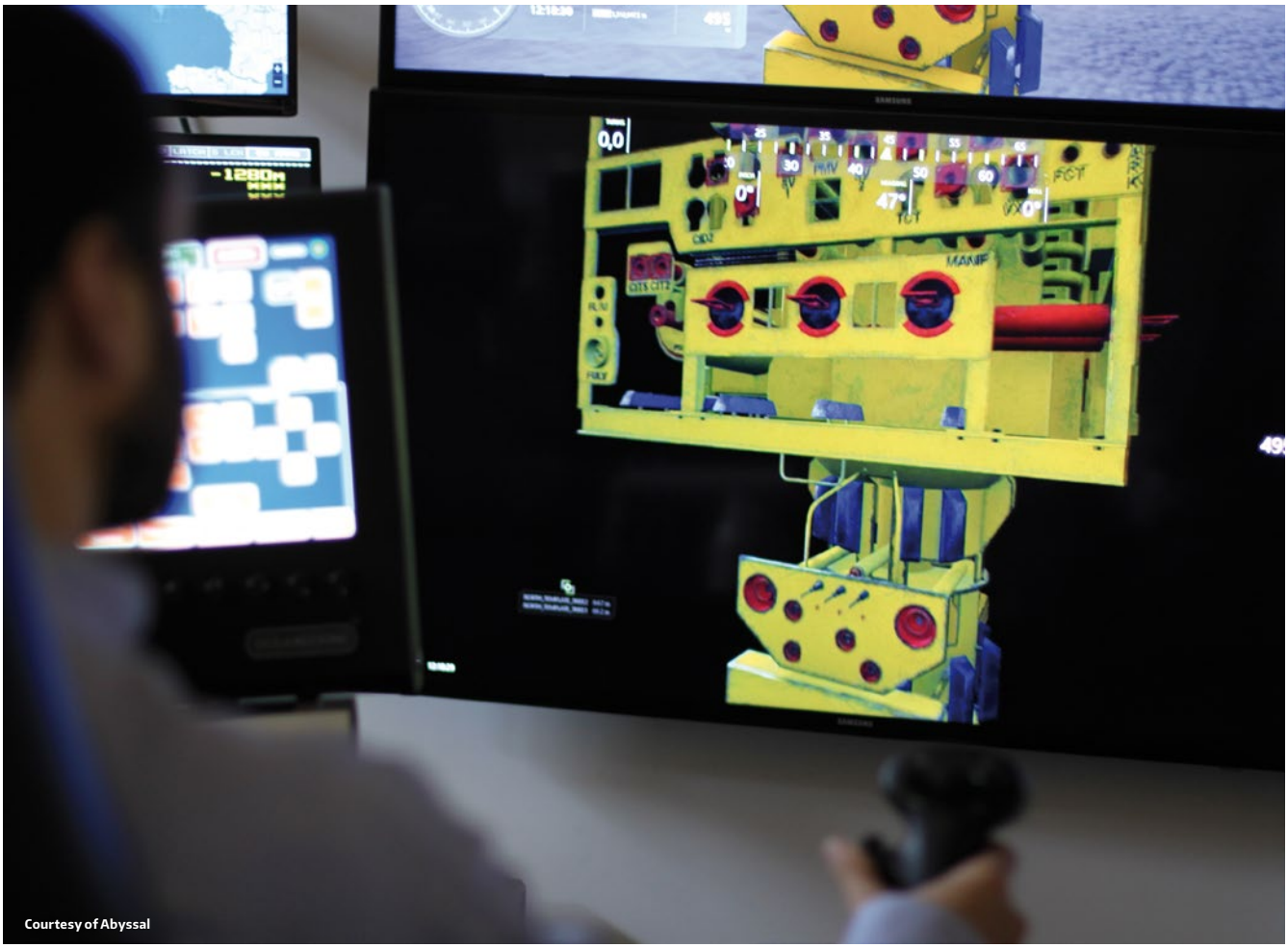
BP LIVE DEMONSTRATION CASE – AN ABYSSAL CASE STUDY

'It was a giant leap to get suppliers to think out of the box about using no manned vessels for inspection and environmental monitoring.', says Joe Little formerly of the Digital Innovation Office at BP and now advising the subsea industry on its march to automation. 'But we needed to go a step further to get the business to feel 100% confident in deploying these systems close to infrastructure.

'What we needed,' explains Little, 'was something we had initially designed out of the program: full visibility of the operations as they happened not processed reports months later.'

Enter BP. They are committed to capitalising on unmanned and autonomous technology for conducting subsea inspection, aiming to have 100% of subsea inspections performed via Marine Autonomous Systems (MAS) by 2025.

Little tells us a little about the steps BP carried out in the process of developing these MAS in recent years. 'We previously thought that low cost devices should be the main



Courtesy of Abyssal

focus and we had a huge success in driving down the cost of operations,' he says. 'But these sensor driven devices didn't provide that final reassurance of seeing it all happen live.'

What the team needed was one further, large-scale trial. In this respect they received a lot of support from Abyssal. They're a well-established independent software company with long-term relationships, having developed and provided state of the art products and technology to major players within the subsea industry.

'We went back a step to look at what was happening at Abyssal and the subsea "air traffic control market"... (we) were astonished at how far this had come in the 3 years we were running trials.'

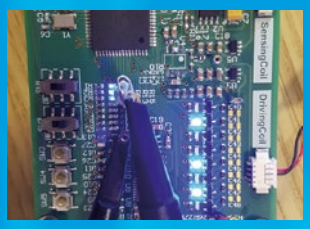
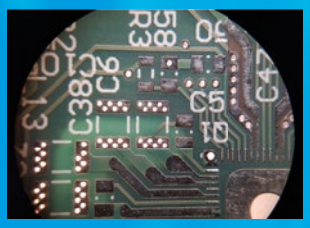
Abyssal – alongside L3 Harris, and Blue Ocean Monitoring – performed a live on-water demonstration to showcase a complete autonomous inspection of a virtual pipeline in the Plymouth Harbour. This was 'just one further trial using the Abyssal platform to rehearse, visualise, and interact (in) real time,' Little recalls. 'Our combined ASV, ROV, and AUV trial in Plymouth was ideal for this. The demonstration involved an Autonomous Surface Vessel (ASV) deploying a Remotely Operated Vehicle (ROV) and supporting an Autonomous Underwater Vehicle, while both subsea vehicles where performing the pipeline inspection.

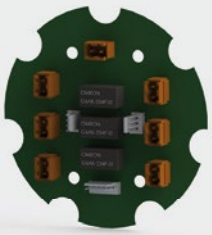
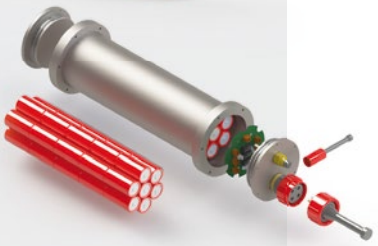
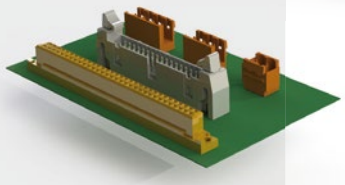
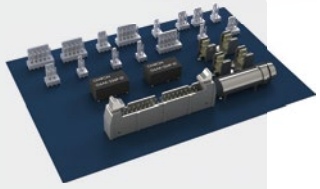
Abyssal's task was to use its products to plan and support the operation, by acting as a traffic and data management system, and by monitoring the entire operation in 3D and in real-time and disseminating the information to several onshore locations – London, Houston, Baku, and Porto. Little describes the entire feat as 'something bigger', something to' beam to our main offices and get people thinking more disruptively about true remote operations.'

'The trial was a huge success and has really changed people's attitudes in the industry about how we approach subsea inspection and monitoring.'

'(Going forward) I see so much written in articles about Digital Twin technology, being able to have a digital asset that replicates in real time the real asset; enabling remote operations, remote decision making, and planning without actually having to be there or even in the office for that matter.

'Just think: very soon we could have global subsea operations for entire companies being run thousands of miles away providing context to industry experts as and when needed. I see this as the cornerstone technology for remote operations and the future of the subsea industry.'

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DIGITAL EDGE SUBSEA

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DIGITAL EDGE SUBSEA ANNOUNCE DYNAMIC NEW RANGE OF SYSTEMS

Digital Edge Subsea Ltd have been prominent in the subsea industry for more than 10 years now and are known for their reliable and effective digital video recording system. While the well-known Edge DVR series has served customers well, John Benson MD recognised the opportunity to improve it for their customers around the world.

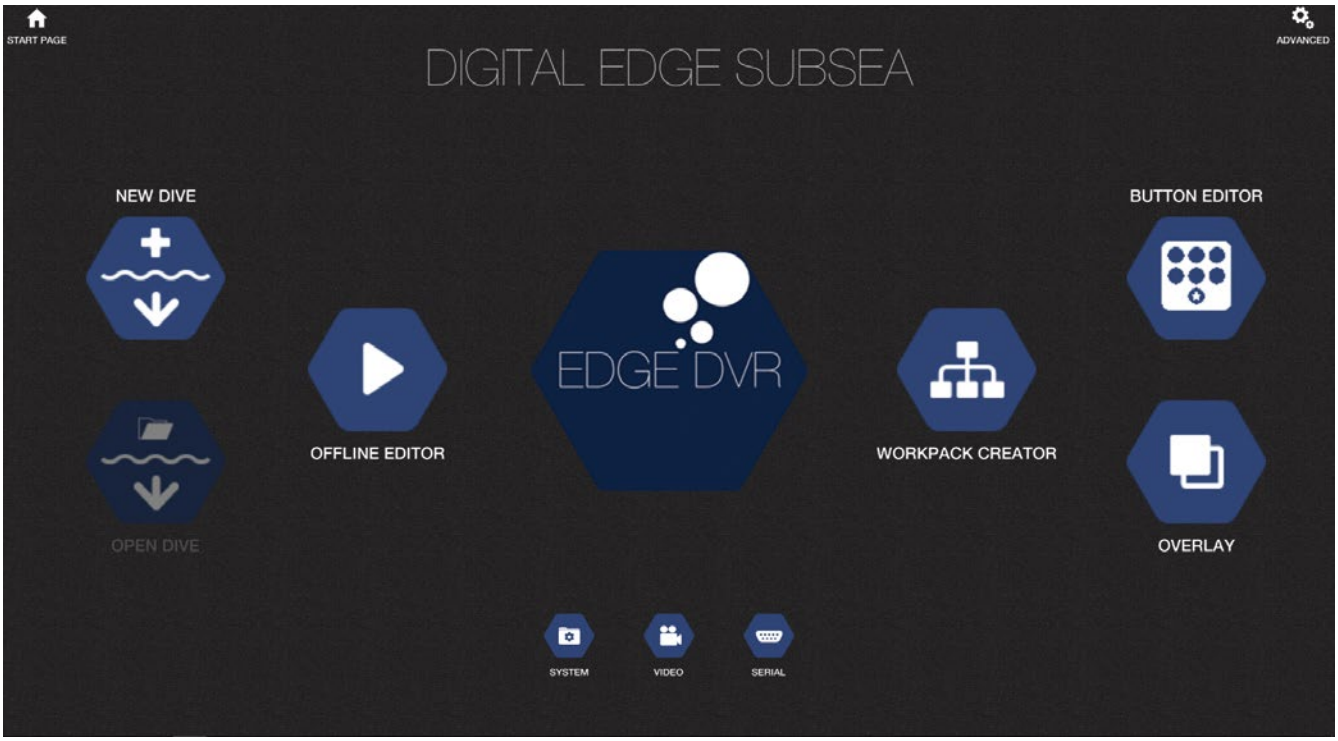
DIGITAL EDGE SUBSEA

And so, John assembled his team and some new additions to make this happen. They have used feedback from their customers in conjunction with their own expertise to produce an up to date system like no other.

Digital Edge is known for its supportive approach towards their clients and they pride themselves on creating great relationships with customers, suppliers, and distributors. Strong links here have helped with the development of the Version 5 product.

Because John spent 20 years offshore, it's this experience that has given him clear insight into the niggles and challenges his customers face. John is a man of ideas and action, in terms of tinkering about with something new or improving an existing idea or product.

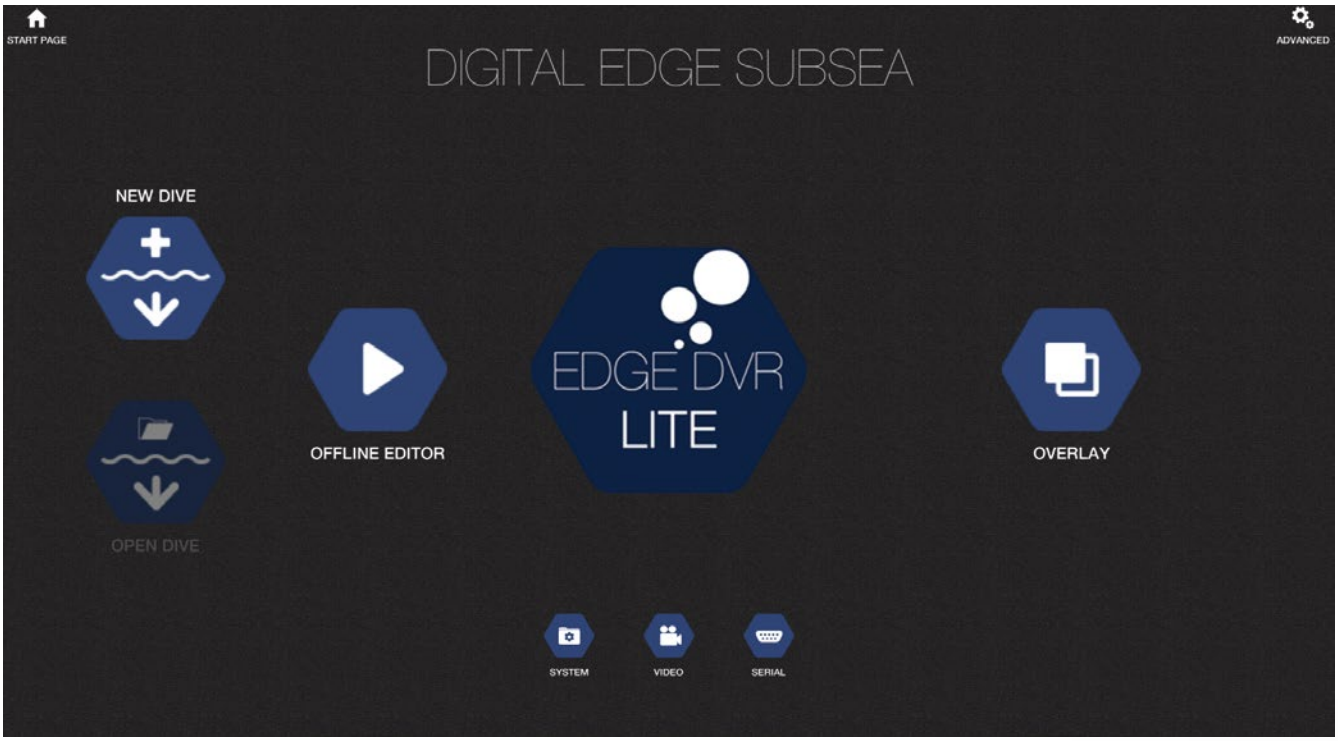
So, 11 years ago he had the idea to create what has since become the Edge DVR. He saw a gap in the market that could support his hard-working colleagues offshore and this drove him to create the company alongside two other business colleagues. The company has changed and evolved to a point now where John remains as the only founder of the business and he has a strong team of 11 around him.

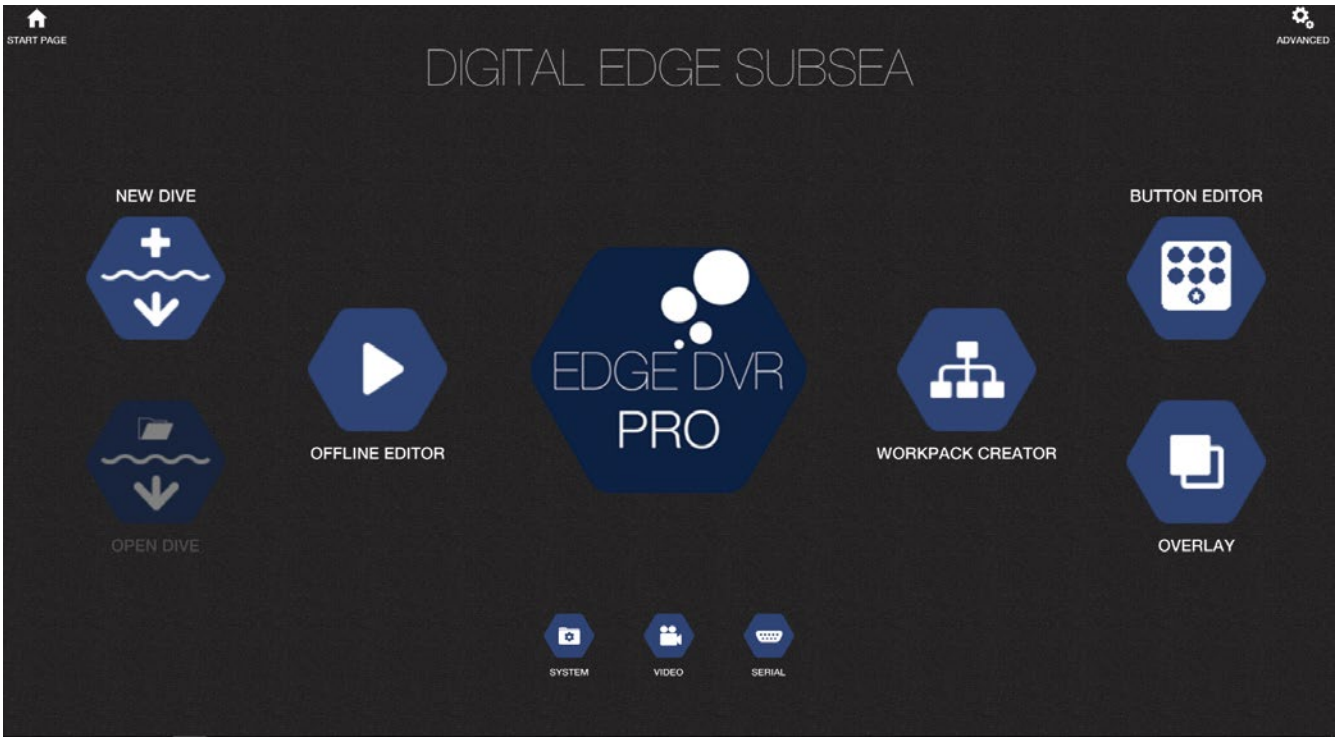


Since 2009 the company has grown immensely and now produces a broad range of products covering all manner of needs. Their primary focus is on the digital video recording systems used by the ROV and diving industries. And the Digital Edge Subsea's digital recorder, digital video overlay, and video inspection equipment are all capable of producing the highest quality output while requiring minimal work from the user.

Version 5 of the Edge DVR began development this year, with testing taking place over recent months. Digital Edge are excited to launch this new product because it's matched with up to date hardware. They've created a fresh look and a device with increased recording capability.

The new system has three levels of software: EdgeLite, Edge, and EdgePro. EdgeLite is the most basic of the recording systems and is the entry level unit, suitable for surveys and inspections where there is no requirement for eventing. This product will record 4 channel video with overlay, but with no eventing capabilities. The company's





customers range in size, and this product has been developed to provide their smaller customers with the same great recording capability at a fraction of the cost.

Version 5 of the EdgeDVR will provide the same capability as the current Version 4 but with the added advantage of being able to record 4 channels of HD simultaneously. As with Version 4, eventing, the creation of work-packs and offline editing are all features that are included. Digital Edge continue to place the main focus on the end user for all of their products.

The EdgePro is an addition to the product range, developed to expand the software into the inspection department. The EdgePro will have all the capabilities of the EdgeDVR, but with the addition of an extended database that allows users to assign tasks to components under inspection. This also means they can then create work-packs themselves from approved work-scopes, or these can be created by Digital Edge, as Tracey Lawson is an experienced CSWIP 3.4u Underwater Inspection Controller. The deliverables to the customer will include an automatically generated report to capture all of the inspection results.

The hardware also has 3 main types, Standard Definition, High Definition, and their first 4K system. The addition of a 4K(UHD) model reflects the technology that is now being used on some of the latest ROV and diving systems worldwide.

The 4U rack-mounted version has a total storage capacity of 12TB. The system has 3 removable hard drives, and the Windows 10 operating system is stored on a solid-state hard drive for increased speed and reliability, with a second mirrored SSD for redundancy.

All versions are available through a rental service and can be delivered worldwide. Customers who rent the models benefit from the company's flawless support service, the same as any other customer.

Some users need portability and often the conditions that they work in have limited space. This was the inspiration to put the system onto a laptop. The laptop version has a total storage capacity of 3TB. The system has an external 2 TB SSD drive which stores the survey data. The Windows 10 operating system is stored on a 2 x solid state hard drive (Raid) for increased speed and reliability. Creating a laptop system is an industry first.

John and the team continue to offer demonstrations of their systems and free offshore trials, Version 5 included. You can also contact the team to request a brochure at: **wendy@digitaledgesubse.com**. Or to find out more or book some time with John, please contact him at: **john@digitaledgesubsea.com**

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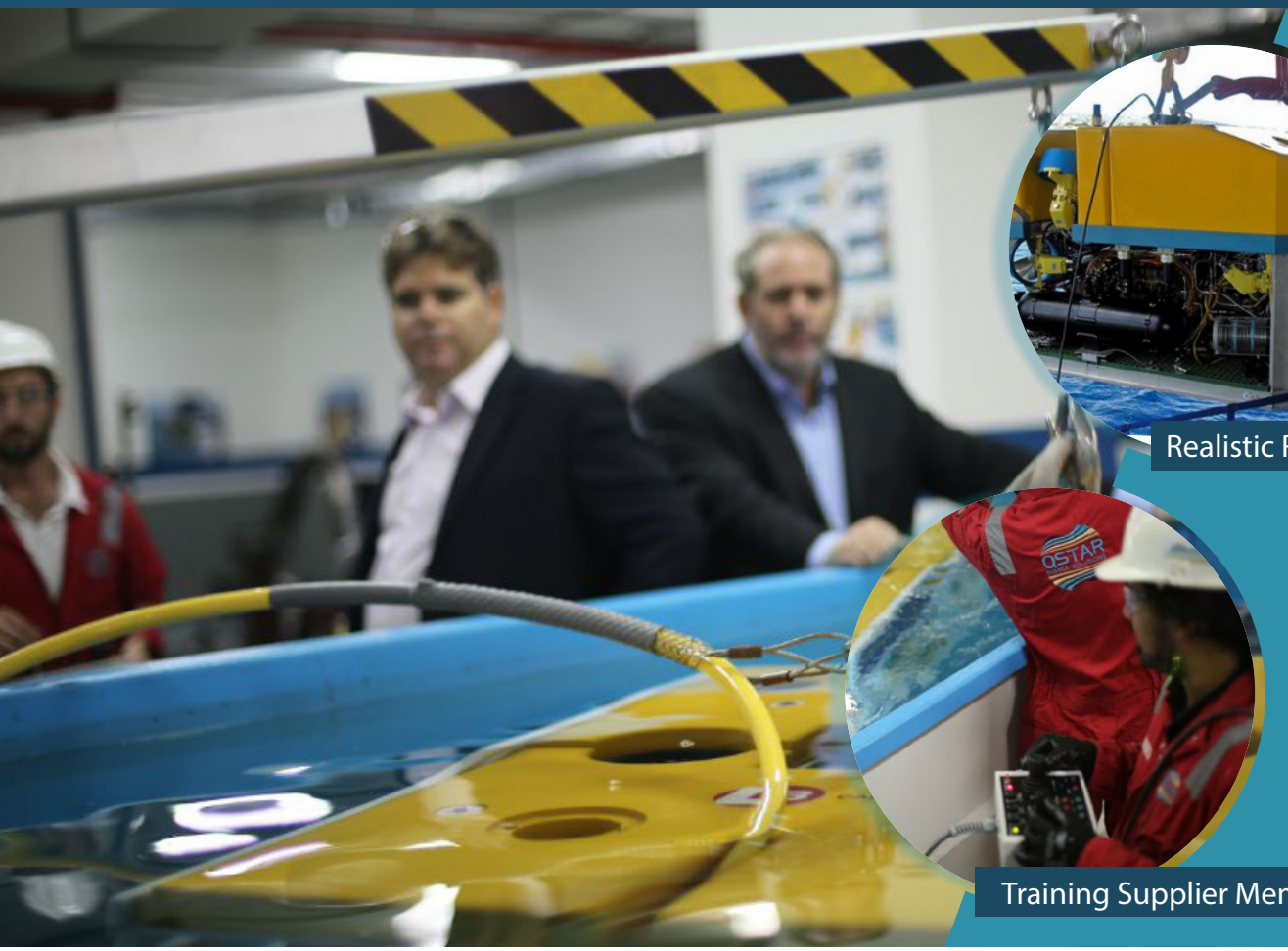

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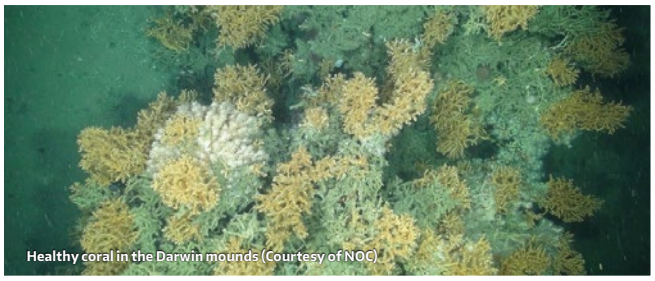
RESEARCH EXPEDITION MAPS SCOTTISH SEABED

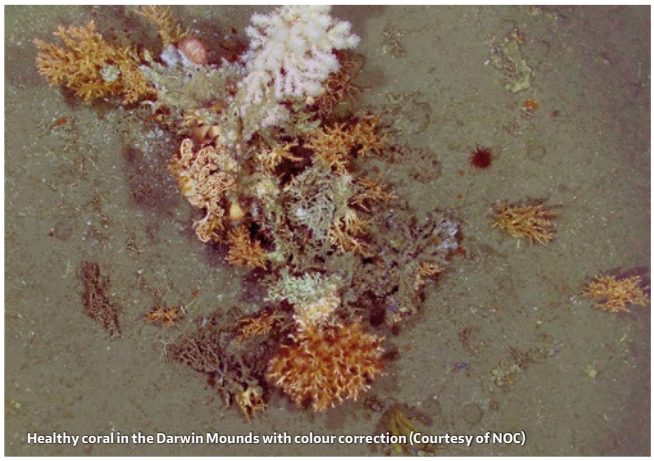
USING THE BIOCAM TO STUDY RECOVERY OF CORAL REEF

Newly developed 3D imaging technology has allowed scientists to map an area of cold-water coral reefs off the coast of Scotland to see whether it has recovered since being declared a Marine Protected Area 16 years ago. The images show that in areas of the Darwin Mounds that had been heavily trawled, coral growth is still very sparse, and there has been no real re-colonisation. However, healthy coral growth was found in parts that had only been minimally damaged by bottom trawling, indicating that marine conservation measures are most effective when they are put in place before damage occurs. The team also discovered a large amount of plastic waste snagged on the coral.

RRS Discovery (Courtesy of NOC)


Healthy coral in the Darwin mounds (Courtesy of NOC)


Coral rubble in the Darwin Mounds (Courtesy of NOC)

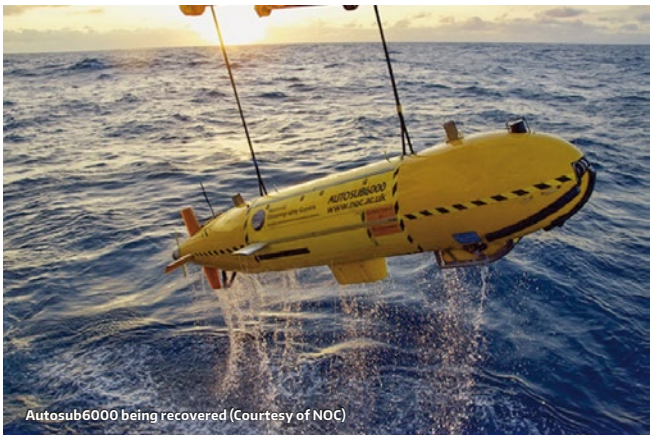

Healthy coral in the Darwin Mounds with colour correction (Courtesy of NOC)

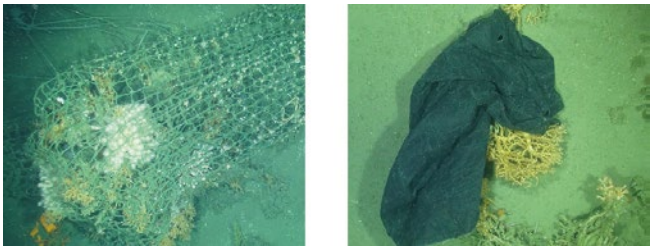
Dr Veerle Huvenne from the National Oceanography Centre (NOC), and Chief Scientist of the expedition that made these discoveries, said "This proves once again that ecosystem recovery in the deep sea is very slow, and that it is better to put protective measures in place before damage occurs. However, encouragingly, settlement experiments deployed in 2011 and recovered on this expedition indicate that new coral larvae can indeed settle in the area."

These findings are the result of a three-week research expedition in the North East Atlantic on board the Royal Research Ship Discovery, which is currently sailing home to Southampton. This expedition was a collaboration between the National Oceanography Centre, the University of Southampton, the Joint Nature Conservation Committee, the University of Edinburgh, University College Cork and the Scottish Association for Marine Science. Using the latest in marine and robotic technology, the team collected data to evaluate the status of the Darwin Mounds, a series of cold-water coral reefs lying at water depths of 1000 metres deep, once that were formerly heavily impacted by bottom trawling fisheries.

This expedition saw the first deployment of a newly developed 3D imaging system called BioCam, a combined stereo camera and laser scanner built by the University of Southampton under NERC's Oceanids programme, which was used to create multi-hectare 3D visual reconstructions of the seabed. Mounted on Autosub6000, a robot-sub developed and operated by the NOC, the system successfully mapped more than 50 hectares of seabed in less than 48 hours at photographic resolution.

Together with an extensive series of samples, and more than 75 hours of high-definition video data collected by the HyBIS Robotic Underwater Vehicle, the BioCam images provided evidence of healthy coral growth in locations that previously had seen only a minimal impact of bottom trawling.


Autosub6000 being recovered (Courtesy of NOC)


Plastic litter in the Darwin Mounds coral reef (Courtesy of NOC)

Cold-water corals are coral species that can live without light, and the reefs they build are important habitats for a wide variety of deep-sea life, including commercially important fish. The Darwin Mounds have been protected from bottom contact fisheries since 2003, and were last studied in 2011, at which point they had not yet recovered from the fishing impacts.

Dr Veerle Huvenne continued "It was very encouraging to see the recruitment of new coral polyps on the settlement experiments, although this has not yet translated into widespread new coral growth in the heavily impacted areas. We will continue to monitor the site over the coming years, to learn more about how deep-sea ecosystems recover after disturbance."

"Working with the new BioCam system gave us an unprecedented insight into the spatial pattern of the coral growth. It also showed us how the associated marine animals are living with and around the coral, and it even provided us with unexpected discoveries, such as a complete whale skeleton which we had no idea was on the seabed in the area".

Dr Blair Thornton, Co-Chief Scientist and leader of the BioCam team said: "The multi-hectare scale maps generated by BioCam highlight a wide range of patterns in the spatial distribution of coral and the ecology at this site. These range from the fine, metre-scale patterns seen in video surveys, to much larger patterns in the distribution of live coral over several hundreds of metres. The data will help scientists identify these and make quantitative measurements of the distribution of live coral in this area."

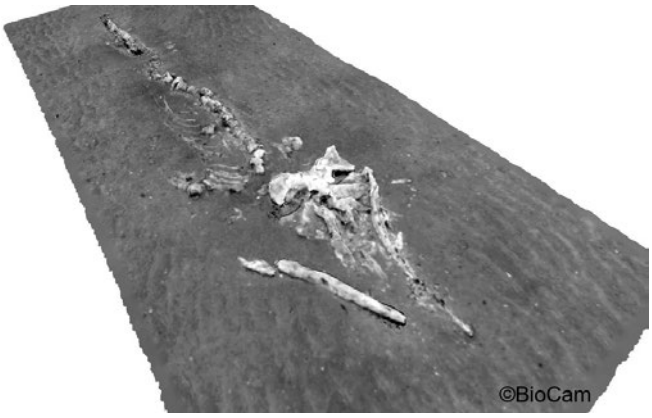
"The fact that BioCam was able to collect data that is useful for scientific monitoring from its first deployment is a tribute to the hard work that went into preparations for this expedition from the teams at the University of Southampton, the MARS team at the National Oceanography Centre, local industry partners and the captain and crew of the RRS Discovery. We are looking forward to its next deployment."

Unfortunately, the imagery also demonstrated the presence of a large amount of manmade litter. The area is characterised by strong tidal currents, and coral colonies form natural obstacles on which plastic debris can get snagged easily.

Hayley Hinchen from the Joint Nature Conservation Committee said: "It has been fascinating to see first-hand the coral mounds in the area, some of which are thriving and others which are struggling to recover. This survey has confirmed that even after more than 15 years of fisheries closures, the impacts of bottom trawling are still evident, and some more novel pressures seem to be growing. The level of litter that we observed across the site is quite shocking, and we still don't know how this is affecting the seabed communities we've seen over the last three weeks.

The wealth of data collected on this expedition will allow us to assess the current status of the habitats and species in the Darwin Mounds both at the small and large scale, and define how it has changed over time. The amazing 3D imagery from the BioCam system allows us to investigate huge areas of the seabed at millimetre scale resolution – a tool that could really support marine monitoring and conservation efforts in the future".

Further detailed analysis of the imagery and samples will be necessary to fully evaluate the changes in biodiversity and communities of marine animals in the area since 2011. This work is part of the CLASS programme (Climate Linked Atlantic Sector Science), which aims to increase our understanding of how the ocean will evolve under a changing climate and increased human exploitation, with the objective to support sustainable marine management. The BioCam project, is funded by the Natural Environment Research Council's (NERC) Oceanids programme.



A whale skeleton recorded on the seafloor in the Darwin Mounds by BioCam (Courtesy of NOC)

Saipem Hydrone-R (Courtesy of Saipem)

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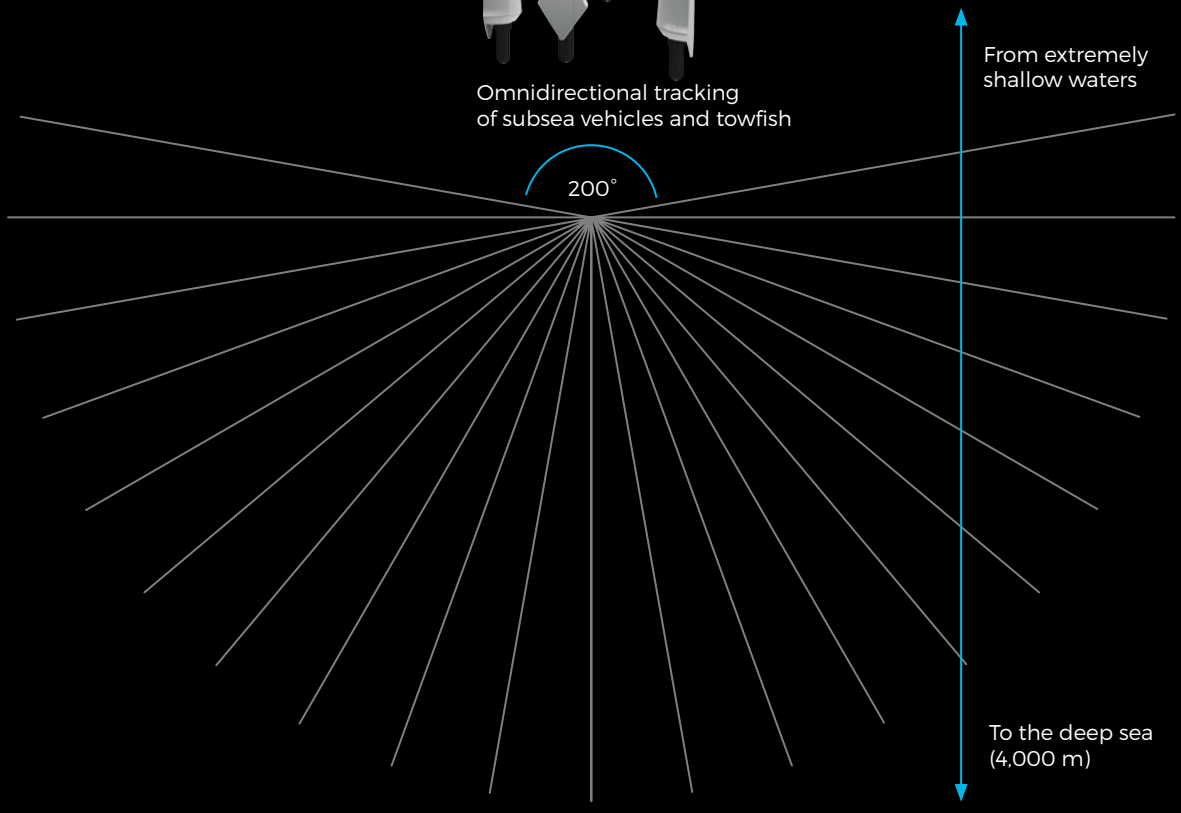


iXblue

INTERVIEW:
HYDRONE
A NEW GENERATION OF UNDERWATER INTERVENTION DRONES

Towards the end of 2019, Saipem signed a subsea service contract with Equinor. Worth approximately 40 million Euro, the contract entails the use of Saipem's Underwater Intervention Drone (UID) Hydrone-R and the all-electric Work Class ROV Hydrone-W in the Njord Field development, off the coast of Norway. This agreement marks the first ever worldwide service contract for subsea drones signed in the offshore Oil and Gas industry, thus making the Hydrone-based technology an unrivalled pioneer in this area. ROV Planet interviewed Roberto Di Silvestro, Head of Saipem-Sonsub and Giovanni Massari, Project Manager at Saipem-Sonsub, to learn more about this new range of underwater vehicles.

Courtesy of Saipem

Roberto Di Silvestro (left), head of Sonsub at Saipem, Giovanni Chiesa, head of subsea engineering and underwater technologies at Saipem, Sophie Hildebrand, chief technology officer Equinor, Hans Henrik Nygaard, procurement Equinor, and Gry Lindboe, manager procurement Equinor. (Photo: Arne Reidar Mortensen)

Courtesy of Saipem

RICHIE ENZMANN: These are very exciting times for Saipem and the underwater robotics community as a whole. There seem to be several new resident ROVs and AUVs coming onto the market recently. Given these developments, how you see the future of underwater operations? Will resident ROVs be common in the next 5-10 years or is this only viable for a limited market with certain subsea field layouts?

ROBERTO DI SILVESTRO: Of course, we would like this to be something mainstream. We have been talking to a vast number of clients and supermajors and they are all interested in moving towards subsea residency. I think as soon as there is someone that can demonstrate to the market that this is actually feasible, then it will fly. All clients are looking to save money, that's obvious. So far, they are mainly looking at this technology in order to save on the operational costs in life of field. They are simply running the equation of how much a subsea resident approach would cost, and how much money it would save compared to the cost of an ROV support vessel. I think that is the common goal that all the oil companies agree on. However, we do believe that there is more. There is the intrinsic value of subsea resident robotics. The first benefit is that you are increasing the frequency of inspection, that you can pre-identify that an asset is developing into a problem or see the nature of failure.

There are also situations in which access to the field is seasonally limited, for instance in Arctic region. In those cases, the resident Hydrone-R can support the continuous inspection of subsea assets and perform first aid troubleshooting without the vessel right after an issue has been detected.

So I think the market is moving in that direction; oil companies are pushing towards resident subsea robotics and some of our competitors are doing likewise, which means we had the right vision a couple of years ago when we started developing the Hydrone-R resident ROV/AUV.

RE: Yes, so all this is proof that you were on the right path then.

RS: Exactly! Now, the industry is not only working on ways to save costs on the delivery of inspections: they also need to realise that by developing resident drones, they can do regular inspections and prevent issues from developing. This is of course feasible, but we may also be able to optimise the economics of subsea installation as the ability to continuously monitor the development of the subsea asset will allow the postponement of some investment decisions like, for instance, the installation of the restraining system to prevent pipeline walking.

We are also working to develop a garage solution typically deployed from an FPSO or a small vessel where we can host a vehicle, recharge its batteries, and upload and download the mission data. The next step will be the development of an autonomous vessel that is able to launch and recover the Hydrone in an economical way.

And finally, nowadays there is great concern about greenhouse emissions and those intervention vessels which emit CO_2. For certain countries where protecting the environment is important, such as in Norway, they put an emphasis on environmentally friendly solutions in their development programmes. The Hydrone-R offers two advantages: it re-

duces the cost and pollution of the support vessel and the cost and the pollution of the helicopter crew changes as it can be remotely controlled from onshore.

RE: You have also mentioned that you are ahead of the competition in the development of resident ROVs. When did you start development activities?

RS: We have come from a different starting point. Our goal is to be in a position to offer comprehensive life of field services and to collect a large amount of data from the field in an economically and environmentally sustainable way and we believed that subsea resident and autonomous robotic was the enabler for this. We conceived three vehicles that share the same technology but are specialised for different activities.

The first one is Hydrone-R, very much aligned with the specification of the Equinor UID. It is able to operate both as an ROV or AUV. In ROV mode it is operated via a tether to cover a range from its base. It can also operate as a drone out of a subsea base and can perform quite complex inspection tasks in subsea fields. This includes the autonomous tracking and inspection of pipelines and umbilicals. It is also able to carry out the inspection of the subsea structures in an autonomous way, while performing their 3D reconstruction for subsequent engineering assessments.

The FlatFish is a resident autonomous drone, somehow similar to an AUV, that is conceived to operate up to a water depth of 3,000 m with an inspection span of approximately 50 km and with the built-in capability of autonomously inspecting vertical risers. It is the industrial development of the FlatFish Technology that was originally developed by Shell in Brazil jointly with the Brazilian National Institute of Robotics, SENAI CIMATEC, and supported by the Brazilian ANP R&D Fund.

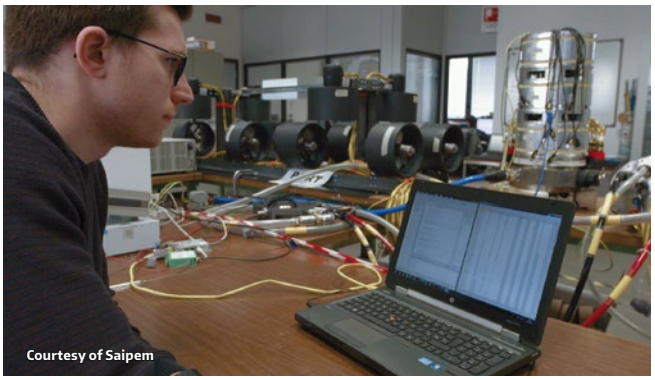
When Shell and their research partners completed the concept development, they wanted to look for an industrialisation partner through an international tender that was won by Saipem. That conceptual design was further developed by Saipem-Sonsub into a vehicle that is able to render commercial services in deepwater. The new drone, the FlatFish, thus shares most of the Hydrone technology, but it has additional artificial intelligence developed by Saipem-Sonsub with the collaboration of the same Brazilian university. The prototype of this vehicle is planned to be ready by May 2020, when we will start extensive sea trials in our offshore "playground" that we have fabricated in front of our marine base in the Trieste port. Once the sea trials are completed, the Flatfish is to be tested in the deep-water, in a Brazilian field operated by Shell.

The Hydrone-W is an all-electric work-class ROV that is designed to be resident and to operate on the seafloor for a considerable amount of time. The work-class is, of course, much more powerful than the previous ones, and we have decided that it would only operate via a tethered connection and the tether will provide its power and control. This is unlike the Hydrone-R FlatFish, where the batteries on board provide the power and can be recharged via a subsea inductive connector in the subsea base. The Hydrone-W is designed to assist the EPCI construction phase, the commissioning and the heavy maintenance of subsea fields.

RE: Interesting. It seems that you have everything covered then; light interventions, pipeline inspection, and even future construction support. Were there any challenges during development?

RS: In my opinion the main challenge was residency. So far, no subsea robot has been designed to be resident, but only to be as reliable as possible, considering that they were launched from the surface and needed to be recovered. We started designing the technology and the components to be resident

Courtesy of Saipem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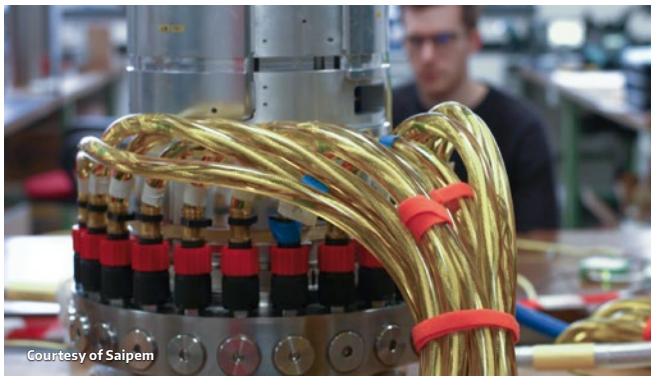

Courtesy of Saipem

and then we moved towards the integration of these technologies. We asked DNV to assist us in designing a qualification programme that was credible to achieve this task. This was also important for the Client to have the support of DNV.

The second element of complexity and challenge was the development of a reliable artificial intelligence. The Hydrone-R and the FlatFish will have to perform complex inspection tasks, hence there are a number of challenges there. For example, they need to recognise structures and be able to avoid obstacles. The FlatFish had an additional level of complexity, as it is supposed to perform inspections in an autonomous way by tracking the riser section. And we are pushing the AI to recognise the subsea asset, to identify the anomalies and adapt its mission profile accordingly. We are already working on this and planning for it to be ready by 2021 or 2022.

Clients are also increasingly looking for data harvesting from subsea instruments. If the tendency is the digitalisation of the subsea field, then it will be required to install several instruments supported by batteries – not hardwired to the subsea network. Consequently, clients are interested in a vehicle that is able to harvest data from this instrumentation by flying to and aligning with it to retrieve information.

We are also developing algorithms and instrumentation so that the vehicle can identify the presence of contaminants in water, such as oil, and is able to recognise the gradient of the leak source and navigate the vehicle onto it. This is also an interesting exercise.

We are very eager to test this in the field, because when the client starts using it, it can open up different modes of operation and feedback. So, we can learn from each other on how to optimize its use.

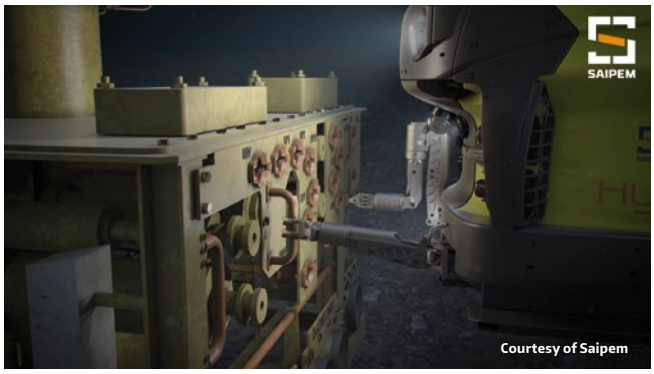
RE: Can you also tell us about the technical specification of the vehicle? What is "under the bonnet"?

GM: All the Hydrone and FlatFish vehicles are all-electric, except for the manipulators of the Hydrone that are hydraulic at the moment, but we are working on that. The Hydrone-R and the FlatFish are battery powered, so they have energy storage on board to make the vehicles autonomous and to fly without the tether. The technology of the batteries is key to optimising the vehicle's performance.

The internal control system that we are developing is our proprietary solution. That is our background and core competency and we are investing a lot in it. Our software department is fully dedicated to development activities and we are working to create high levels of artificial intelligence layers, control systems for robotics, deep learning, subsea networking and communication, etc. We also have ongoing cooperation with academic partners in Italy and Brazil.

The vehicle has sensors on board, video cameras, laser scanners, a sonar that is advising the vehicle and all the usual navigation tools: inertial navigation system, depth sensor, altimeter, and so on. And some leak detection capabilities are also embedded on board. All the vehicles are designed to be interfaced with some additional payload and each one can be mission specific. These payloads are designed to be connected to both Hydrone-R and FlatFish, in order to extend their capabilities to particular project needs.

RE: Thank you very much for taking the time to tell us about Saipem's new Hydrone platform.



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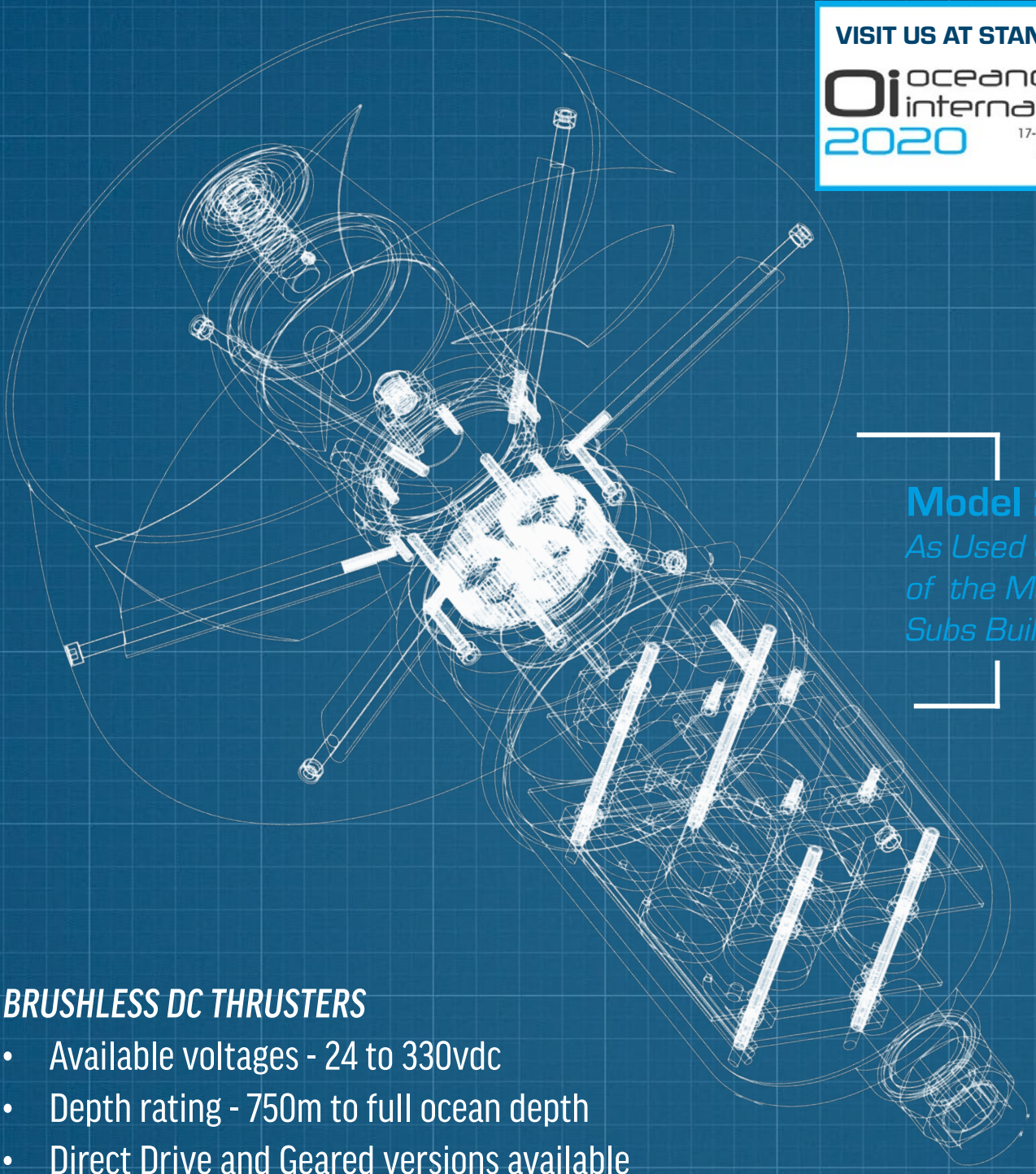

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POWER QUALITY MONITORING

FROM BENDER UK PROVES A VITAL TOOL FOR ROV OPERATORS

Power quality monitoring equipment from Bender UK is being used by a global subsea ROV operator to verify the integrity of power supplies offshore.

It is the first application of Bender power quality monitoring technology in the subsea sector. The company's insulation monitors and earth fault location technologies are widely employed within the oil and gas industry to protect personnel, subsea equipment, installations and associated electrical infrastructure from insulation failure.

Subsea contractor Film-Ocean provides ROV inspection and intervention services. They trust Bender power quality monitoring (PQM) systems to identify issues with fluctuating power supplies on board support vessels and offshore installations.

Bender's LINETRAXX® PEM735 measures and records the precise current status of electrical supply networks and displays the current/voltage harmonics for assessment of the power quality. The product was first deployed by Film-Ocean after a project was affected by a fluctuating electricity supply that resulted in damage to high-value PCB boards in their ROV equipment.

Mike Mackie, Operations Manager at Film-Ocean explains: "Bender's power quality monitoring equipment alert us to spikes or troughs in the power supply voltage that can seriously affect the ROVs and cause permanent damage. Equally serious is downtime of the equipment and delays that can result from fluctuations in the power supply. If damage occurs, we can now track the cause and most importantly identify the source of the problem using Bender PQM ensuring maximum utilisation for our clients.

"The bigger ROV units can be more seriously affected by a dip or spike in supply. The Bender units won't protect against the effects, but they let us know that it is happening, and that enables us to identify the root cause. They are

Courtesy of Film-Ocean

Courtesy of Film-Ocean

proving very successful and we are aiming to use more of the Bender power quality monitors in the future."

The biggest power quality problems occur on three phase systems. Cranes are often one of the most common causes of spikes and drops in the power supply. A crane pulls a lot of current when it starts up, and that can cause a fluctuation in the power supply. When the crane stops, the power can sometimes spike and potentially cause damage to other electrical equipment, but Bender's PQM technology records the changes in the power supply and alerts the Film-Ocean team.

If there is a problem, then Film-Ocean can look at ways to make the power supply more stable - either by bringing in a separate dedicated generator or installing voltage conditioning equipment.

Film-Ocean also uses Bender insulation monitoring devices to safeguard personnel and equipment subsea. Mike adds: "We use a variety of Bender line insulation monitors in multiple locations on all our ROV systems. Not only are they a critical safety device they are also used as condition-based monitors to identify a gradual or complete breakdown of insulation within our systems."

For more information visit:

www.bender-uk.com/solutions/oil-gas

www.film-ocean.com

STEM FOCUS:

OCEAN ENGINEERING AT FLORIDA INSTITUTE OF TECHNOLOGY

Stephen Wood, Ph.D., P.E.

Ocean engineering is a multidisciplinary field of technology applied to the ocean environment. Combining aspects of civil, mechanical, and electrical engineering, naval architecture, applied oceanography, applied physics, and computer science. Ocean engineering students gain fundamental expertise in chemistry, math, and physics and build in-depth knowledge of coastal processes, ocean systems, and design technologies. It is the profession of applying science to solve engineering problems in the marine environment. If this all sounds very intriguing, then ocean engineering is probably a good fit for you.

Diver on the student designed and built Underwater Archaeological Crawler (Courtesy of Stephen Wood)

Autonomous Surface Vehicle of the Dry Tortugas (Courtesy of Stephen Wood)

Instrumentation buoy (Courtesy of Stephen Wood)

PROFESSION

The profession of Ocean Engineering is especially important today as the oceans are the source of so many vital resources, and because so much of the world's population live in coastal areas. Ocean Engineers study the world's ocean environment and apply their knowledge of engineering to analyze its effects on vessels and structures. They are also involved with deep sea exploration and may work to design or operate ocean platforms or sub-surface vehicles. Career paths for Ocean Engineers can lead to many industries including governmental options. Some will focus on remote sensing, while others work on climate monitoring, environmental protection, oil recovery, underwater vehicle development, or defence.

Graduates can enter interesting, well-paid jobs after graduation. Furthermore, all the programs throughout the U.S. are fully accredited by ABET: the professional engineering society's board. This means our graduates are eligible to become Registered Professional Engineers, a certification that enhances both job opportunities and income.

WHAT TO EXPECT

Ocean engineering is a demanding major that features many challenging courses and projects. Undergraduates are treated as capable scholars, and they share the same facilities as graduate students. Classes are small, quantitative, and focused. The program is very hands-on. Courses such as the ones offered at Florida Tech: Coastal Structures, Corrosion Protection, Ocean Engineering Systems Design, Fundamentals of Naval Architecture, Offshore Engineering, Coastal Engineering Processes and Shoreline Design, Marine Hydrodynamics, Acoustics and Data Analysis, Design of High-Speed Small Craft, and Composite Materials are typical for many of the universities offering Ocean Engineering.

During your studies, you will have the chance to work on actual design projects such as Remotely Operated or Autonomous Underwater Vehicles (ROVs and AUVs), ocean energy systems, and ship design including building and testing. You also can compete in national competitions and spend some time studying and working aboard a research vessel.

Ocean engineering is field intensive and seagoing; students often participate in research projects on board vessels in the open sea. Students interested in underwater vehicles have access to multi-million-dollar AUVs. Students can also specialize in coastal engineering, hydrographic engineering, marine vehicles, marine materials and corrosion, and underwater technologies.

As seniors, all engineering students complete a capstone project that challenges them to design, develop, prototype and present a complex engineering system. The small student-to-faculty ratio means that students get lots of facetime with professors and often work closely with them in the laboratory on innovative research projects. Student organizations include the Society of Naval Architects and Marine Engineers, and the Marine Technology Society.

Ocean engineering faculty conduct research in diverse areas of interest, some of which include: Hydrodynamics and sediment transport, Ship motions in harbors, High-speed-small-craft hydrodynamics, Ship corrosion and biofouling, Artificial reef design, Converting wave and current energy into clean electricity, Design of novel marine technologies & vehicles, and Hydro/ocean acoustics.

OCEAN ENGINEERING CAREERS

Miles below the surface, an ROV is exploring the ocean floor. The ROV may be taking pictures, collecting samples, recovering treasures from a shipwreck, or performing repairs on an underwater structure.

In the tragic BP oil spill of 2010, underwater robots were the first on-scene to try to fix the spewing oil pipe. In 2009 AUVs were used to locate Air France Flight 447 and in 2014 to search for Malaysia Airlines Flight 370. Every instrument, device, and process in an ocean environment is the responsibility of ocean engineers. These engineers are at the top of their game because the ocean environment is so corrosive, volatile, and changeable. Waves are never-ending and the gear that is used to explore the marine environment must be able to withstand the forces of Mother Nature.

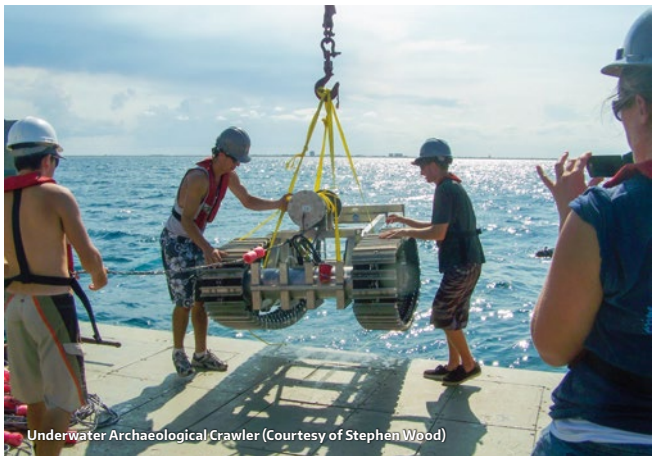
Ocean engineering is a fast growing and dynamic field with opportunities that are expanding as people turn to the oceans for food, transportation, and energy. One of the great things about ocean engineering is that many different types of engineers can work together to find solutions for ocean infrastructure, research, and utilization. Ocean engineering integrates disciplines such as oceanography, materials science, and the entire engineering spectrum.

In addition to creating ROVs, ocean engineers develop underwater structures (oil rigs, wave buoys for data collection, etc) and they are hard at work developing ways to transform the energy of waves turn it into electricity. They develop transportation systems, plan new uses for waterways, and integrate land and water transportation systems. They are concerned with discovering, producing, and transporting offshore petroleum, and developing new ways to protect marine wildlife and beaches against the unwanted consequences of offshore oil production and storm erosion.

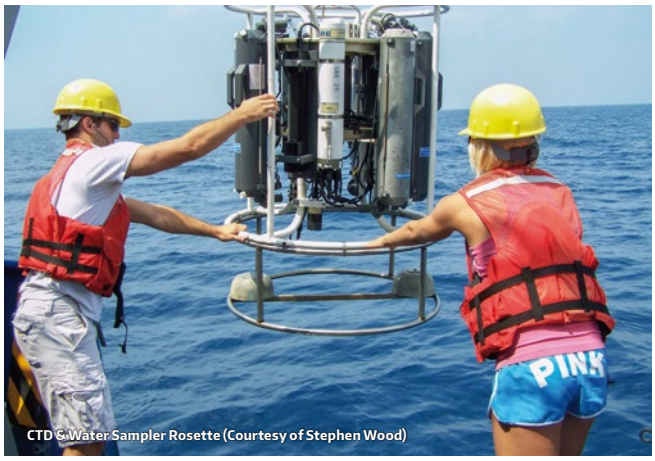
Ocean engineers study all aspects of the ocean environment. The work is global in nature and has never been more important because these professions connect people and places in a way that is unmatched by other engineering careers. Think of the planet Earth as one big web of biodiversity that connects us to all living things. Many people may say that the United States and Japan are separated by the Pacific Ocean. However, in the maritime industry, they say that the oceans connect them.

Graduates of Florida Tech's ocean engineering program have gone on to work for: National Oceanic and Atmospheric Administration (NOAA), Oceaneering, Inc., U.S. Army Corps of Engineers, U.S. Navy, and many other coastal engineering and petroleum companies.

Engineers in general are life-long learners because there are many considerations in the design of each and every ship. For example, a Navy ship must have systems that can detect airborne, surface, and subsurface threats, operate continuously over long periods, and defend themselves and others against attacks. To do this, Navy ships must be able to withstand shock and blast effects, operate when damaged, prevent detection in hostile waters, be acoustically quiet, and much more. The demands are uncommon and therefore the training to enter these fields is very specialized. Anything that operates in or on the ocean has special design require-


Underwater Archaeological Crawler (Courtesy of Stephen Wood)


Wing Wave Ocean Energy System (Courtesy of Stephen Wood)



CTD & Water Sampler Rosette (Courtesy of Stephen Wood)


Bluefin Autonomous Underwater Vehicle (Courtesy of Stephen Wood)

ments for seakeeping, staying upright, capsizing, station-keeping, and enduring the random motions and loads of rogue waves and intense winds. Due to these unique requirements, manufacturing is often more challenging.

Another form of Ocean Engineer is the Naval Architect. The Naval Architect is a professional engineer who is responsible for the design, construction and repair of marine vessels and offshore structures, both civil and military, including: Merchant ships – oil/gas tankers, cargo ships, cruise liners, etc., Passenger/Vehicle ferries, Warships - frigates, destroyers, aircraft carriers, amphibious ships, etc., Submarines and underwater vehicles, Offshore drilling platforms, semi-submersibles, FPSOs, Workboats – fishing vessels, tugs, pilot vessels, rescue craft, etc. Some of these are among the largest and most complex and highly valued moveable structures produced by mankind. Without them to provide for the safe and efficient transport and recovery of the world's raw materials and products, modern society as we know it could not exist.

Stephen Wood after a dive on the Johnson SeaLink II submersible (Courtesy of Stephen Wood)

Modern engineering on this scale is a team activity conducted by professional engineers. However, it is the Naval Architect who integrates their activities and takes ultimate responsibility for the overall project. This demanding leadership role requires managerial qualities and ability to bring together the often-conflicting demands of the various professional engineering disciplines involved to produce a product which is 'fit for the purpose.' In addition to this vital managerial role, the Naval Architect has also a specialist function in ensuring that an effective design is produced. To undertake all these tasks the Naval Architect must understand the many branches of engineering and must be in the forefront of high technology areas such as computer aided design and calculation. A Naval Architect also requires a creative, enquiring, and logical mind; the ability to communicate clearly with others; sound judgement and qualities of leadership.

It's very important that you choose a career field that you are naturally interested in. If you love being by or in the water, then maritime engineering might be a great fit. If "The Deadliest Catch" is your favorite television show, or if you like to watch boats come in and out of the harbor this may be the career for you.

WHO ARE OCEAN ENGINEERS?

Ocean engineers, naval architects, marine engineers, or naval engineers have a bachelor's or master's degree in these fields. Sometimes ocean engineers study civil, mechanical, or electrical engineering with an emphasis or special training in marine or ocean engineering. All ocean engineers usually love to travel and want to work near the water to enhance the world's transportation and energy systems and make the world a better place. These engineers may be married or single; they can have disabilities and include men and women from every culture in the world. But they share a problem-solving orientation. An important part of understanding and thriving in this career is your worldview. The work is global in nature and has never been more important: think of the planet Earth as one big web of biodiversity that connects us to all living things.

Ocean engineers design: Sailboats and yachts used in the America's Cup races; Hydroplane racing boats; Scuba-diving and other deep-sea exploration equipment; Underwater robots; Boats such as small rowboats, Jet skis, tugs, workboats, barges, yachts, and many others; Boats and ships for the military such as aircraft carriers, submarines, cruisers, destroyers, frigates, corvettes, and command-and-control ships; Ways to harvest energy from the ocean, such as offshore wind turbines, tidal and current converters, wave energy converters and much, much more.

When you think about being near, in, or on the ocean, think about ocean engineering. Without these important people, we could not understand, research, or use the 73 percent of our planet that is covered in water.

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ENHANCING HARBOR SECURITY WITH UNMANNED SURFACE VEHICLES

George Galdorisi, Director of Strategic Assessments and Technical Futures at the U.S. Navy's Command and Control Center of Excellence

(Photo: Jack Rowley)

BACKGROUND

Much ink has been spilled on the term "globalization" – typically defined as the international interaction of information, financial capital, commerce, technology and labor at exponentially greater speeds than previously thought possible. Globalization has lifted hundreds of millions out of poverty. And most would agree that it is trade – carried primarily by sea – that has been the engine of globalization in the past, and continues to be so today.

While most breathless press reports have focused on the importance of ships in carrying this vital trade, these same accounts have failed to identify the critical nodes that support this globalization and burgeoning world trade. Those nodes are the world's harbors. From Shanghai, to Rotterdam, to Los Angeles, to other mega-ports, as well as hundreds of other, smaller ports, these harbors are critical to world prosperity. A disaster in one of these ports – an oil tank explosion, a fire or other catastrophe on a large oil tanker, or any of a host of other events – could close one of these ports for an indefinite time and also spill an enormous amount of pollution into the oceans.

Port authorities must ensure port security 24 hours a day, 365 days a year. This task includes threat detection and security response, continuous inspection of port assets, as well as on-demand inspections after storms or other disasters, ongoing surveys to ensure navigable waterways, hull inspections, and a wide-range of other missions.

The magnitude of providing comprehensive security for an average size port – let alone some of the world's mega-ports like Shanghai, Singapore, Hong Kong, Shenzhen and others – can sometimes lure port authorities into "wishing away" the challenge. But in an increasingly dangerous world where not just terrorists, but others, may wish to make a statement or lash out at a particular nation, ports that can be attacked via land or sea present an all-too-inviting target.

THE CURRENT STATE OF THE ART FOR PORT SECURITY

Current security measures in most ports involve monitoring the video provided by cameras throughout the port, as well as patrolling the ports' expanse of water with a fleet of manned vessels. This methodology stresses the ability of port authorities to provide 24/7/365 security and typically leads to serious – and potentially fatal – gaps in coverage.

Cameras seem to offer a cheap and effective solution, but what people forget is that someone – often several people – must monitor the video for the cameras to have any purpose, let alone effectiveness. With some ports maintaining scores of cameras – or more – this entails having a command center and enough watch-standers to monitor all of the cameras in real-time, twenty-four hours a day. Depending on how the watch center is staffed, this often means that multiple crews must be available and paid to provide round-the-clock monitoring of these cameras.


(Photo: Jack Rowley)

Similar issues accompany the use of manned craft to patrol a harbor of any size – let alone mega-ports. Manned vessel operations are increasingly expensive, are often limited by weather and water conditions, and physically stress port professionals. For most ports, multiple manned vessels are needed to guarantee sufficient revisit time to ensure that a threat has not slipped through the security net.

Compounding the issue is the physical toll of riding a small vessel – either a rigid hull inflatable boat (RHIB) or other small craft. Unlike watch standers on land who might be able to work shifts as long as eight or even twelve hours, pounding through an often-choppy harbors in a RHIB or other small craft means that a watch rotation of somewhere between three and four hours is about all most people can endure.

With such short watch rotations, it is easy to see how the need to provide round-the-clock security can quickly multiply costs, even in the most optimistic scenarios. Add rain, wind, waves, fog and other natural phenomena that often reduce visibility and slow patrol speeds, and the need for more craft and more people can multiply significantly, often without warning, driving the need for standby crews. All-in-all, this is an expensive undertaking.

Additionally, there are many shallow areas throughout ports that are beyond the reach of any manned vessels. Even limited draft craft like RHIBs draw some water when they are loaded with people, communications equipment, weapons and the like. A manned vessel pushing too close to shore also runs the risk of impaling itself against visible or invisible hazards. This risk is compounded at night and during fog and other adverse weather conditions.

Given the manifest challenges of providing adequate – let alone comprehensive – security for ports with current state-of-the-art systems and capabilities, it is little wonder that port officials are searching for technology solutions that will enable them to provide better security, at lower costs, and without putting humans at risk.


(Photo: Jack Rowley)

THE PORT OF LOS ANGELES: A MEGA-PORT WITH A CHALLENGE

The Port of Los Angeles (POLA) is the busiest port in the United States. This mega-port comprises 3,200 acres (42 square miles) of water, 43 miles of waterfront, 26 passenger and cargo terminals and 86 ship-to-shore container cranes. POLA handled over 9.3 million twenty-foot equivalent units (TEUs) of cargo in 2017 (up from 8.8 million TEUs in 2016 and 8.1 million TEUs in 2015 – and predicted to increase year-over-year). Additionally, POLA is scheduled to soon bring on a substantial liquid natural gas (LNG) handling capability.

Current capabilities to secure the Port of Los Angeles' 42 square miles of water involve monitoring the video provided by 500 cameras throughout the port, as well as patrolling the ports' expanse of water with a fleet of manned vessels. This methodology stresses the ability of POLA authorities to provide 24/7/365 security. Additionally, POLA has a large number of shallow areas throughout its 43 miles of waterfront that are beyond the reach of any of the manned vessels.

Providing security for this mega-port is a massive undertaking, and one made more challenging by the understanding that it is the port's very prominence as the most active harbor in the United States that make it an inviting target. Port of Los Angeles officials must ensure


(Photo: Jack Rowley)

security against a wide range of human attacks as well as natural disasters. One need only spend a short time on the ground and on the water of this port to understand the magnitude of the challenge.

A BEST-PRACTICES DEMONSTRATION FOR THE PORT OF LOS ANGELES

For these reasons, Port of Los Angeles officials had a mandate from a number of stakeholders to explore the possibility of using unmanned surface vehicles to enhance the ability of POLA authorities to ensure the security of the port. To that end, the port invited Maritime Tactical Systems Inc. (MARTAC) to visit in 2019 and demonstrate the capabilities of their MANTAS USV. MANTAS is a high-performance USV

built on a catamaran-style hull, and comes in a number of variants ranging in size from six-foot to 50-foot. A demo was conducted with a 12-foot MANTAS as it was deemed that this size was the most viable for the wide-variety of POLA missions described above.

The 12-foot MANTAS (otherwise known as the T12) has a length of twelve feet and a width of three feet. It is fourteen inches high and draws only seven inches of water. The vessel weighs 260 pounds and has a carrying capacity of 140 pounds. Its twin-screw electric propulsion prime mover enables the T12 to cruise at a comfortable 20 knots in sea state four.

The MANTAS can be equipped with a wide variety of above-surface sensors (EO/IR/thermal video) and below-surface sensors (sonars and echo-sounders), as well as other devices such as chem/bio/nuclear sensors, water quality monitors, and above/below surface environmental sensors. Real-time monitoring is provided by a MANTAS communications package that can support redundant radio, 4GLTE, or satellite communications.

LEVERAGING PREVIOUS SUCCESSFUL DEMONSTRATIONS

One of the primary reasons that POLA authorities requested the MANTAS system demo was the fact that the MANTAS had performed well in a port security demonstration conducted by the U.S. Army. In September, 2017, three MANTAS T-series vessels were part of the Mobile Ocean Terminal Concept Demonstration (MOT-CD) in Concord, CA coordinated by the Army Physical Security Enterprise & Analysis Group. The primary objective of this demonstration was to assess MANTAS' ability to patrol and protect the harbor, and especially the loading of ammunition ships.

For these missions, three MANTAS vessels, T6, T8 and T12, were used to perform different operations. The MANTAS T6 was utilized as an intercept vessel to quickly address potential threats at high-speeds up to 55 knots. This T6 was equipped with a standard electro/optical camera focused on rapid interdiction and base threat identification. The second vessel was a MANTAS T8, with a medium performance envelope of 30 knots. Its role was as a forward-looking harbor vessel situational awareness asset. Mounted with a FLIR M232 thermal camera, the T8 operated forward of a harbor patrol vessel working in areas that were not accessible with manned vessels.

The final vessel was a MANTAS T12 tasked with prosecuting above and below surveillance operations to detect and identify intruder vessels, divers, kayaks or other threats to harbor assets. The MANTAS T12 sensor kits included a SeaFlir 230 for above surface ISR capabilities and a Teledyne M900 for subsurface diver/swimmer detection, and worked at slower speeds of five knots with the specific requirement to detect and provide the precise images for operator threat identification to determine appropriate response level.

MANTAS heading out to patrol. (Photo: Jack Rowley)

FOCUSING ON THE PORT OF LOS ANGELES UNIQUE REQUIREMENTS

During the visit to the Port of Los Angeles, MARTAC representatives provided a comprehensive briefing on MANTAS capabilities, took a three-hour boat tour to observe the entirety of POLA authorities' span of operations, and then provided a remote demonstration where port officials controlled and observed MANTAS operating off the eastern coast of Florida. The demonstration validated the going-in assumption that employing a thoroughly tested and proven USV is a solution POLA is keen to pursue.

After observing the MANTAS remote demonstration, it was determined that the capabilities of this USV met the requirements for the wide variety of missions for the Port of Los Angeles. The MANTAS has an open architecture and modular design, which facilities the rapid changing of payload and sensor components to provide day-to-day port security as well as on-demand inspections. Additionally, this USV features closed-loop cooling of propulsion components which improves performance and extends its life cycle.

MOVING FORWARD WITH PORT PROTECTION INITIATIVES

This POLA demonstration certified that commercial-off-the-shelf unmanned surface vehicles can ably conduct a comprehensive harbor security inspection of a mega-port. As a facility with a longstanding need to augment its manned vessel patrol activities with emergent technology in the form of unmanned surface vehicles, the Port of Los Angeles demonstration provided a best practices example of the art-of-the-possible for enhancing port security.

Until recently, the technology to provide reliable, adaptable and affordable USV support to augment manned capabilities and expand the reach of port police at facilities such as the Port of Los Angeles simply did not exist. Today it does in the form of commercial off-the-shelf unmanned surface vessels, and these can be harnessed to increase the effectiveness of port protection while driving down costs. The end result will be an enhanced comprehensive port security, not merely wishful thinking.

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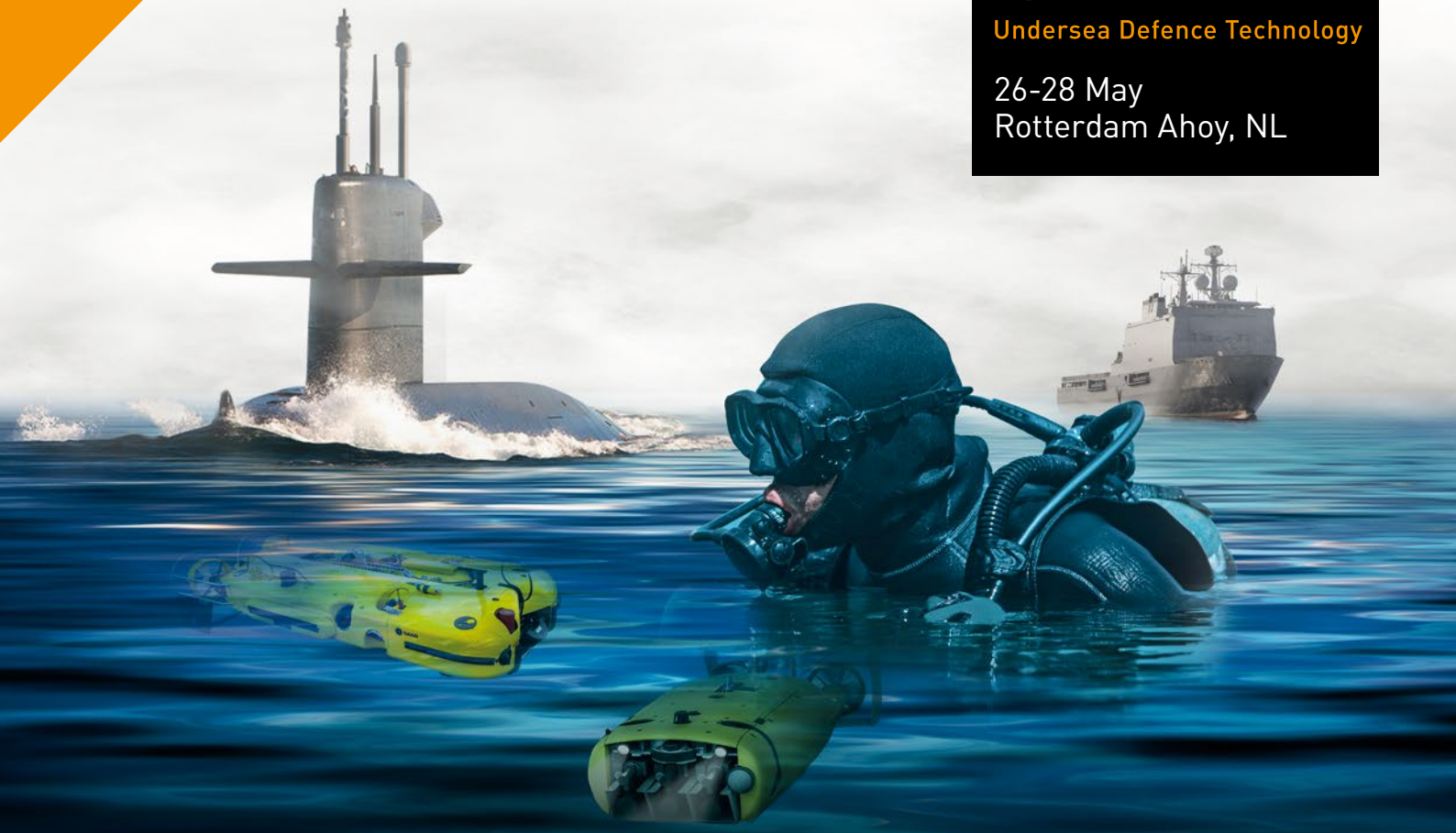

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OCEANS 2019 SEATTLE
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Fritz Stahr, Ph.D., Chair, OCEANS 2019 Seattle

More than 1700 people attended OCEANS 2019 Seattle, October 27th through 31st, at the Washington State Convention Center and the new Hyatt Regency in downtown Seattle. The area's unique history of forward-thinking ocean research, technology development, federal agency and Navy presence, and focus on the Blue Economy combined to make this a great place to host OCEANS this fall. Co-sponsored by the Marine Technology Society and IEEE Oceanic Engineering Society, this year's meeting was themed "Blue Sky. Blue Sea. Blue Tech." The conference attracted professionals and students from 38 countries representing industry, academia, and the public sector to exchange information and ideas on developing next-generation technologies to work in the oceans for science, resource extraction, and remediation.


The University of Washington's new research ship, RV Rachel Carson, available for tours at Bell Harbor Marina downtown on Monday. (Courtesy of Rick A. Smith, www.rickspix.biz, volunteer photographer for the OCEANS 2019 Seattle LOC.)

The local organizing committee, in partnership with the societies and the conference event planner, presented new features at OCEANS 2019 Seattle including: a Technical Program track for exhibitors in both oral and poster formats; a Start-Up Pavilion in the Exhibit Hall so innovators could catch the eyes of established makers and service providers; and, moving the tutorials, workshops, and demonstrations to Thursday. All met with significant success, engaging many people and companies in ways new to them and valuable to all. Successful activities from prior OCEANS continued – lunches in the Exhibit Hall where over 120 entities displayed the latest in research and observational tools for the marine environment. The Innovation Theatre space in the Exhibit Hall – a feature introduced in 2018 – was available to companies as well as the societies to bring special activities right to the heart of the space. As a special feature, local research institutions and private researchers gathered a small fleet of research vessels at Seattle's waterfront marina for tours on Monday... a classic fall day with bright blue skies and cool, crisp air.

Some of the popular features of the conference continued, including the Office of Naval Research and Integrated Ocean Observing Systems sponsored Student Poster Competition (see article elsewhere in this edition), several special Town Halls on key topics such as marine debris and plastics, and a Gala reception at an iconic location – the Frank Gehry-designed Museum of Popular Culture (MoPOP) at The Seattle Center.

The local organizing committee particularly focused on students and young professionals, with several programs aimed to foster their participation beyond the traditional poster competition and student reception. The Canadian government sponsored a group of young women to attend the conference, and several exhibitors volunteered to lead small groups of students around the exhibit floor to introduce them to colleagues and the technology shown there. Further, a number of students participated in the relatively new General Poster session offered as part of the main Technical Program, as well as presenting papers.

The plenaries held first thing each morning offered a selection of new things, from Stockton Rush on building a new submarine from carbon fibre, to Lisa Vollbrecht on why we all should help design new technology for aquaculture, to a panel of scientists and engineers from the University of Washington on how the area offshore the Pacific Northwest is being instrumented to give us warning for the next major earthquake coming from the Cascadia subduction zone. The various society awards programs followed those each day before the first coffee break and the thrice-daily paper presentations started up.

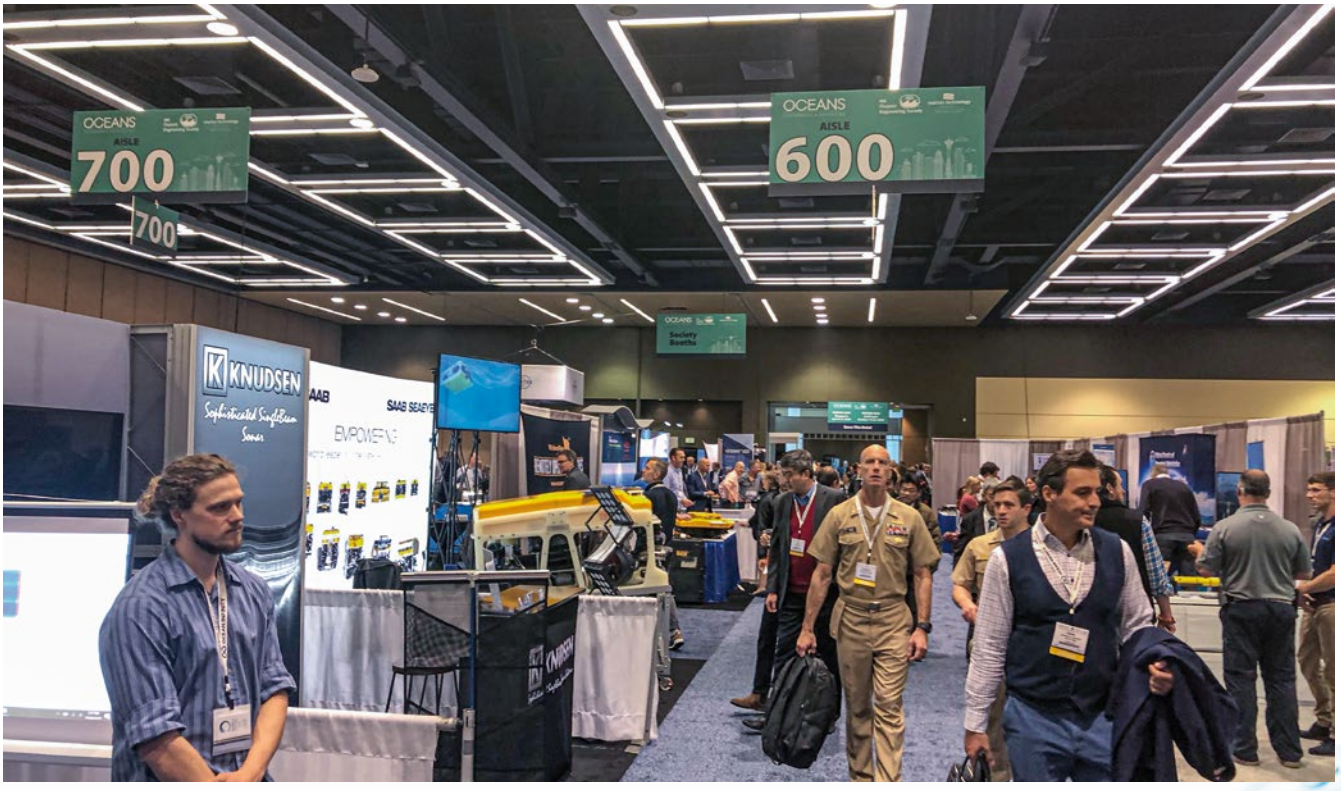
As usual, the Technical Program featured content across the board of topics for marine technology, from best prac-

tices in deploying instruments to best techniques for analyzing data, from key considerations for vehicle design to key attributes of vehicle guidance and control systems, and from results of open-ocean deployments to results of model and lab experiments. The local organizing committee put considerable effort into improving the quality of the program by stringent review of abstracts and challenging authors to make original contributions. Based on some of the immediate feedback from attendees, those efforts paid off in high-quality talks during our 67 sessions presenting over 230 papers, and six panel sessions. We thank all those who contributed to this meeting and encourage any who have not done so to contribute at future OCEANS – it's well worth the effort.

In closing this year's major conference activity for the two societies, I would like to especially thank all members of the local organizing committee who put in countless hours to make this event successful. Without them, this could never happen.

Two gentlemen are accepting the IEEE OES Institute Award for Aanderaa (Photo: Stan Chamberlain)

OceanGate's Cyclops-1 submarine Bell Harbor Marina for viewing and tours. (Courtesy of Rick A. Smith, www.rickspix.biz, volunteer photographer for the OCEANS 2019 Seattle LOC.)



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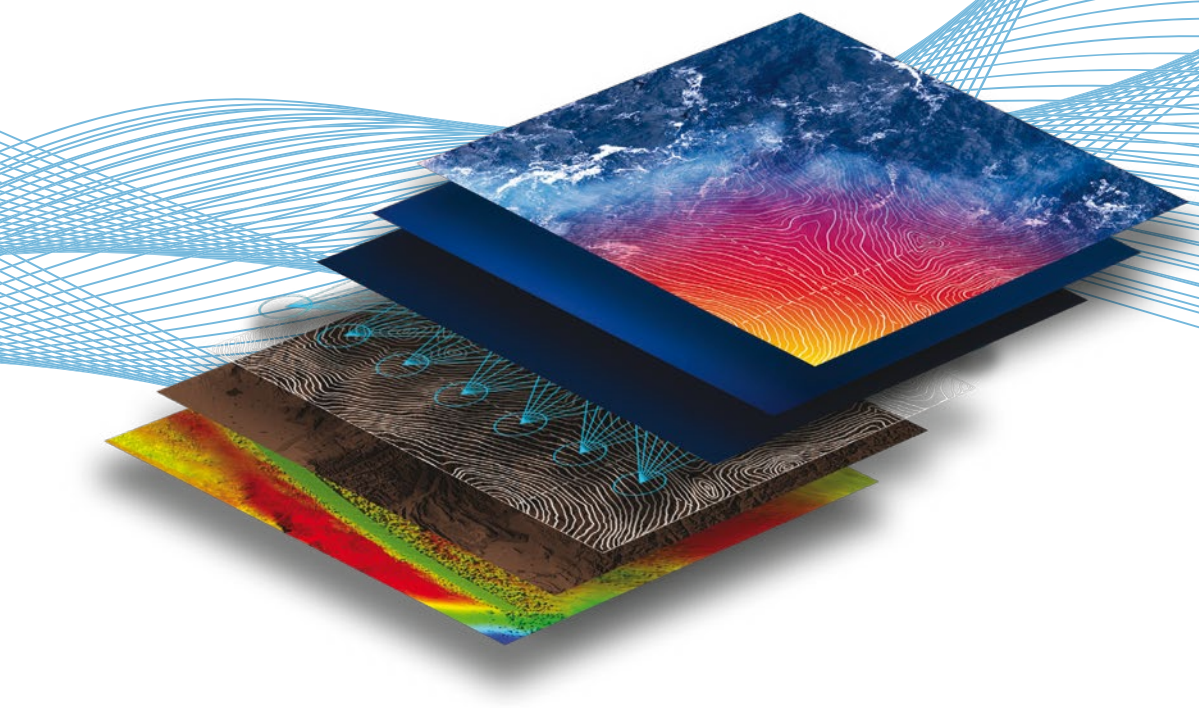

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Key industry exhibitors and a range of focused seminars make OI London 2020 a must-visit for ROV and AUV professionals

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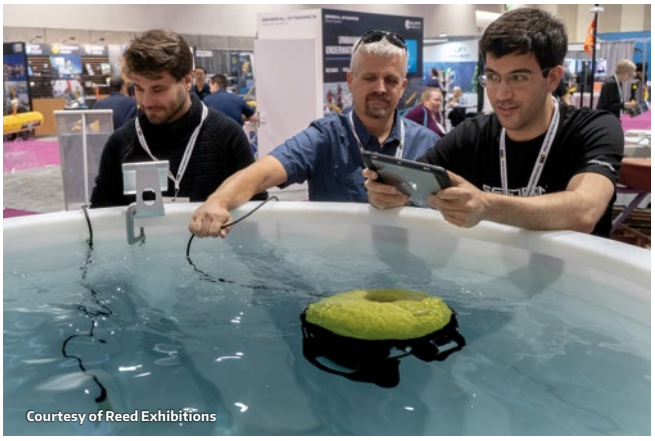
In the 50 years which have passed since the first Oceanology International (OI) exhibition and conference, marine technology has transformed. And one of the biggest changes is in the vehicles which now support underwater exploration and operations: ROVs and AUVs.

Consequently, this year's OI event – organised by Reed Exhibitions and to be held at ExCel, London, from 17-19 March – will see exhibitors from across the industry showcasing innovative products designed to further push the boundaries of what is possible beneath the waves. This follows the pattern of recent exhibitions, where pioneering initiatives in subsea robotics have proved to be an area of consistent interest as autonomous ocean research techniques become ever more widely used. At the previous, 2018 edition of OI London, both Catch The Next Wave and the Ocean Futures Forum were sponsored by Shell Ocean Discovery XPrize, a 36-month competition which invited global teams to present their most innovative technologies

Courtesy of Reed Exhibitions

for the development of autonomous, real-time and high-resolution ocean exploration. The $4m grand prize went to GEBCO-NF Alumni, an international team whose winning entry integrated the autonomous SEA-KIT USV with existing ocean-mapping technologies and a radical cloud-based data processing system. Designed as a mothership to AUVs and ROVs, SEA-KIT is a glimpse of the future of hydrography and oceanography.

Key to the SEA-KIT design are KONGSBERG's K-MATE autonomous surface vehicle control and HiPAP positioning systems, and Kongsberg Maritime's long association with Oceanology International will continue at the London 2020 event on stand D600, where company representatives will be on hand to supply details about solutions in a wide range of maritime contexts including simulation training and the subsea sector.



A host of other exhibitors will present their skills in every aspect of subsea technology, from software and AI through to the hardware required to operate kilometres below the surface. Sonar manufacturers such as Echologger (K500) and Norbit (H600) will share their solutions for such diverse applications as hydrographic survey, forward-looking obstacle avoidance and subsea leakage detection, while others such as Inertial Labs (N150) and Water Linked AS (C350) demonstrate their positioning and communication products. Meanwhile, companies such as Kongsberg Maritime and Teledyne Marine (G100) can offer solutions across the entire gamut of subsea requirements.

Oceanology International London will also offer a broad selection of free-to-attend technical conferences, the majority of which are relevant to subsea operations. A session on Unmanned Vehicles and Vessels is particularly noteworthy – sponsored by underwater measurement and acoustic systems specialist Seiche (P501), the meeting will focus on innovative developments and applications in marine autonomous systems, including Robotics, AUVs, ROVs and ASVs.

Other relevant sessions include: Hydrography, Geophysics & Geotechnics; Navigation & Positioning; Imaging & Metrology; Ocean Observation & Sensing; Data Interpretation & AI (with a special focus on analytics, autonomous vehicles and imaging recognition), and Ocean ICT. "The technical conferences run across all three days of the event," says David Ince, Event Director, Reed Exhibitions, "and, as has been shown time and again, remain largely unparalleled in the sheer breadth of expert knowledge they draw upon and

Courtesy of Reed Exhibitions

Courtesy of Reed Exhibitions

the insights they provide, all under one roof. The London 2020 expo will of course be no exception, and delegates can look forward to detailed and absorbing discussions on important topics including Unmanned Vehicles & Vessels, Ocean Observation & Sensing, Offshore Energy Development and Ocean ICT.

"I should of course add that the vast potential of OI events for forging lucrative new business relationships and collaborations can never be underestimated, and for the London 2020 expo we've enhanced our networking tools with an increase in the number of OceanSocial events while making it easier to pre-arrange one-to-one meetings with prime contacts."

In addition to the technical conferences, a range of forums and networking events will continue throughout the show. Innovative new technologies will be showcased by the Future Tech Hub, dedicated to promoting start-up companies or research institutes with fewer than 10 employees which have either developed or launched a ground-breaking new tech product between January 1, 2019 and the show's opening date. The newly introduced Ocean ICT Zone, meanwhile, will examine the latest solutions and systems for the acquisition, transfer, analysis and storage of ocean data, the volume of which is growing exponentially.

"With remotely and autonomously operated vessels revealing new mysteries from our ocean environment virtually on a daily basis," commented David Ince, "marine technology has rarely been more important or exciting. Here at OI, we are delighted to be hosting many of the industry's most influential players and look forward to stimulating and educational discussions at our many technical conferences and forums."

This edition of OI is expected to be the largest yet. Floor space has been increased to over 17,000m^2 to accommodate an anticipated attendance of over 500 exhibitors and 8,000 visitors from 90 countries. Pavilions for Italy and Massachusetts will open for the first time, joining existing facilities for countries including Germany, France, Canada, the Netherlands, Norway and Ireland. Double the number of companies will stage on-water product demonstrations in the adjacent Royal Victoria Dock, compared with the last OI London event in 2018. These displays will be viewable from a covered private meeting area or from elevated viewing platforms on the dockside.

For more information, visit www.oceanologyinternational.com.

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HIDDEN RESOURCES

Anja Schuetz

The surface of the ocean conceals many secrets – unexplored depths, grotesque life forms, and precious resources. To find these resources, a Norwegian company has developed a technology for scanning the bottom of the ocean in greater detail.

At a depth of 1,000 meters, it is ice cold and dark. No natural light penetrates here. At first, only silhouettes are discernible in the glare of the underwater robot's floodlights. Then strange, three-legged objects appear on the bottom of the ocean. They are receiver stations for electromagnetic waves transmitted into the seafloor, to visualize its geological strata and find resource deposits.

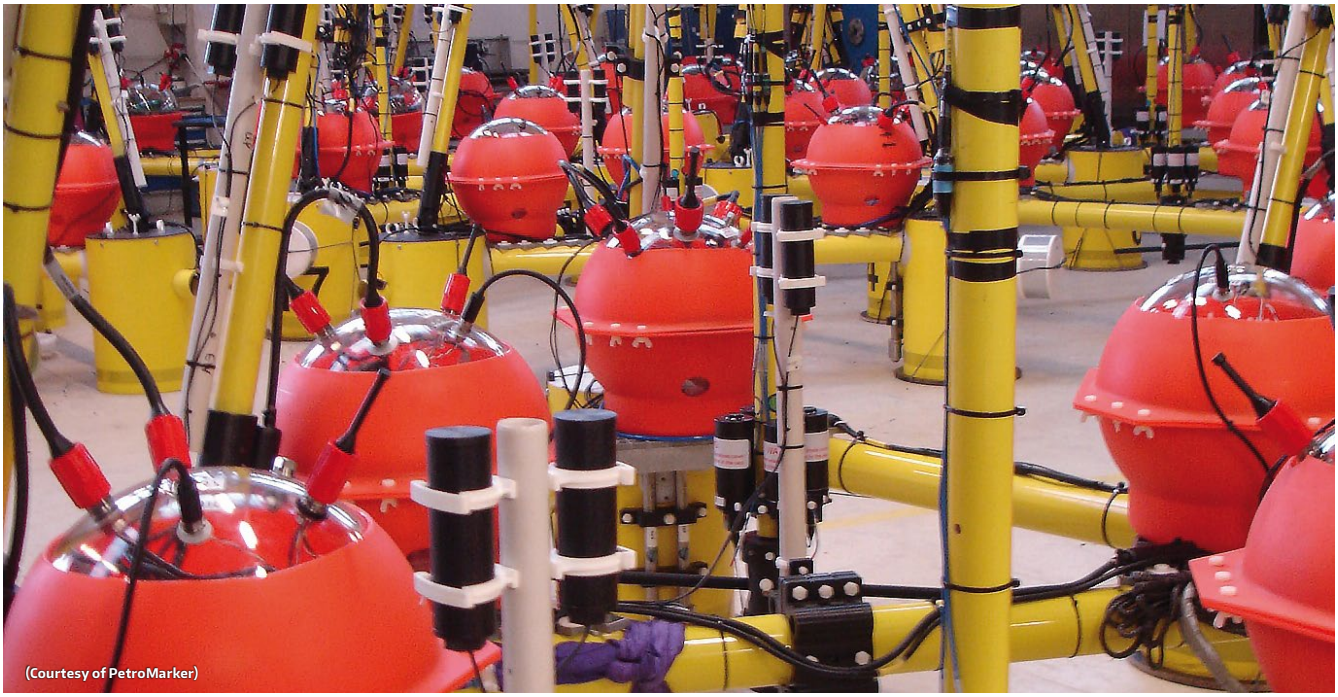
When oil companies want to find out whether drilling at depth is worth the cost, they often rely on Controlled Source Electro Magnetic (CSEM) technology. This technology exploits the differences in the electrical resistance of different bottom layers to provide clues about the location and size of oil fields.

The CSEM technology uses a very strong power source to generate an electro-magnetic field, as well as several receivers to record the fields. These tripod receivers are placed on the sandy bottom and pick up electromagnetic signals that have been changed by the layers through which they passed.

5,000 METERS BELOW THE SEAFLOOR

Since 2016, the Norwegian company PetroMarker is working with new tripods. The special thing about this measuring method is that, unlike other measuring methods, the company uses a vertical transmitter and receiver to find resources under the bottom. This enables a much more detailed resolution and data measurement up to 5,000 meters under the seafloor, the company claims.

The tripods are about 4 meters high and made from a combination of glass fiber and special foams. Due to the sensitive electronics, metal parts cannot be used. This far below the surface, the pressure is extreme, and the salt water is aggressive.



(Courtesy of PetroMarker)


(Courtesy of PetroMarker)

UNDERWATER DRIVES FOR VERTICAL ALIGNMENT

A prerequisite for the exact capture of electromagnetic data is that the antennas are aligned perpendicular to the seafloor – or as close to perpendicular as possible, as the seafloor isn't always flat. To this end, the company has developed new receivers that enable a vertical alignment of the antennas at the center of the tripods with high precision. This is where the underwater drives from maxon come in. They are installed at the lower end of the receiver antenna to align it vertically as nee¬ded. The maxon drive solution excels through its compact design and low weight. The centerpiece of the oil-filled underwater drive system is a motor-gearhead combination, comprising a brushless DC motor (BLDC) and planetary gearhead.

At the center of the tripods (receivers), the antennas are aligned as vertically as possible on the seabed. (Courtesy of PetroMarker)

The system is completed by a controller (EPOS) and a compensator. The units are encased in plastic to protect them from corrosion. Several modifications were required to meet the specifications for this application: The EC-I 40 motor and the GP 42 planetary gearhead are customized, and the compensator isn't off-the-shelf either. A dual seal, imitating typical submarine technology, ensures that the system is able to resist the enormous water pressure. The control electronics of the underwater drive are housed in a pressure-neutral glass ball that is able to resist the pressures of up to 600 bar – one of the challenges of this extreme application. Carsten Horn, Aquatic Solutions project manager at maxon Sexau: "This is an extremely interesting project where the new maxon underwater drives are used. The successful field trial of the tripods in the North Sea proves that maxon's technology works exceedingly well."


Maxon drive solution (Courtesy of maxon motor)

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Science designed.

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Science proven.

ROV ODYSSEUS

6000-meter ROV System in a small footprint with outstanding capabilities to accommodate science missions. We design and build custom sampling tools and also integrate existing industry standards or legacy sampling equipment.

- **Precision sampling for all science disciplines**
- **Environmental assessments & surveys**
- **Archeological site investigation & documentation**
- **Through frame lift to 4000 lbs**
- **Outstanding support and capabilities**
- **Rapid mobilization, globally**

PELAGIC
RESEARCH SERVICES

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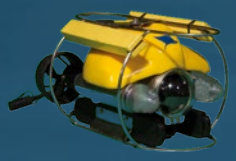
proven solutions



From large Workclass systems to Micro ROV's we have a proven track record of delivering projects globally

Life of field • IMR projects • Diverless UWILD surveys • Drill Support

Our ROV systems are managed and operated in a safe, cost effective manner whilst achieving the highest quality standards and deliverables. Please contact us to discuss any of your ROV requirements.

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