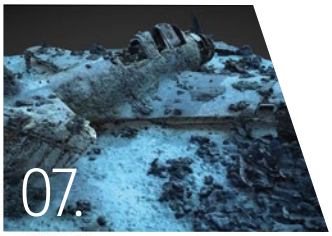
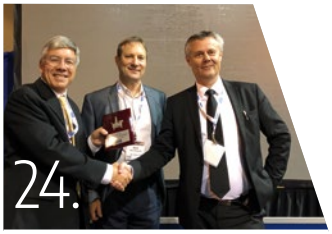
ROV PLANET





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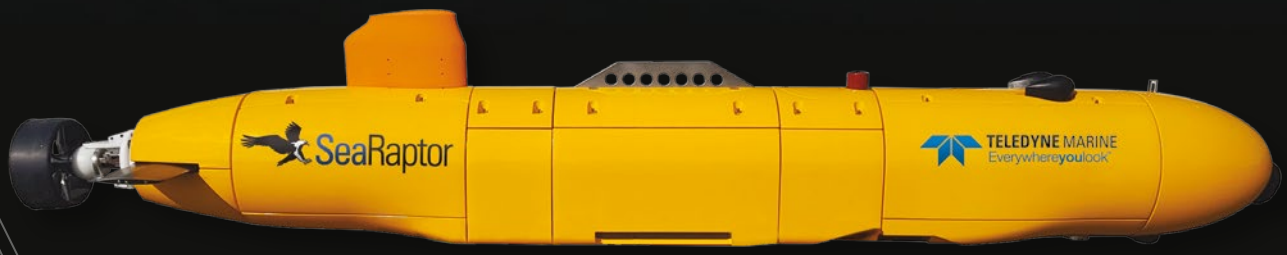

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Front Page Cover Photo: Courtesy of 3D at Depth | Poster Photo: Courtesy of Comex Innovation

WELCOME TO ROV PLANET

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

Dear Reader,

New advanced survey methodologies are being introduced to the underwater survey world. 3D at Depth's 3D laser lidar integration with photogrammetry and Comex Innovation's now BV marine certified 3D photogrammetry techniques have taken subsea survey to the next level.

Meanwhile Impact Subsea, an innovative company founded by two young talented engineers, are introducing their new ISS360 imaging sonar to the market. Their ISA500 altimeter has already been a great success and now they are adding a new product to their portfolio going from strength to strength.

This year at Underwater Intervention in New Orleans the 2025 Offshore Oilfield BP hosted panel discussion took place. You can read the highlights of the discussions and the recommendations from both the operators and service companies – a great piece of summary written by Bob Christ from SeaTrepid.

Finally, the use of unmanned surface vehicles (USV) are on the rise ranging from shallow water surveys to AUV integrated deep-water surveys and now George Galdorisi explains their possible use to safeguard the infrastructure of the oil & gas industry. And ECA have announced their new mothership type USV that hosts unmanned underwater vehicles on its deck, ideal for MCM operations.

Best regards,
Richie Enzmann

Please check out our website on:
www.ROVPlanet.com

UPCOMING EVENTS

9-11 April 2019 – Ocean Business – Southampton, England, UK
The hands-on ocean technology exhibition and training forum.

29-30 April 2019 – Deepsea Mining Summit 2019 – London, UK
The international forum for deep sea mining professionals.

6-9 May 2019 – Offshore Technology Conference (OTC) – Houston, TX, USA
The World's biggest offshore oil & gas conference and exhibition.

8-9 May 2019 – Unmanned Maritime Systems Technology – London, UK
Forum for the discussion of current and future projects and programmes delivering unmanned and autonomous technology for modern Navies.

13-15 May 2019 – Undersea Defence Technology (UDT) – Stockholm, Sweden
The underwater defence and security community's most relevant exhibition and conference.

4-5 June 2019 – IOSTIA BlueTech Expo – Washington, DC, USA
Event organized by IOSTIA to coincide with Capitol Hill Ocean Week (CHOW).

17-20 June 2019 – OCEANS 2019 – Marseilles, France
The OCEANS conference is the flagship event of the IEEE OES and the MTS.

3-6 September 2019 – Offshore Europe – Aberdeen, UK
SPE Offshore Europe is recognised by offshore E&P professionals as Europe's leading E&P event.

18 September 2019 – Subsea UK Underwater Robotics Conference – Aberdeen, UK
This conference will discuss the fast-approaching future of underwater robotics, discussing innovations and new technology, as well as the challenges and obstacles faced.

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1. Would you take an underwater measurement using Acoustics without applying sound velocity scaling based on local water conditions?

Multiple Choice Answers:

A. Some say that you need to apply SVP/CTD values – Frankly, I don't believe they even exist, it's my first day.
B. How could you even consider collecting data without applying such corrections?
C. As long as data looks pretty who cares, I generally mess with it in post-processing.

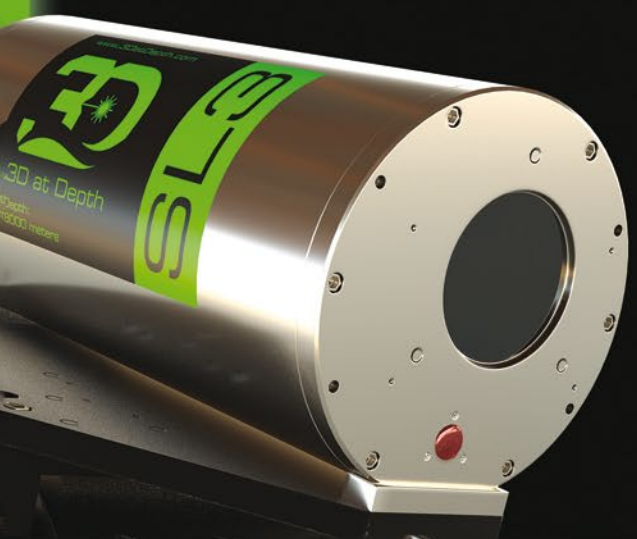
Correct Answer = B.

2. Would you take an underwater measurement using a Laser or any other optical method without applying an Index of Refraction correction derived from local water conditions?

Multiple Choice Answers:

A. Some say that you need to apply SVP/CTD values – How can you even tell?
B. The customers are still learning Optical measurement requirements so we'll get away with this for as long as we can.
C. As long as data looks pretty who cares – It's new and exciting, isn't it? I mean it's a laser and a camera!
D. How could you even consider collecting data without applying an SVP/CTD value? Optical measurements bring errors just like acoustic measurements do.
E. We'll spend ages measuring something we already know the size of at different distances, estimate the correction and do our survey. Hopefully, nothing will change while we are doing it.

Correct Answer = D (as in 3D at Depth)



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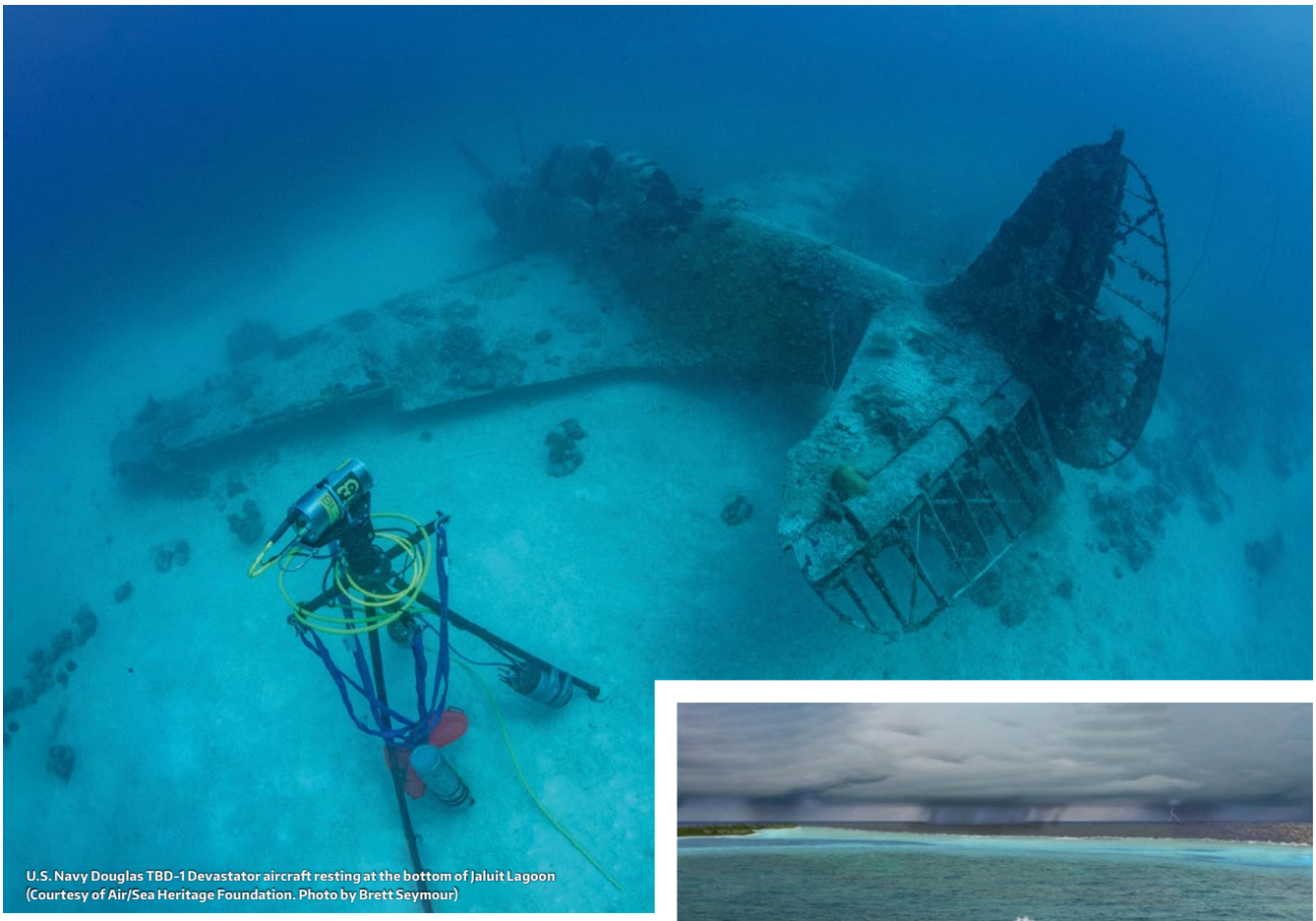
3D MODEL OF A DOUGLAS TBD-1 DEVASTATOR WWII AIRCRAFT

INTEGRATION OF UNDERWATER 3D LASER LIDAR AND PHOTOGRAMMETRY OFFERS NEW HOPE FOR MARTINE HERITAGE SITES AND SENSITIVE MARINE HABITATS

Colleen Hahn, Gryphon Media Strategies

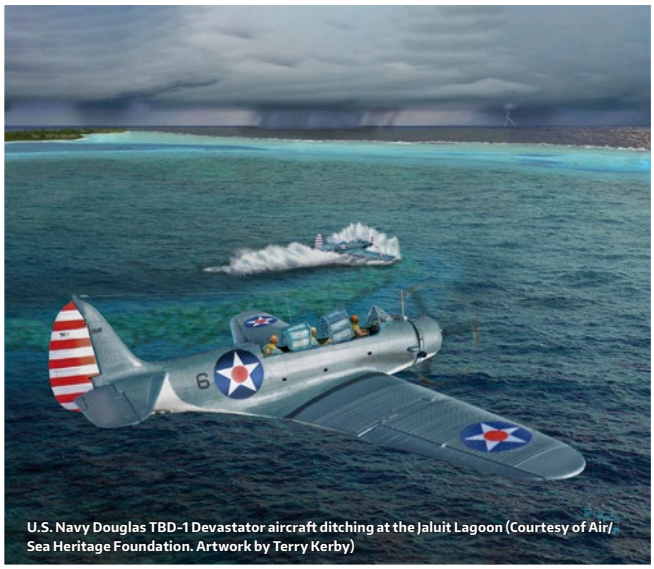
Survey vessel where the work was carried out from (Courtesy of Air/Sea Heritage Foundation. Photo by Brett Seymour)



U.S. Navy Douglas TBD-1 Devastator aircraft resting at the bottom of Jaluit Lagoon (Courtesy of Air/Sea Heritage Foundation. Photo by Brett Seymour)

OVERVIEW

Precise, measurable 3D baseline surveys are an important tool to help protect, preserve, conserve and monitor underwater historical, cultural and marine habitat sites. The ability to capture actionable data while maintaining a low environmental footprint in sensitive areas is crucial for the long-term integrity of both the target and the location. In October of 2018, 3D at Depth participated with the nonprofit Air/Sea Heritage Foundation in an expedition to document the largely intact wreck of a rare US Navy Douglas TBD-1 Devastator (Devastator) aircraft resting at the bottom of Jaluit Lagoon in the Republic of the Marshall Islands (RMI). The goal: capture precise, repeatable, millimetric data to build an accurate 3D model as a 21st century site map for this significant cultural heritage asset and to serve as a "pre-disturbance survey" for the proposed recovery, conservation and public exhibition of the historic plane at the National Museum of the United States Navy in Washington, DC. The Devastator Project expedition was conducted under a Special Use Permit granted by the Underwater Archaeology Branch of the Navy History & Heritage Command. The team worked in close coordination with the RMI Historic Preservation Office and were accompanied in the field by Susan Underbrink, an archaeologist with the Ministry of Culture and Internal Affairs. They also consulted regularly with local Jaluit government and the Atoll's traditional leadership.



U.S. Navy Douglas TBD-1 Devastator aircraft ditching at the Jaluit Lagoon (Courtesy of Air/Sea Heritage Foundation. Artwork by Terry Kerby)

Of the 129 Devastators built, all were either lost in battle, destroyed in operational accidents, or scrapped before the end of World War II (WWII). Today, no complete aircraft exists on dry land anywhere around the world. In addition, little or insufficient engineering information has survived in the archival record. This particular plane is US Navy Bureau of Aeronautics Number (BuNo) 1515, formerly assigned to Torpedo Squadron Five (VT-5) aboard the aircraft carrier USS Yorktown (CV-5) with the fuselage code "5-T-6". It was lost in a raid on Jaluit on 1 February 1942 and is one of the few remaining examples of this important historical icon that is both reasonably accessible and retains enough structural integrity to potentially generate an accurate 3D model. Located in a sensitive marine habitat, the expedition brought together a group of leading experts and volunteers to conduct a safe, touchless, accurate survey that would generate a world-class 3D rendition.

3D at Depth's SL3 laser was deployed at varying ranges from the wreck site while maintaining a safe distance, so as not to disturb the surrounding area (Courtesy of Air/Sea Heritage Foundation. Photo by Brett Seymour)

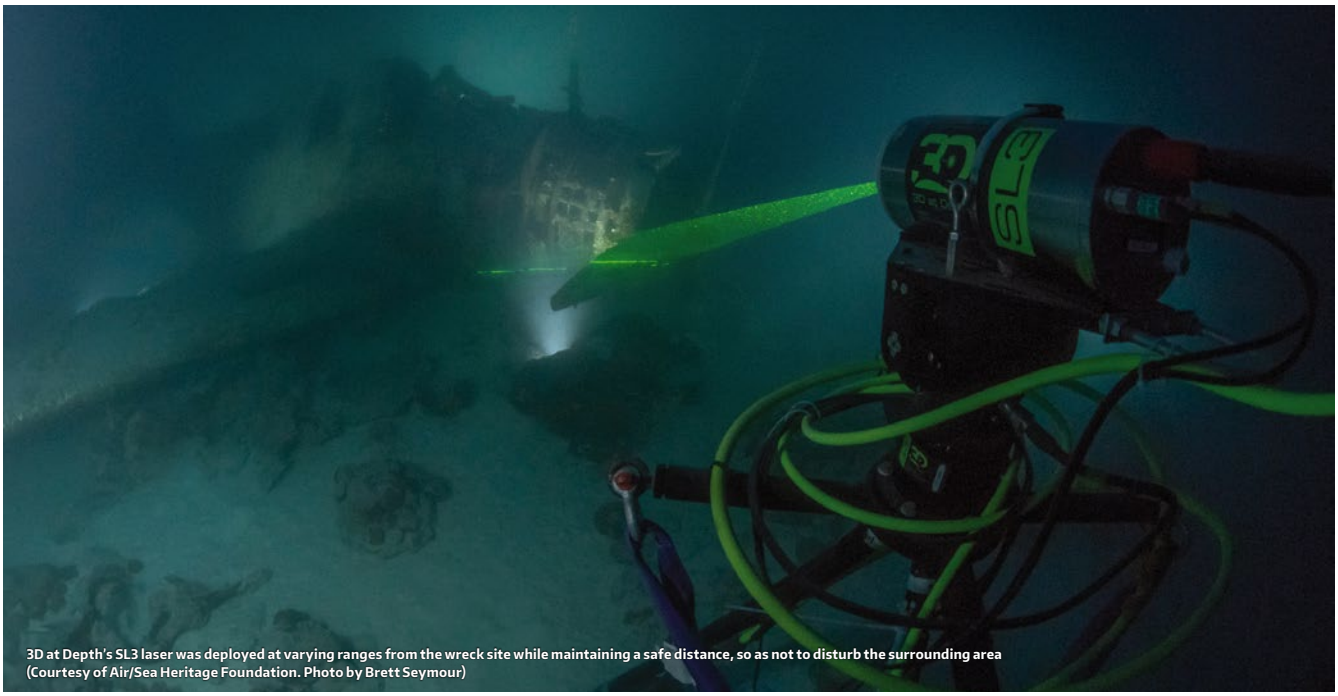

Both 3-man crews survived their forced landing in the water and were sheltered by residents on the nearby islet of Pinlap (Courtesy of Air/Sea Heritage Foundation. Photo by Brett Seymour)

HISTORY

Devastators and their crews played a significant role in the Pacific Theater during the early part of WWII, especially during the Battles of the Coral Sea and Midway. At the time of its introduction to the fleet, the TBD-1 was considered the most advanced aircraft of its kind. As the United States Navy's first all-metal combat aircraft, it was the first torpedo bomber to see action. In addition, it was the first Navy plane with a fully enclosed cockpit, and the first aircraft to have powered hydraulically folding wings. The TBD-1 Devastator was considered to be a major force in the 1st sea-air battle in history, the Battle of the Coral Sea, where torpedo squadrons from USS Lexington (CV-2) and USS Yorktown (CV-5) scored several hits to help sink the Japanese light carrier Shōhō.

During the Marshalls-Gilberts raids Devastators were used in tactical airstrikes against Imperial Japanese Navy (IJN) garrisons in the Marshall and Gilbert Islands in February 1942. The Jaluit raid of 1 February 1942 was the first offensive action taken by the US Navy in WWII. BuNo 1515 was armed as a level bomber and tasked with attacking a major seaplane base on what was then the administrative capital of the Japanese-mandated Marshall Islands. Flying in company with another Devastator, BuNo 0298 ("5-T-7"), they were separated from the rest of the Yorktown strike group in poor weather. Unable to locate the target, the pair attempted to return to their ship, but became disoriented, resulting in a lengthy detour that consumed precious fuel. Short on gas, the two Devastators returned to Jaluit and ditched on the western edge of the lagoon, in the vain hope of finding a boat to sail back to Allied territory. Both 3-man crews survived their forced landing in the water and were sheltered by residents on the nearby islet of Pinlap. The late James "Ace" Dalzell, radioman/gunner on BuNo 0298, spoke with Devastator Project researchers in 2004 about his wartime experiences. He especially recalled the kindness of the Marshallese and stated that he knew on his first night at the island that they were all going to be OK. Remarkably his premonition proved correct. He and the other five aircrew surrendered to the Japanese a few days later and, despite the tribulations of more than 3 years as POWs, every one of the crew from 1515 and 0298 lived to return home after the war. The airplanes remained where they sank, which ironically ensured their survival as well. Others of their kind were not so fortunate.

The TBDs' final act came at the pivotal Battle of Midway, where dozens of Devastators were launched from the aircraft carriers USS Enterprise (CV-6), USS Hornet (CV-8), and USS Yorktown (CV-5). Very few survived. The aircrafts' slow speed and poor maneuverability were no match for the advanced Japanese Mitsubishi Zero fighters counter attacks. A string of uncoordinated assaults against an alerted enemy with almost no friendly air cover ensured that the TBDs would pay dearly – not a single direct hit was recorded from all of the torpedoes launched in the attacks, despite a significant loss of life. Thirty-seven out of forty-one Devastators that



3D at Depth's SL3 laser was deployed at varying ranges from the wreck site while maintaining a safe distance, so as not to disturb the surrounding area (Courtesy of Air/Sea Heritage Foundation. Photo by Brett Seymour)

sortied that day ended up in the water, taking 70 out of the 82 pilots and air crew with them. Most tragic of all was the story of Hornet's Torpedo Squadron 8 which lost all 15 of the TBDs that flew off the ship. Only one man, Ensign George "Tex" Gay, survived. The Devastator crews knew the odds were stacked against them and they went anyway. What they didn't know, and most would never live find out, was that their relentless and courageous attacks would keep the Japanese fleet off balance, taking evasive maneuvers, drawing the enemy air cover to wave top level dealing with the threat while leaving their valuable aircraft carriers vulnerable to a sudden and devastating attack by American dive bombers. The resulting success at Midway would mark the end of eastern expansion for the Empire of Japan in the Pacific and a clear victory for Allied Forces.

The action at Midway represented the last of combat mission for Devastator crews. With a total combat tenure lasting just six months, the aircraft was pulled from frontline service in mid-1942 and completely retired in 1944. With a war still to fight, no examples of the now thoroughly obsolete aircraft were set aside for posterity.

THE EXPEDITION: A REVOLUTIONARY WAY TO SURVEY

The powerful legacy of service and sacrifice -set by USN TBD-1 crews, combined with the unique Marshallese-American history embodied in BuNo 1515 is at the very heart of the Devastator Project, an ongoing effort launched in 2004 by Russ Matthews, president of the nonprofit Air/Sea Heritage Foundation. Over the course of 15 years and five previous expeditions, a dedicated team of historians, archaeologists, conservators, technicians, engineers, and documentarians have come together to monitor and evaluate the Jaluit aircraft as a candidate for recovery in hopes of preserving this artifact and its story for future generations.

The October expedition team included project co-lead and Air/Sea Heritage Foundation co-founder Dr. Peter Fix, a specialist in the field of materials conservation of watercraft and aircraft with the Conservation Research Laboratory and Center for Maritime Archaeology and Conservation (CMAC) at Texas A&M University; Brett Seymour, a top flight underwater photographer on loan from the National Park Service's Submerged Resources Center; Evan Kovacs an innovative engineer and experienced technical diver who runs Marine Imaging Technologies; Matt Christie, a talented field technician with 3D at Depth, INC and its world leading expertise in subsea laser LiDAR technology; Brian Kirk an expert local guide and original co-discoverer (with historian/explorer Matt Holly) of the wreck of BuNo 1515; plus archaeologist/divers Chris Dostal, Carolyn Kennedy, and Michael Terlep. Advisors from the Advanced Imaging and Visualization Laboratory at world-renowned Woods Hole Oceanographic Institute were also part of the expedition planning and post-production stages.

On 17 October 2018, the group boarded Indies Surveyor, a 75 ft live aboard dive vessel chartered from Indies Trader Marine Adventures and specially outfitted to support technical diving operations in remote areas like Jaluit Atoll and set sail.

THE CHALLENGE

Although Devastator 1515 appears largely intact, the sensitive nature of the wreck and the often low water clarity provided limitations for the data collection process and other optical imagery collection methods. In addition, as a pre-disturbance survey, it was important to capture not only the repeatable, accurate, millimetric details of the aircraft but also the substance and structures of the marine biomass on and around the aircraft. Soft corals, sponges, and other underwater species could not be affected during the survey process.

The result was not only an aesthetically pleasing image, but the survey produced actionable data so post-production can render the entire aircraft (Courtesy of Air/Sea Heritage Foundation)

THE PROCESS

In approaching what was intended to be the ultimate Jaluit Devastator site survey, the group decided to integrate a wide variety of the latest technology including still photography, 4K video, 3D photogrammetry, and 360° VR. During the planning discussions, Brett Seymour suggested the possibility of adding 3D at Depth's technology to the survey mix. Brett was aware of 3D at Depth's reputation from their successful collaboration with the National Park Service on a previous project and from their underwater scans of Pompeii for BBC ONE's television program "Invisible Cities." Serendipitous timing and the generosity of 3D at Depth, made it possible to secure a SL3 subsea LiDAR laser with its powerful real-time 3D data processing unit for the expedition's field package. The addition of this revolutionary technology would take the survey capabilities to another level where it would be possible to virtually reverse engineer the sunken aircraft. Using 3D at Depth's SL3 Subsea laser LiDAR technology, the team could create a baseline survey with 3D point clouds that could be layered with photogrammetry and other optical imagery (including the addition of stills and 360 VR) rendering a highly accurate 3D model.

Over a period of six days on site, dozens of dives were conducted to the wreck located under 130 ft of water. Some divers were required to used closed-circuit rebreathers throughout the process of positioning and repositioning the scanning head for complete coverage. Others collected further structural and environmental data, making observations on changes in the condition of the plane which is slowly, but inevitably deteriorating due to natural forces. In addition, registration markers were deployed in pre-approved areas to check accuracy for both laser scans and photogrammetry technology. 3D at Depth's SL3 laser was deployed at varying ranges from the wreck site while maintaining a safe distance, so as not to disturb the surrounding area. The steerable beam allowed for flexibility and accuracy while working alongside other technology applications. The SL3 pulsed at 40,000 measurements/sec for each scan position acquiring very high-density sector scans. 3D at Depth's patented index of refraction correction algorithm was able to deliver repeatable data sets in low clarity water quality where other optical solutions would struggle to operate in. Along with the LiDAR laser data, the team captured 1,398 still images with photogrammetry.

THE RESULT

The SL3 LiDAR laser delivered a total of 92 million points with 5.7 million vertices. Each dense point cloud was then surfaced modeled and moved into a 3D design computer. Optical imagery from photogrammetry, 360° VR and stills were integrated into the designs to render an exact 3D model of the Devastator. The result was not only an aesthetically pleasing image, but the survey produced actionable data so post-production can render the entire aircraft.

CONCLUSIONS

The fusion of underwater LiDAR laser technology and 3-D volumetric photogrammetry offers a revolutionary step towards the accuracy of digital preservation and visualization for large features on the seafloor including maritime heritage sites, coral reefs, and seafloor habitats. In addition, the Devastator Project expedition highlights the collaboration between a dedicated group of individuals who used enabling technology to preserve an iconic aircraft for future generations.

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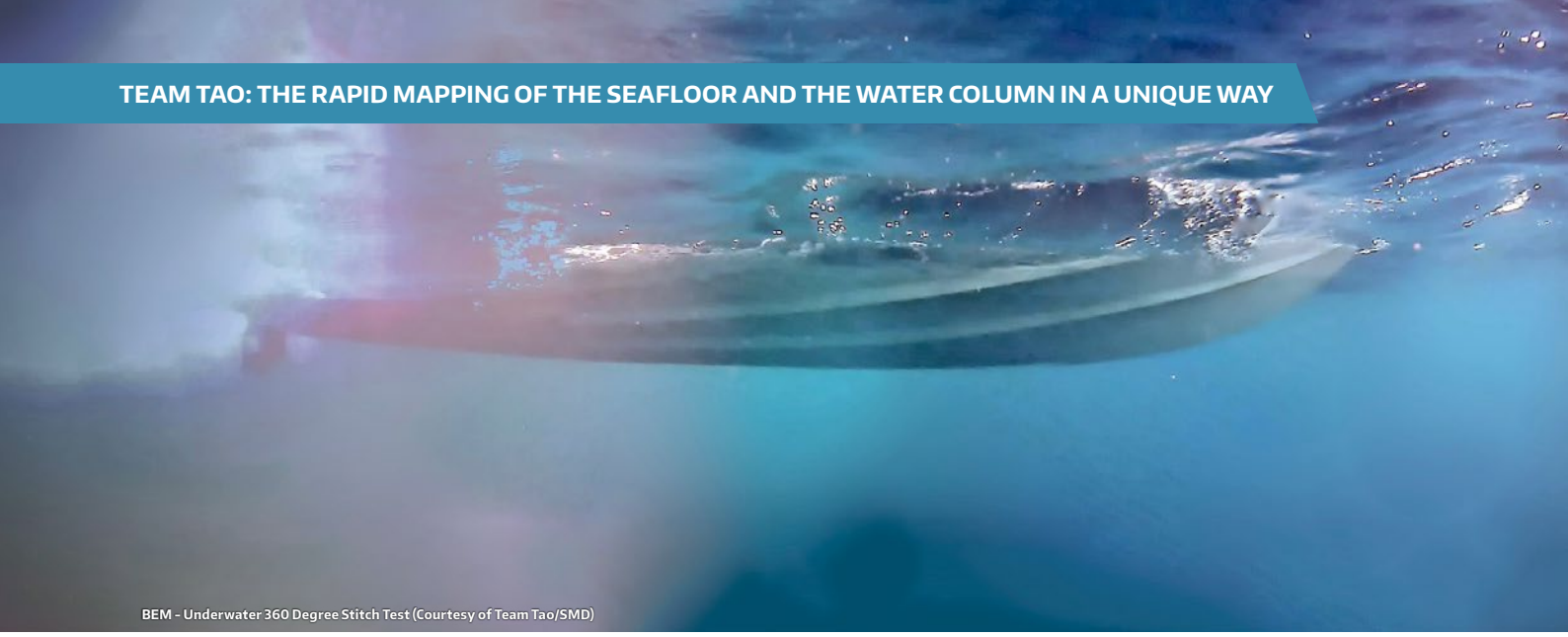
TEAM TAO

PIONEERING RAPID SEAFLOOR MAPPING & WATER COLUMN SURVEY

Team Tao is a small team competing in the Shell Ocean Discovery XPRIZE and is made up of 4-5 individuals with different skillsets. Dale Wakeham is the team leader. He has a background in industrial design, while the other members are specialised in electronics, software, and subsea engineering. They are all very passionate about what they do and are on a mission to change the way ocean discovery and surveys are performed.

Enroute to the competition area (Courtesy of Team Tao/SMD)



BEM - Underwater 360 Degree Stitch Test (Courtesy of Team Tao/SMD)

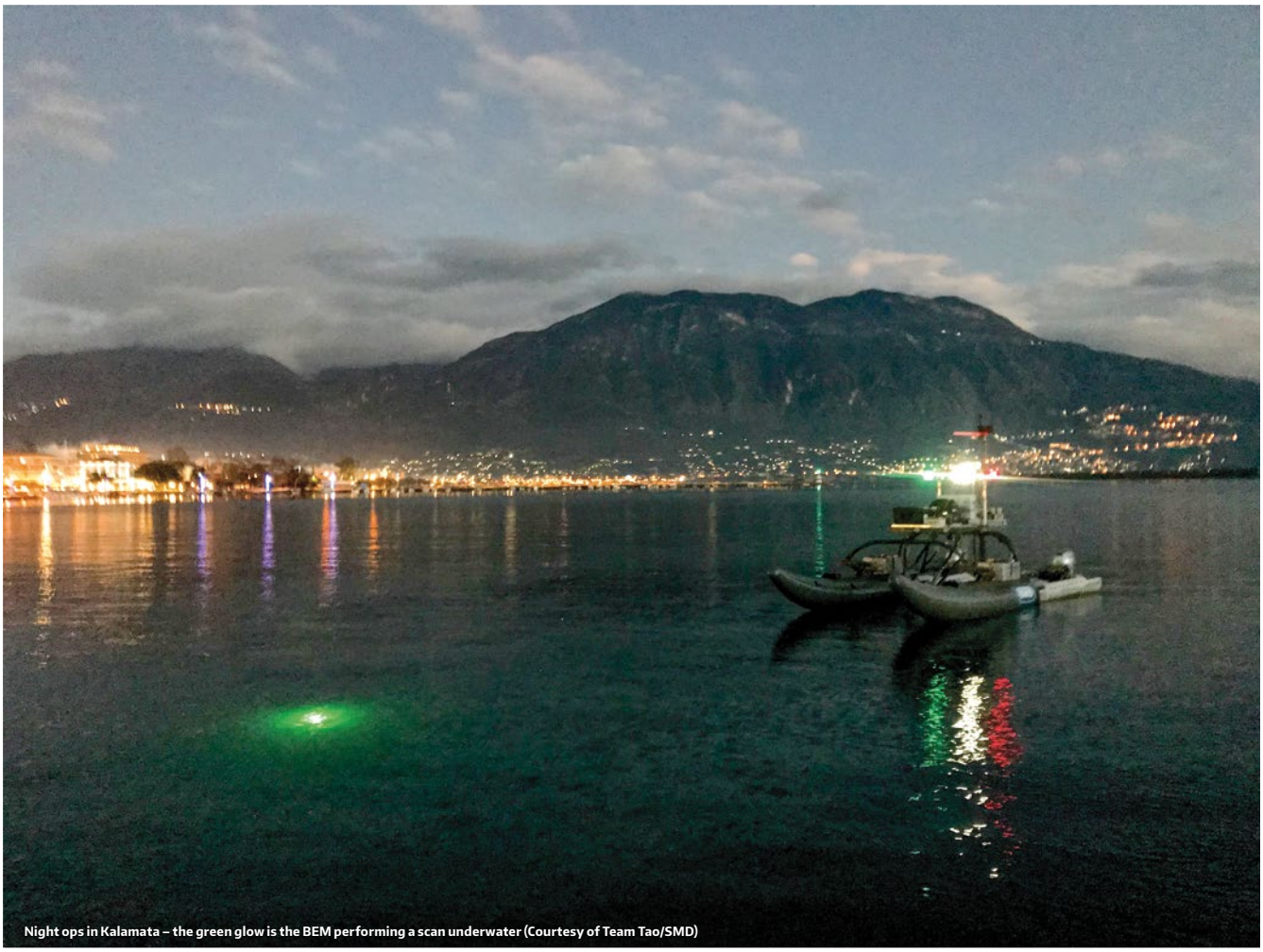
Driven by this common goal they have put in a huge amount of time, effort, and energy into the past year-and-a-half. This is the start of their journey; their ultimate-goal is to commercialise their systems' capabilities, which were validated during the XPRIZE finals.

Size comparison of Team Tao's BEM (recharging) to the two Japanese traditionally sized AUVs (Courtesy of Team Tao/SMD)

THE TECHNOLOGY

Many of the teams in the competition are applying the best commercial, off the shelf technologies that currently exist in the subsea industry in different ways to map a large area of the seabed. In contrast, Team Tao have developed a new technological concept that completely rethinks what it is to conduct a marine survey.

Team Tao and the development partners from SMD and Newcastle University (Courtesy of Team Tao/SMD)



Night ops in Kalamata – the green glow is the BEM performing a scan underwater (Courtesy of Team Tao/SMD)

Other teams have adopted the traditional approach which uses a single, high value asset AUV deployed from a boat or they launch their AUV from the shore. However, one of the XPRIZE requirements was to have the entire kit fit within a single 40ft container, which limited the possibilities of using an expensive large, long range AUV and deployment vessel.

Team Tao went back to the drawing board. Working with Soil Machine Dynamics (SMD) and Newcastle University, they came up with the idea of a vertically swimming swarm of mini AUVs. These AUVs are completely different to anything else in the world. Theirs is a revolutionary approach that can gather data – salinity, temperature, conductivity, turbidity, etc. – throughout the water column transit in addition to a 360-degree camera array that allows the viewer to look everywhere in 3D.

SMD has a great history in making robust industrial products, but the way TeamTao has designed their AUV has a completely different philosophy: low cost, light weight, with extensive use of additive manufacturing. The Bathypelagic Excursion Module (BEM) AUV weighs only 19kg and it can dive to 4,000m. Almost every aspect of this drone has been developed in-house and where off-the-shelf components are used, they have been extensively modified to suit this compact, lightweight vehicle. Many parts are 3D printed and the team have developed their own methods to create hybrid parts that incorporate printed plastics and cast resins resulting in high strength, lightweight components. Special buoyancy materials are used to bring down costs and optimise the vehicle dynamics.

The BEM floats so it is positively buoyant and relies on a single thruster for propulsion down to the required depth. The thruster has two counter-rotating propellers and is mounted on a gimbal to allow both trajectory and rotational position control. Once the required altitude above the sea floor has been achieved a 600m diameter, 360-degree sonar map is produced, the thrusters are then turned off and the BEM floats back to the surface. This reduces battery depletion and ensures that the drone will return to surface even if there is a problem with propulsion or electrical power.

The batteries used are standard Lithium Polymer type, although newer cell technologies which offer greater power density and longer life are being considered for the future. For underwater communications Sonardyne has provided a special version of their Nano modem which has

been modified by the team to allow it to be used down to 4,000m without the need for a metal can electronics housing. Over-the-horizon communications between the surface vessel drone deployment hub and shore use Rajant IP meshed radios with a dynamic, directional antenna system fitted to the vessel and a land based, tethered drone from DJI.

The team chose a WAM-V unmanned surface vessel manufactured by Marine Advanced Robotics. This vehicle is a clever platform with twin hull catamaran construction and a stable payload platform for the deployment and retrieval of the BEM out on open seas. A BEM catching mechanism was developed through scale testing at Newcastle University's large tow tank facility that would be deployed at the front of the boat which is then used to scoop the BEM AUVs out of the water.

The next development step will be to refine this mechanism in order to be demonstrated in the first half of 2019, then to make the AUVs communicate with each other to control their special positions which will allow the mapping of much larger areas. The field trials will be somewhere in the UK, most likely Loch Ness.

SHELL XPRIZE OCEAN DISCOVERY COMPETITION FINALS

At the end of last year TeamTao completed their sea trials at the Shell Ocean Discovery XPRIZE Competition Finals in Kalamata, Greece. The team worked tirelessly through 2018 to get there.

During the competition they performed some shallow water testing before progressing to the deeper water near the Port of Kalamata. Finally, they entered the main competition area; a 500m² range located about 15 nautical miles from Kalamata mission control. The depths there ranged between 500m to 4,000m. TeamTao cruised to the competition area using their unmanned surface vehicle (USV) at about 10 knots – unlike some of the other teams that used submersibles swimming underwater at 2 knots.

XPRIZE presentation at Oceanology International in San Diego

Once on target the USV deployed the BEM. It travelled down to the seabed and performed a rotational scan. As soon as the BEM retuned to the surface the sonar scan data was transmitted straight back to the shore via a tethered drone incorporating a YAGI antenna operated from a hillside near Koroni. The data was immediately forwarded to a computing cloud with its servers located at Newcastle University which allowed analysis in near real time. By the time the USV arrived back in Kalamata Port, the data had already been analysed and the point cloud map was created.

Dale Wakeham was very satisfied with the results: 'The way that we produce the sonar data, the scan size, our speed, and the rate of deployment to create a map, with the added bonus capability to sample the water column is something a traditional AUV wouldn't do. We were able to deploy our system rapidly onto the target area and then come back up to create a map in a completely unprecedented timeframe. The goal for the finals was to reach the competition area, create a map, and do this all autonomously. The team was able to demonstrate that proof of concept successfully. We are now continuing the development to create swarm capabilities, enhance our autonomous surface vessel's systems and move ahead with our plans to grow this venture into a commercial entity.'

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SAAB AUV-62 (photo credit: Saab Seaeye)

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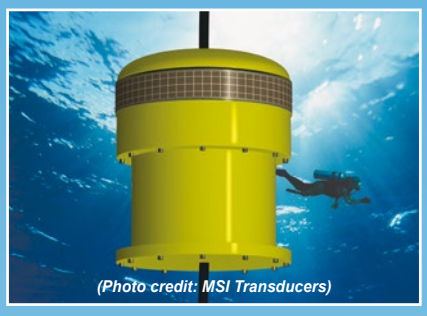

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GAPS

ACCURATE AND RELIABLE ROV POSITIONING AT 3,000M WATER DEPTHS

P&O Maritime, a premier maritime solutions provider, recently carried out a series of tests using iXblue Gaps USBL (Ultra Short Baseline) system for the accurate positioning of their SMD Holland 1 Work-class ROV. The tests, that were conducted off the West coast of Ireland at 3,000 meters of water depths, proved to be highly successful, with a positioning repeatability of around 0.07% of the slant range thanks to Gaps USBL system.

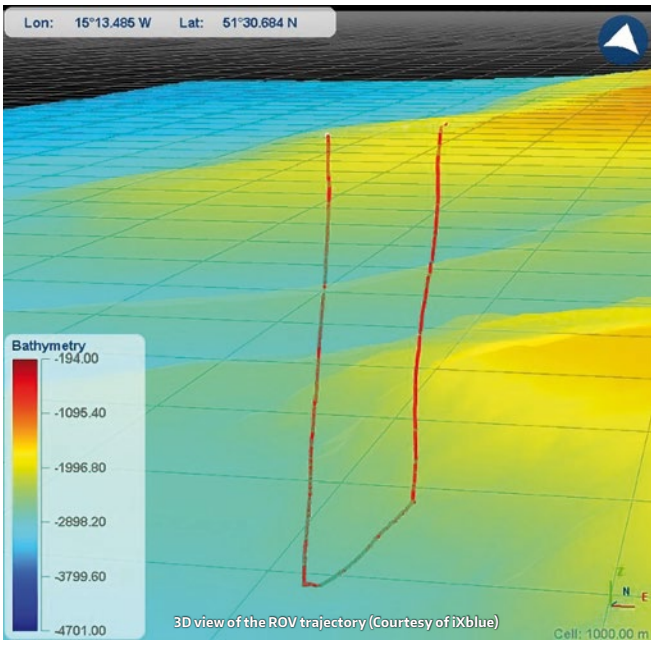
Accurate positioning of a subsea vehicle operating on a field at great depths is a key challenge for companies working on the challenging offshore market. Indeed, unlike ground systems that can rely on GNSS signals, AUVs and ROVs, having no access to such signals, have to be equipped with performant and robust Inertial Navigation Systems (INS), coupled to Doppler Velocity Logs (DVL) to get a reliable and accurate positioning information.

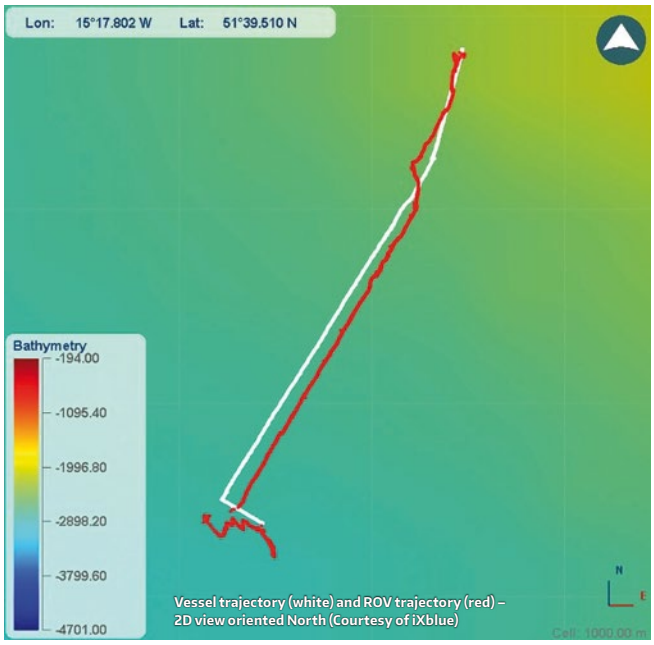
While the INS will calibrate its initial position thank to the GNSS signal available at the surface, it will eventually accumulate navigation errors leading to drift when operating underwater during extended periods of times. Furthermore, when the subsea vehicle descends through the water column to operate in deeper waters, DVLs will not initially have bottom lock and will not be able to provide the accurate velocity information needed for the reliable positioning of the vehicle. It is to address those limitations that acoustic position aiding systems, such as iXblue's Gaps USBL system are used.

GAPS: A HIGH-PERFORMANCE USBL SYSTEM

Benefitting from iXblue's 40-year expertise in subsea acoustic technology, Gaps offers a high-performance USBL system that enables accurate and reliable positioning of subsea vehicles and assets. Integrating a USBL antenna and a Fiber-Optic Gyroscope (FOG) based INS in the same housing, Gaps is a pre-calibrated system that does not require any on-the-field calibration and makes USBL underwater positioning extremely simple to operate from any kind of vessel. Portable, Gaps does not require any complicated and time-consuming installation and features very high-performance thanks to data fusion of acoustic, inertial and GNSS technologies.

An all-in-one system, it can provide the accurate position of both a surface vessel and of several subsea assets (ROVs, AUVs, tow-fish, divers, structures...). It is furthermore the perfect solution for dynamic positioning applications where transponders are fixed on the seabed. Gaps also provides very accurate heading and attitude for the surface



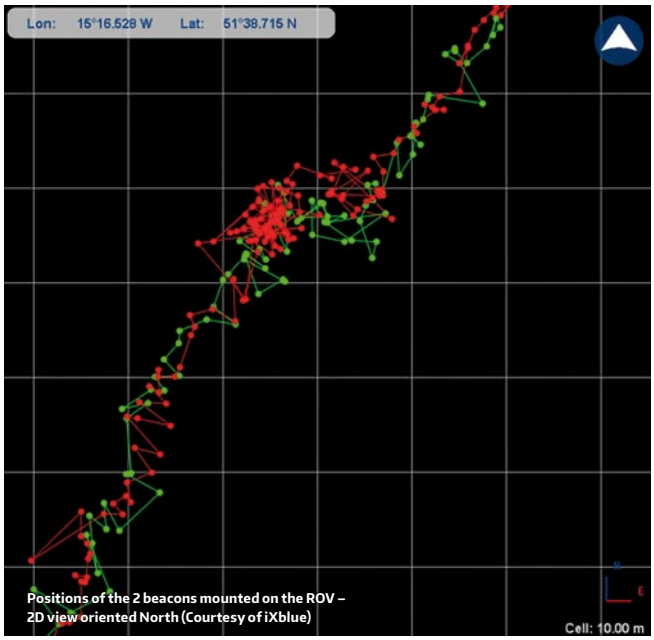


vessel and unrivalled performances in shallow or extremely shallow water depths due to its unique receiving antenna design and enhanced digital signal processing techniques.

Thanks to its 200 degrees hemispherical coverage, Gaps is able to measure the absolute position of subsea assets and vehicles, on which an acoustic transponder is installed, and that can navigate at water depths down to 4,000 meters. Depending on the environmental conditions, Gaps can provide a positioning accuracy that can reach up to 0.06% of the slant range.

P&O MARITIME SUCCESSFUL TRACKING RESULTS IN 3,000M WATER DEPTHS

During the tests conducted by P&O Maritime off the coast of Ireland for the accurate positioning of their SMD Holland 1 ROV, iXblue Gaps USBL system successfully provided an estimated positioning repeatability of around 2 meters, or 0.07% of the slant range.



"We recently used iXblue's Gaps USBL during a scientific cruise for navigation positional tracking of our work class ROV Holland 1. I found the Gaps pre-calibrated system extremely quick and straight-forward to integrate from the start. Once the ROV was deployed its displayed tracked position was extremely reliable as we worked at a range of depths down to 3,000 meters. This was with the vessel in a stationary position and also in a following transect direction of the ROV." states Paddy O'Driscoll, ROV Superintendent with P&O Maritime Services, Ireland.

Such accurate positioning was achieved thanks to the use of iXblue Gaps pre-calibrated USBL system and two Applied Acoustics USBL transponders that offer a directivity of around 45 degrees, as well as a transmit level of 203 dB ref µPa for one meter.

As shown on the graphics, Gaps USBL and the two transponders were able to successfully track the ROV at great depths during the whole duration of the operation with high repeatability of the position within 2 meters. It was furthermore estimated that iXblue's Gaps maximum tracking range could have reached 7,000 meters in the conditions encountered during the operation.

Adopted by over 120 companies, institutes and navies worldwide, Gaps has now become the preferred solution for operations requiring the precise positioning of an underwater vehicle and was also recently recommended by Teledyne Gavia for the successful tracking of their AUVs in shallow and deep waters that both highlighted a very accurate positioning together with a great simplicity of integration and operation.

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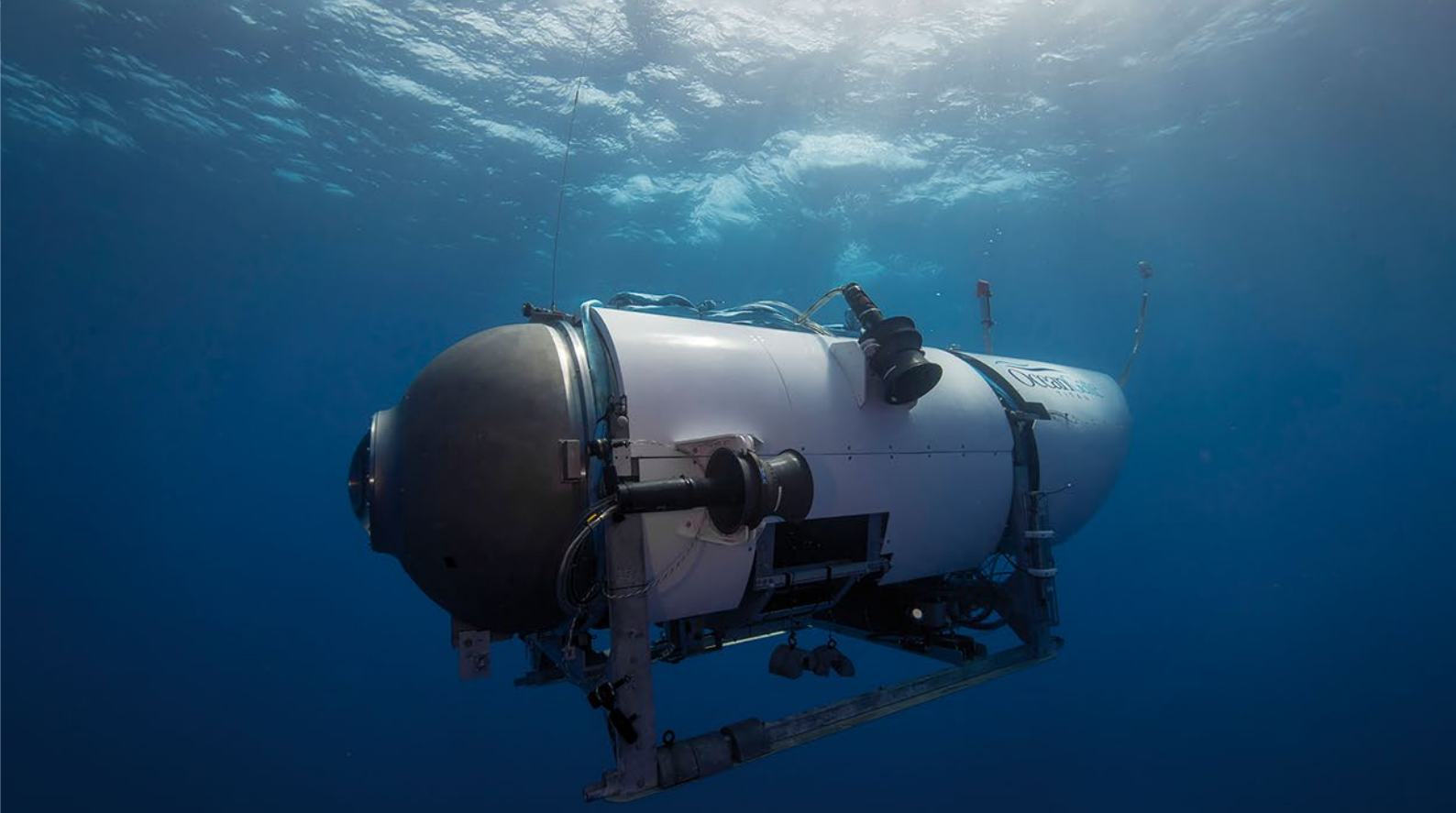

Courtesy of Teledyne Marine

TELEDYNE MARINE TECHNOLOGY UTILIZED EXTENSIVELY ONBOARD

OCEANGATE'S TITAN MANNED SUBMERSIBLE

On December 10, 2018, OceanGate's Titan Manned Submersible reached a major milestone by successfully completing a 4,000m validation dive off the coast of the Bahamas. This dive makes Titan the only commercially operated manned submersible capable of reaching this depth. With the completion of this dive, Titan is now poised to usher in a new era of increased access to the deep ocean for commercial exploration and research ventures, allowing up to five crew members to dive to the ocean depths for a myriad of tasks and operations.

Teledyne Marine, with its wide breadth of sensors and technology, has become a key partner and extensive technology provider to OceanGate for this innovative project. Teledyne Benthos acoustic modems have been designed into this vehicle to provide real-time "text" communications up to 6 km, allowing for the critical exchange of information between the vehicle's pilot and the surface throughout the dive. More recently, OceanGate has also enabled the modem's positioning capability through the use of Benthos DAT, allowing them to capture the position of the vehicle relative to the ship's surface.

A 6,000m Teledyne RDI phased array Pioneer DVL, with XRT extended tracking, has also been installed to provide critical precision vehicle navigation capability at full depth, complimented by a Teledyne RDI Citadel CTD. Teledyne BlueView's 2D and 3D high-resolution imaging sonar systems are also installed. The 2D system is used to support navigation and obstacle avoidance while the 3D sonar provides detailed 3D point clouds of areas/objects of interest.

"We could not have completed this amazing project without the great products and customer support of the Teledyne Marine team", said Stockton Rush CEO of OceanGate.

With the completion of the recent validations dive, Titan is now preparing for its first major expedition, which will explore the Titanic in June 2019.

THE 2025 OFFSHORE OILFIELD

A BP-HOSTED PANEL DISCUSSION

By: Bob Christ, CEO, SeaTrepid

Courtesy of Bob Christ

The BP-hosted 2025 Offshore Oilfield Panel Discussion took place at Underwater Intervention 2019 in New Orleans on February 5th and February 6th in a specially-designated area of the conference as its own venue. Over the course of two days, both invited operators and selected service companies voiced their views and vision for the future of subsea offshore operations in the 2025 timeframe. Both sessions were moderated by Mark Siegmund, an established expert in the field of subsea life-of-field support.

The sessions were attended by conference attendees with audience sizes in the 100-person range. A range of points were raised during the sessions with the operating companies expressing their vision towards lowering HSE/Regulatory/Financial risks through more autonomy allowing for reduced field-based personnel and surface vessels while extending the life of field through better information and data management. The service companies mostly concentrated on competitive strategies towards fielding a first-mover solution thus allowing control of the technological evolution.

VENUE

The panel sessions took place on the floor of The New Orleans Convention Center aside from the UI19 exhibit hall. Full conference credentials were required for access to the panel discussion.

SCHEDULE

- 1. TUESDAY, FEBRUARY 5 (1330-1500): Operator Panel Discussion – BP, Chevron, Shell and Petrobras were first up on Tuesday.
- 2. WEDNESDAY, FEBRUARY 6 (1330-1500): Service Company Panel Discussion followed with Oceaneering, TechnipFMC, One Subsea, Saipem and Houston Mechatronics discussing their views.

PANEL DISCUSSION

Bob Christ of SeaTrepid was appointed Master of Ceremonies for introducing the panel format and leading off the introductions. Doug Hernandez of BP provided the safety moment then Mark Siegmund took over for the main program. Individual panelist provided a short description of their

Operator Panel (left to right): Martin Dove, Bill Nisbet, Mike Brashear, Bob Christ, Mark Siegmund and Marcos Morais (Courtesy of Bob Christ)

companies' vision for the future with a short Q&A period on each topic by Mark. An open forum Q&A followed with a lively discussion by the audience over both days.

DISCUSSION FORMAT – OPERATOR PANEL

To summarize the operators' message in as few words as possible, the oil companies want: 1) better data to analyze their operations, 2) fewer vessels and personnel in the field in order to achieve better autonomy, and 3) through better information, field life extension can be achieved for lowing of cost per unit production.

Panelist were:

- Martin Dove – BP
- W. (Bill) Nisbet – Shell
- Mike Brashear – Chevron
- Marcos Guedes Gomes Morais – Petrobras

SERVICE COMPANY PANEL

To summarize the service company message in as few words as possible, the service companies want: 1) to focus their research and development funds towards fielding a solution that provides an edge over their respective competition, 2) to achieve "first mover" position so as to lead the technology evolution and 3) to dig deeply into the operators' procurement structure in order to achieve required vendor status.

Panelist were:

- Todd Newell – Oceaneering
- Arnt Reilstad – Technip FMC
- Jack Vincent – One Subsea
- Giovanni Massari – Saipem
- Sean Halpin – Houston Mechatronics (HMI)

Mark Siegmund gathered an interesting panel mix with four large international service companies and one small innovative startup (HMI) as the proverbial "kids in the garage paradigm busters". The large company panelists were all polished with tight presentations. But Sean Halpin of HMI delivered a very strong "think outside of the box" presentation of the sort that disrupts the status quo. Sean's concept of "correspondency" or focus on number of personnel


Bob Christ and Mark Siegmund present service company participant's award to Arnt Reilstad of TechnipFMC (Courtesy of Bob Christ)

per unit robot was recognized as that thinking twist that drives step change. Watch this company!

SUMMARY AND RECOMMENDATIONS

The 2025 panel discussion was both timely and relevant. What seemed to keep arising as a coherent path forward was a consensus document agreed to by stake-holders whereby a technical path towards the future could be mapped out with room for variation as the technology evolves. A template for this document was suggested similar to the US Military's "Road Map" series for technological evolution.

During the wrap-up session, all participants voiced their desire to continue this discussion so as to form a cohesive vision from stake-holders towards a better future for our industry. All agreed to ongoing participation in further meetings on this exciting vision for our industry's future.


Master of Ceremonies Bob Christ presents the moderator appreciation award to Mark Siegmund (Courtesy of Bob Christ)

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COMEX INNOVATION PERFORMS 3D PHOTO-GRAMMETRY WITH BV MARINE CERTIFIED ACCURACY

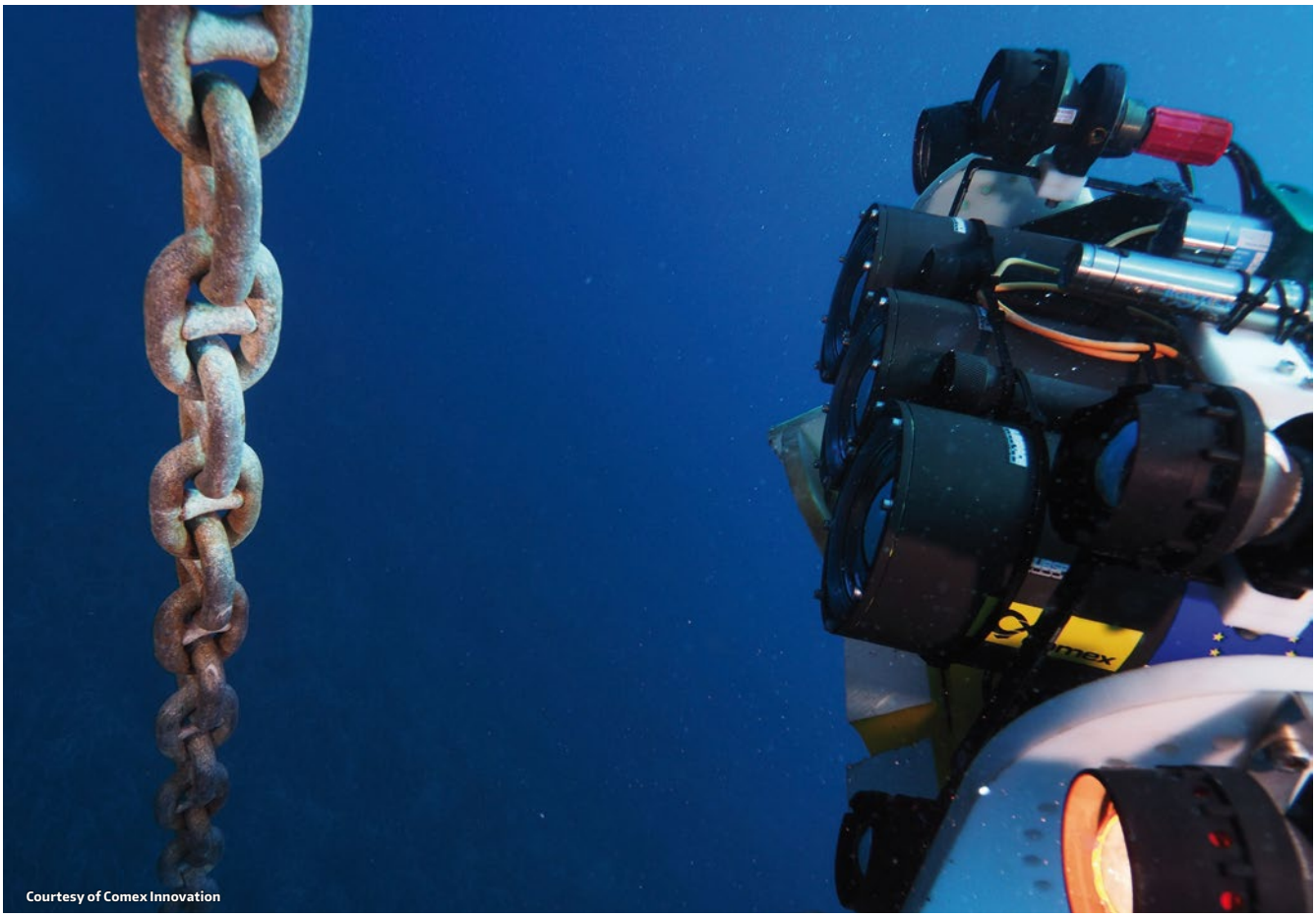
ORUS 3D
Optimal Reconstruction of Underwater Sites

THE COMEX HISTORY

Comex (French for Compagnie Maritime Expertise) was created by Henry Germain Delauze back in 1962. Starting with diver subsea inspection and expertise, the company quickly became worldwide pioneers in the development of technologies to allow robotic and human operations in extreme environments. Leading the market in saturation diving for more than 25 years, the Comex group sold its main subsidiary Comex Services to the Norwegian Stolt Nielsen. It then operated under the new name Stolt Comex Seaway before changing to Stolt Offshore, Acergy, and what is today referred to as Subsea7.

During this period, the Comex group continued to develop pioneering technologies in the space, robotics, and nuclear fields, but always with knowledge of hyperbaric and subsea skills at their core. Nowadays a medium-sized company employing 70 people, Comex continues to provide a wide test platform, engineering services, and bespoke design and manufacturing solutions for everything from deep sea systems to space craft.


Courtesy of Comex Innovation


Courtesy of Comex Innovation

COMEX'S INNOVATION BACKGROUND
(VISION ROBOTICS / CORE KNOWLEDGE)

Comex's innovation department – a team of experts in subsea vision and robotics – based its unrivalled knowledge of underwater photogrammetry on 40 years of experience. Comex divers operated their first commercial subsea photogrammetry job for Elf in Norway back in 1979. From there the team started the development of a unique fully integrated subsea vision system called ORUS3D (Optimal Reconstruction of Underwater Sites in 3D) to produce extremely accurate 3D point clouds and texturised models of subsea structures and seascapes. This doesn't require any external navigation sensors or markers.

In 2014, a working prototype was released, and the team started to provide services with the kit, always improving the system hardware and software suite. Comex innovation also contributes to research and development projects; they design and manufacture bespoke subsea vision and robotics systems for private companies and the French Navy.

TECHNOLOGY BASICS AND SYSTEMS

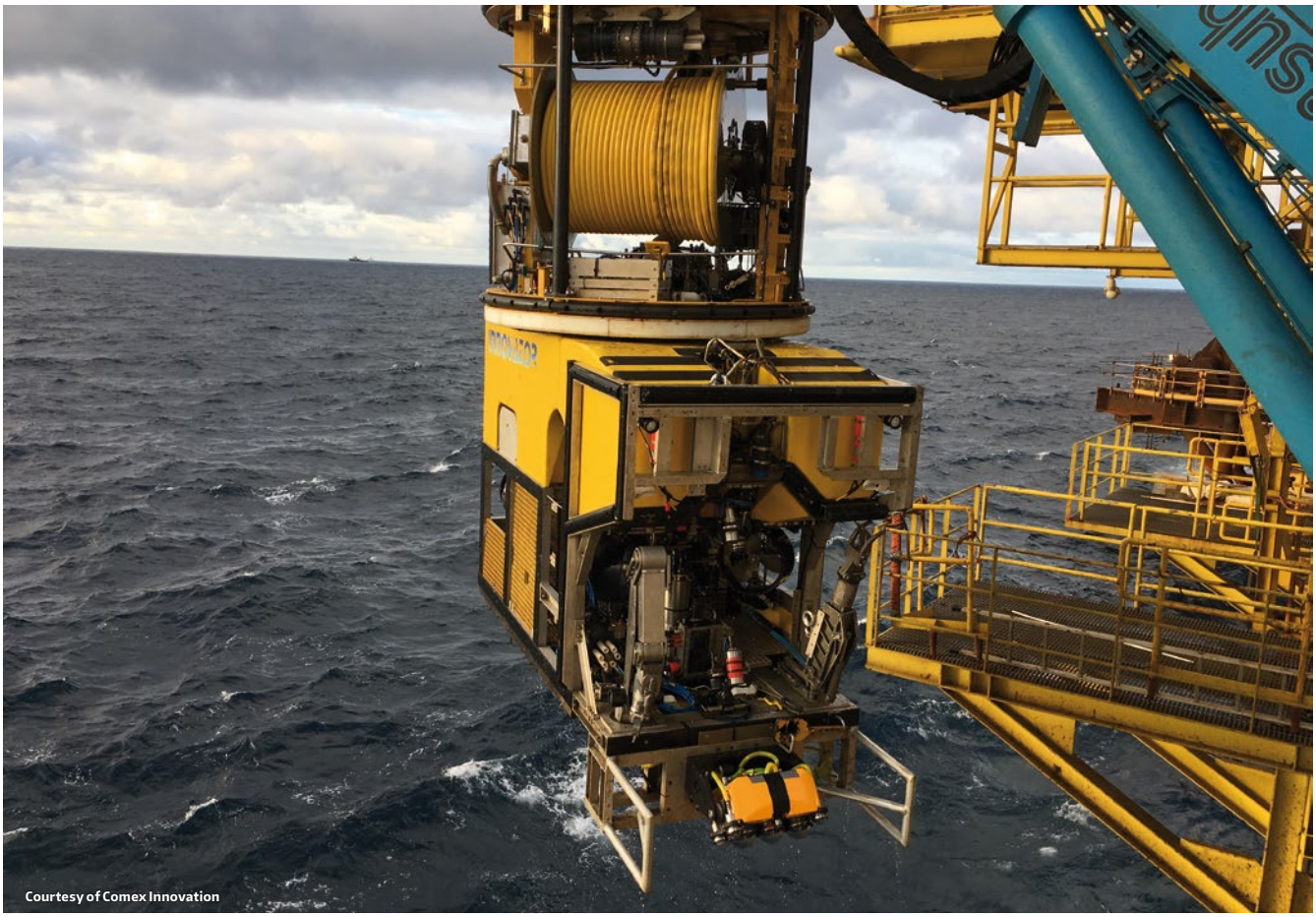
The ORUS3D system is a standalone system that only requires a power, video and datalink to the surface from the ROV. The system is made of 2 subsea parts: an acquisition unit holding the sensors on a tiltable frame that is generally fixed on the front of the subsea vehicle, and an embedded processing unit generally fixed inside the ROV or additional skid.

The technology is built around a trifocal optical sensor and built-in LED lights. The system acquires still images strobing at a rate fast enough for the ROV pilot to follow the video return during inspections. The subsea acquisition unit is storing and processing live data to produce a real time scaled 3D point cloud providing direct quality control and coverage that allows fast and efficient data acquisition during inspections. All of this data is acquired without the need for subsea positioning input in order to produce unrivalled accuracy in the 3D models created after post processing.

APPLICATIONS AND DEVELOPMENTS
(SCIENCE, ARCHAEOLOGY, DEFENCE, OIL & GAS)

Since 2014, this system has been used widely in the archaeological domain to map in detail both ancient and modern wrecks for cultural heritage needs or deep-sea salvage projects. It has also been used in Marine Science to map deep sea coral reefs of madrepora white corals, populations of rare and carnivorous sponges, and unique maerl attols in the Mediterranean Sea.

The technology of the system is also used in mine countermeasure vehicles to accurately map targeted areas in order to apply deep learning and automatic recognition algorithms to assist the crucial decision making of the French Navy. In the Oil and Gas and Renewables sector, it has been used on several projects since 2016. These have included minor damage to jacket inspections that needs really accurate models



Courtesy of Comex Innovation

to fit engineered clamps, laid structure surveys, spool and jumper metrologies, up to a subsea field part real digital twin, fulfilling and often outmatching all clients initial requirements. The system has performed in very harsh visibility conditions and from shallow to 6,000m deep environments.

CERTIFICATIONS WITH BV MARINE

These vision-based technologies are able to contribute to a range of industries, and as such are attracting a great deal of outside investment. Furthermore, this technology offers unique access to remote and deep-sea locations which were previously inaccessible to the human eye. 3D rendering and measurement technologies are therefore generating a lot of interest in the subsea field. In fact, some young companies and start-ups are already expounding the incredible accuracy and definition based on basic optical sensor usage with foggy explanation when it comes to their system accuracy qualification.

In order to prove accuracy statements, Comex have to base them on an external measurement comparison and method statement analysis performed by a certification-class company. Comex innovation team started this process in 2018 and ended in early 2019 when they received the certification stamp of the Bureau Veritas Marine from Paris. Two applications of the systems have been certified during this process; chain link measurements (performed on 55cm long chain links) and spool metrology (performed

Courtesy of Comex Innovation

on a target array of 30m in Comex test tanks facilities). This has qualified the ORUS3D system as the only vision measurement-based system of its kind in the world.

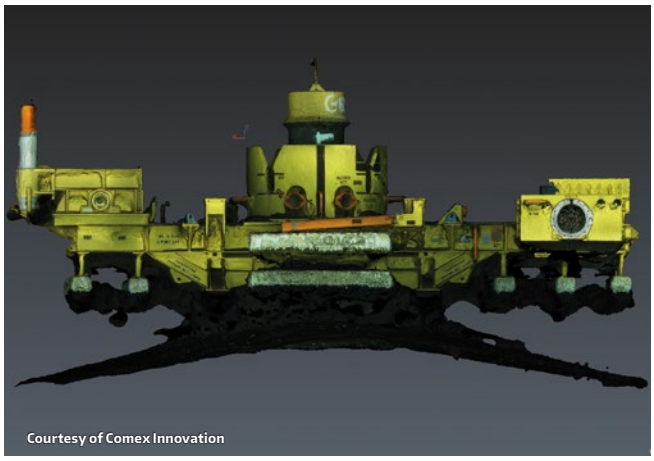
BUSINESS MODEL

As a new technology on the market and other unique technology-based companies on the market, Comex Innovation are providing all-inclusive services from the scope of work analysis to the data deliverables and engineering measurements on dimensional control charts by renting the system kit with associated experts operators. The unrivalled know-how and commitment of the Comex expert applied to the offshore service guarantees that the clients' expectations will be fulfilled in terms of timeline and results accuracy.

FUTURE OUTLOOK
(INHOUSE CAPABILITY / EXPERT DATA EVALUATION)

The ORUS3D operators offshore – backed by teams of international experts – are performing continuous quality control on the data. This includes system tuning and calibration checks prior to acquisition, real time data acquisition while guiding the ROV pilot to assure a full zone coverage, data transfer to topside, and all processing steps to deliverables in order to assure that the accuracy requirements of the scope of work will be attained.

With technology and bandwidth getting better, all these steps will soon be possible by controlling the system from ashore and being virtually present to guide the ROV team during data acquisition. No data transfer is required as everything will be remotely operated and stored on the vessel network or project hard drives. This removes the need for constant experts offshore, as well as time and money for contractors and operators. Applying AI to such technologies which is already in development will soon make such systems a main component of all subsea vehicles.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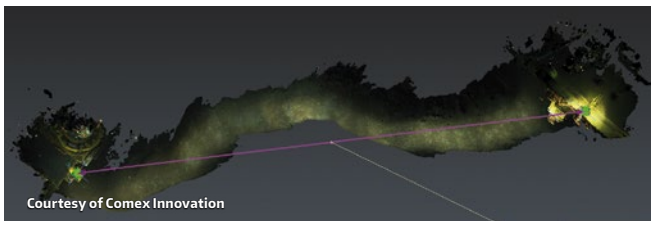
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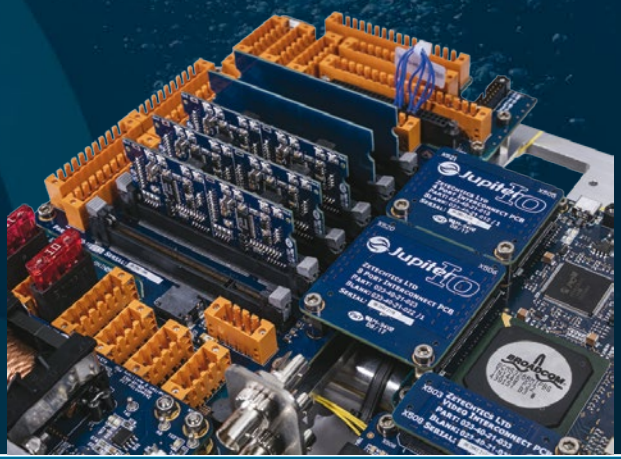

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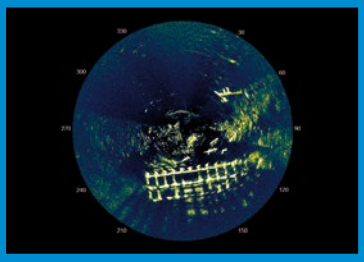

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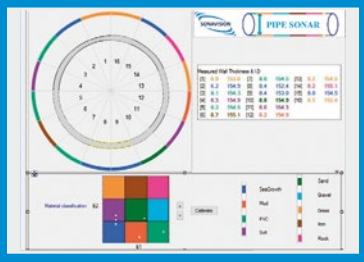

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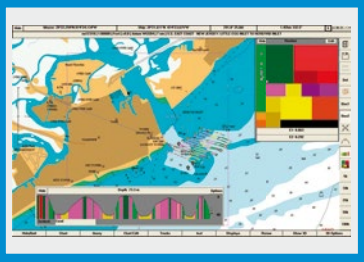

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THE IMPACT SUBSEA STORY

Early in 2015 as the ROV market was experiencing the effects of the continuing decline in the oil price; two entrepreneurial engineers in the North East of Scotland had an idea. The ROV market could benefit from an enhancement of sensing technology with smaller sensors, and significantly improved performance and reliably. The time was right to start working on a new generation of underwater sensors to better meet the future needs of the underwater ROV & AUV market.

Establishing a company in a downturn may have seemed counter-intuitive. However, it presented the opportunity to create a technology platform and company infrastructure ready to meet the demands of the market in the future without the burden of trying to scale up rapidly from day one.

Alastair Mclennan-Murray and Ben Grant believed that a new breed of subsea technology company was required. One which would be highly dynamic and capable of producing a new generation of ROV & AUV sensor technology. Jointly they formed Impact Subsea to set about making their vision a reality.

THE EARLY DAYS

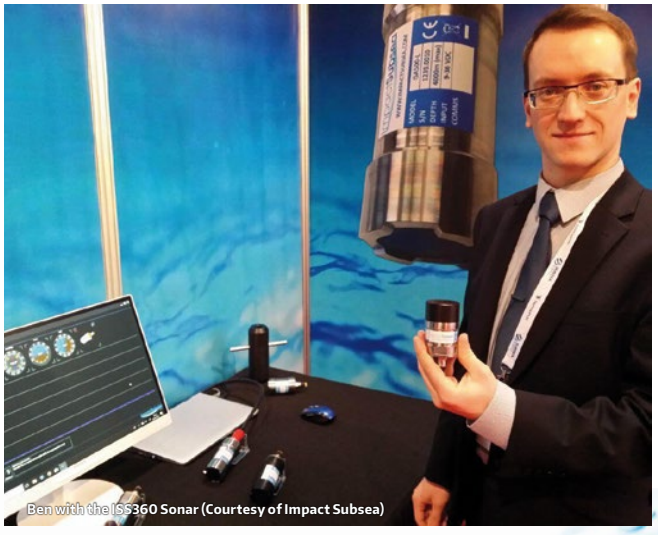
For the first eight months of the company's existence, there were two key areas of focus. The first was the business side, ensuring that systems for development, QA control, stock control, sales and marketing and all the other business essentials were put in place. The second was the development of the core technology platform and first product.

The first product would re-envision the underwater Altimeter market. By applying composite transducer technology, digital correlation acoustic detection methods and significant processing power a new Altimeter was produced – the Impact Subsea Altimeter, 500kHz. Otherwise known as the ISA500.

The ISA500 achieved significantly longer range than any other Altimeter of the same frequency, with range readings accurate to 1mm. Yes, an underwater range measurement accuracy of 1mm – not just resolution. The Altimeter was coupled with an integrated AHRS, providing heading, pitch & roll. This also allowed the automatic correction for slant range measurements – providing exceptionally stable altitude readings regardless of ROV motion.

Following the first ISA500, several other variations of this sensor were produced leading to a range of Altimeters available in various housing materials and mechanical configurations.

Alastair Mclennan-Murray and Ben Grant, the founders of Impact Subsea (Courtesy of Impact Subsea)


Ben with the ISS360 Sonar (Courtesy of Impact Subsea)

Lisa Mann, Marketing Advisor, with the ISS360 – the World's smallest Imaging Sonar. (Courtesy of Impact Subsea)

BUSINESS GROWTH

Based on the success of the ISA500 range, the company continued to develop its product range. Early in 2016 the company launched a survey grade depth sensor, complete with temperature and AHRS. This sensor again developed into a family of depth sensors available in a variety of pressure ranges and housing materials. This family of sensors is known as the ISD4000 range.

Later in the year the company complimented its growing product range with the addition of a Flooded Member Detection system. The Flooded Member Detection system is the only acoustic based system to make use of digital correlation techniques to determine the presence of water in an underwater structure. This provides a step change in the flooded member detection market.

In 2017 the company launched a highly compact Heading and Motion reference sensor which provides complete immunity to temporary magnetic interference. Thus, providing a consistent heading in the presence of steel structures. Ideal for ROV navigation. In collaboration with Scottish Enterprise, 2017 also saw the start the companies most in-depth project yet: to reimagine imaging sonar from the ground up.

THE PRESENT

Now in 2019, the company has released the ISS360 imaging sonar to the market. This is the world's smallest imaging sonar. The sonar provides a full 360° field of vision with a range of up to 90 meters. The sonar also boasts exceptionally high range resolution capabilities.

The ISS360 is a scanning sonar, unconventionally however it does not utilise slip rings. Rather the transducer is fully inductively coupled, ensuring there is no wear and tear and thus an exceptionally long lifetime of operation. Coupled with integrated AHRS and with a depth rating of 4,000m, the ISS360 brings a new sonar capability to the market at a very cost-effective level.

As of today, Impact Subsea manufactures and supports a range of Sonars, Altimeters, Depth Sensors, AHRS, Flooded Member Detection Systems and Pressure Housings.

THE FUTURE

Impact Subsea has further product launches planned from late 2019 to continue to expand its range of ROV and AUV sensors. To learn more about the company's products please visit www.impactsubsea.com or visit the company at Ocean Business 2019 in Southampon, UK at stand A13.

The new ISS360 Imaging Sonar (Courtesy of Impact Subsea)

The ISA500 Altimeter Range (Courtesy of Impact Subsea)

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TRITECH'S MULTIBEAM IMAGING SONARS BEYOND ROV INSTALLATION

TRITECH SONARS UTILISED ACROSS THE ROV MARKET AND INTO SEARCH AND RECOVERY

Tritech International Ltd's Gemini Multibeam Imaging Sonar series has been utilised on ROV and WROV operations for a number of years but with the recent addition of the Gemini 720im, Micro ROVs are now able to be equipped with the same multibeam technology.

Courtesy of Tritech

The Gemini 720im is the world's smallest multibeam sonar offering a dependable sensor for use in navigation, obstacle avoidance and target recognition. With its extremely small build – 99mm x 63mm – and lightweight body – 0.435kg in air – the Gemini 720im is ideal for installation on small and mini-ROVs which were previously unable to utilise multi-beam technology.

The Gemini 720im is now also available with the increased depth rating of 750m (compared to the previous depth rating of 300m) allowing ROV operators more freedom to explore deeper waters. This will also be beneficial to AUV and micro AUV operators who will also benefit from the additional depth.

Currently the Tritech Gemini Multibeam sonar is regularly used on ROV missions such as pipeline inspections within the Oil and Gas industry. Micro-ROVs are often utilised in missions where the target may be hard to get to or within a hazardous underwater environment meaning the compact, easy to install nature of the Gemini 720im makes it an ideal sensor for these types of missions as its installation does not affect the ROV or AUV's ability to fly.


Courtesy of Tritech

Courtesy of Tritech

Alongside the ROV and Micro installation options, the Gemini multibeam series can also all be pole mounted. Pole mounting offers an alternative to ROV installations which is often utilised in aquaculture and vessel operations. Pole mounting sonars also allows for data to be gathered from a fixed point over a length of time. This can be very beneficial in aquaculture studies as it can allow the marine life in the same body of water to be studied over a period of time.

The versatility of the Gemini 720im is now being utilised in a new way and a new industry: diving. Tritech International's Diver Mounted Display offers divers vision in zero visibility water by displaying a sonar image of the water ahead onto a small, eye-level screen. By using the Diver Mounted Display combined with the Gemini 720im, the diver is able to navigate zero visibility water with a view of the water ahead up to 50m away.

The Diver Mounted Display has been utilised in a number of different industries but it has proven particularly useful in the Search and Recovery Industry. Public Safety Divers in the USA regularly use the DMD to locate and recover targets allowing these operations to be done more quickly and ultimately they are better able to offer closure to a victim's family more quickly.

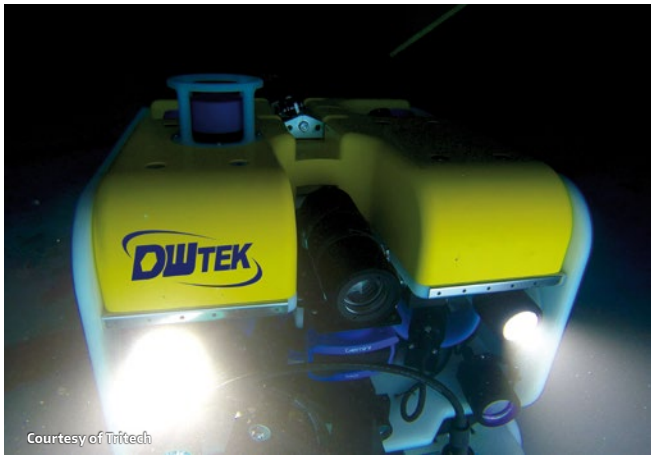
Another advantage of the Diver Mounted Display is that it helps to ensure diver safety in low visibility missions. It's not uncommon for divers to become entangled or injured during diving missions due to the low visibility but by allowing the divers to see a sonar image, the diver is able to avoid hazards and obstacles during their mission. The sonar image is also fed back to topside through the diver's umbilical at a real-time rate and is recorded allowing the data gathered to be collected, stored and reviewed for future missions.

The Diver Mounted Display can be mounted onto most diver helmets using a series of custom made mounting brackets provided by Tritech. The sonar can also be mounted as a pistol grip allowing the diver to hold the sonar while they swim which they may prefer.

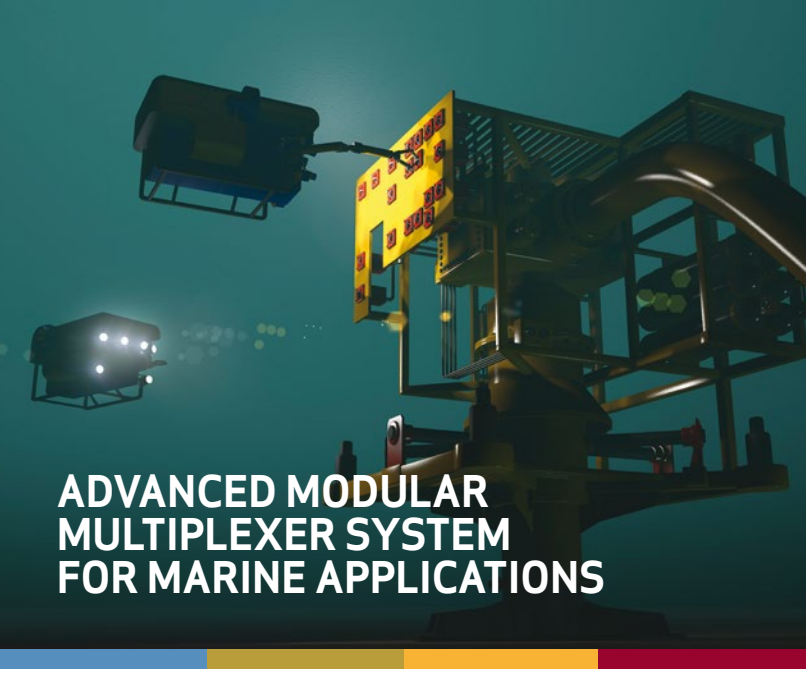
As well as the Gemini 720im multibeam imaging sonar, the Diver Mounted Display can also be paired with the Gemini 720ik – a larger multibeam imaging sonar available in the Gemini series – which offers a higher resolution sonar image and a range of up to 120m.

The Gemini 720ik is also light and compact but has traditionally been used on ROVs. With CHIRP processing and SeeByte embedded target algorithms, it is ideal for low visibility environments.

The Gemini 720ik has recently been installed on a number of new ROVs and AUVs which offer cutting edge technology and will be used in missions where visibility is key. The Gemini multibeam imaging sonar series offers ROV and AUV operators a high resolution sonar image suitable for installation any vehicle.



Courtesy of Tritech



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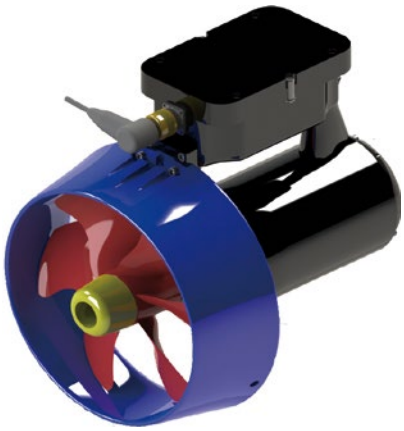

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SUBSEA SECURITY IN THREATENING WATERS

Hydro Group Plc engineers reliable subsea cabling and connectivity for harsh environments (Courtesy of Hydro Group)

Amidst a backdrop of increasing geopolitical tensions, Hydro Group's subsea connectivity solutions are helping to maintain the security of sovereign waters around the globe.

A recent Deloitte study into the global defence market (2019 Global Aerospace and Defence Industry Outlook) shows an increasing trend of expenditure not just by the world's traditional superpowers, but also from key and emerging regional players. Seven of the top ten countries with the highest military expenditure as a percentage of GDP can now be found in the Middle East, while India's defence budget alone has jumped by 7.7% in 2018/19 compared to last year.

Increasing defence expenditure from regional powers – in addition to traditional superpowers such as the United States and Europe – is driving continued demand for versatile solutions to maintain and improve waterborne defences.

With defence applications requiring innovative subsea products, Hydro Group has over 30 years of experience and knowledge in designing and manufacturing subsea defence connectivity solutions for global defence forces including the United Kingdom's Ministry of Defence and the US Navy.

The Group's expertise includes purpose-built tethered communications systems, pressure hull and through bulkhead penetrators, acoustic range cables and outboard submarine cables for use in a wide variety of subsea defence systems.

COMMUNICATION IS KEY

Hydro Group were recently asked to design an innovative solution to prevent ROVs operating in murky waters becoming entangled.

Hydro Group engineered an illuminated LED tether using electroluminescent (EL) wire. The finished tether bundles electrical power, control elements and high density polyethylene insulation with a filler buoyancy layer for underwater use. Illumination of the 2.3mm wire is achieved when electricity is fed through a strand of phosphor-coated copper.

This wire offers 360-degree illumination and is controlled by a 35W EL Inverter with gradient and flash illumination options. The cable's four cores benefit from a load-bearing Vectran strength member and are protected by a polyurethane sheath. This allows operators to physically berth the ROV via the cable when operations have ceased, as well as protecting it from water ingress.


An example of a right-angle moulded NPT Bell Penetrator (Courtesy of Hydro Group)


Courtesy of Hydro Group | Crown Copyright 2012


The company's global headquarters are in Aberdeen, Scotland (Courtesy of Hydro Group)


Courtesy of Hydro Group | Crown Copyright 2012


Courtesy of Hydro Group | Crown Copyright 2012

The end product is fully-compliant with the client's existing electrical and signal transmission needs, as well as their buoyancy and size requirements. Durability is assured through the use of EL wire, which uses less electricity and is more reliable than string lighting as it has no moving parts.

Hydro Group can create a range of ROV umbilicals and tethers to suit defence-related requirements, incorporating neutral, negative or positive buoyancy as well as data, power or signal transmission.

HARSH ENVIRONMENT CONNECTIVITY

Subsea defence systems can take many forms and are relied upon to operate in inhospitable conditions both at the waterline and far below the surface. The advanced technology found on latest-generation submarine platforms requires reliable connectivity able to withstand high hydrostatic pressure and corrosion from saltwater and organisms for up to three decades at a time.

Typical Hydro Group Pressure Hull Penetrator (PHP) applications have historically featured up to 50 fibre contacts, with three-phase 540 Amp, 440V power capabilities. PHPs are a key element of a submarine's systems functionality, used to route an electrical or optical circuit from outwith a submarine's pressure hull to the inside while ensuring that there is no risk of leakage or depressurisation. The UK's Dreadnought-class submarines will be supplied with Hydro Group Through Hull Penetrators and associated outboard cable assemblies, while Astute-class subs utilise precision-engineered outboard cables compliant to NES517 specification.

Featuring multiple connectors, composite connection interfaces can be made with electrical, RF and fibre optic compatibility. Advanced materials such as Inconel or aluminium nickel bronze are used to increase resistance to shock and impact, as well as oils, insulating gases, vacuum or low temperature scenarios.

Connectivity solutions are also required for diving bell and deck decompression chamber applications. Hydro Group is the first engineering firm in the world to offer manned

submersible electrical penetrators type-approved for use at a working depth of up to 650 MSW (Metre sea water), protecting divers at challenging depths.

With rising numbers of submarines operating in our seas, the challenges facing defence forces are being met with increasingly innovative anti-submarine warfare solutions. Hydro Group draws on their experience to supply sonar towed array cables and terminations for submarine platforms, as well as heavy/light tow cables for surface ships with towed and dipping sonar applications.

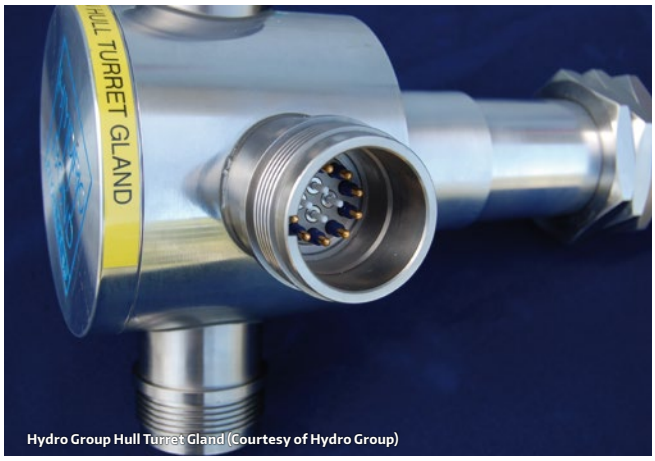
Whether used on the seabed or at the surface, the integrity of subsea cabling is of paramount importance in the defence sector. Hydro Group offers full armouring capability from its cutting-edge global manufacturing facility in Aberdeen, Scotland. Mechanical protection of multi-core power and data cables allows cables to withstand higher stresses, with superior crush resistance as well as better cold impact bend performance.

Steel wire armour, which can resist or mitigate damage from threats such as dragged ship anchors, is suited to small diameter applications. Contra-helical armouring, where two layers are wound in opposing directions around the cable elements to protect them, adds pulling strength and is highly resistant to cutting.

Hydro Group is certified to ISO 9001:2015 standard to design and manufacture specialist subsea connectivity, giving clients peace of mind that their order is in the hands of the experts. And with the resurgence in defence spending looking set to continue, durable undersea connectivity will be key to maintaining effective marine defence networks.

Hydro Group will be exhibiting at Ocean Business 2019 in Southampton, UK on Stand F8 and at Undersea Defence Technology 2019 in Stockholm, Sweden on Stand D32.

Only the highest-quality materials are used, including Polyethylene or Polyurethane (Courtesy of Hydro Group)



Hydro Group Hull Turret Gland (Courtesy of Hydro Group)

Subsea connectivity solutions to suit a range of applications (Courtesy of Hydro Group)

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USING UNMANNED SURFACE VESSELS (USVs) TO SAFEGUARD OFFSHORE OIL AND GAS PRODUCTION

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

A decade ago, America imported sixty percent of its oil and twenty percent of its natural gas. Now the nation exports energy and is on track to export even more in the next decades. The dramatic shift in the United States position as a net energy importer to net energy exporter is having – and will continue to have – major repercussions that are being felt not just economically, but politically and strategically as well.

Few saw this change coming. Indeed, in the early 2000s, U.S. oil and gas production appeared to be headed downward. Today that situation has been completely reversed. Between 2007 and 2018, domestic output of crude oil and natural gas liquids in the United States rose from seven million barrels per day to fifteen million barrels per day. Additionally, America has also shifted from being a net importer of chemicals derived from petroleum products, moving from importing six million metric tons in 2007 to exporting four million metric tons in 2018.

Fracking, which has opened up billions of barrels of oil and trillions of cubic feet of natural gas to production and transformed the global energy sector in a matter of a few years, has had a great deal to do with this shift, but it is the offshore oil and gas industry that still provides a huge amount of the United States' energy production. Offshore energy production has been increasing this decade and now stands at over two-and-one-half million barrels of oil, and almost three trillion cubic feet of gas a day.

This massive production effort is sustained by hundreds of U.S. offshore drilling rigs, primarily in the Gulf of Mexico. Indeed, a recent Westwood Global Energy 2019 Offshore Rig Market Outlook noted a substantial increase in utilization and day rate energy production in the Gulf of Mexico. This production is slated to increase and have more rigs come on line in the next decade due to the fact that the U.S. Bureau of Ocean Energy will soon offer 78 million acres for a region-wide lease sale under the 2017-2022 National Outer Continental Shelf (OCS) Oil and Gas Leasing Program.

This expansion is good for the industry and great for the United States. But those cheering for more offshore oil and gas production are also mindful that the 2010 Deepwater Horizon disaster in the Gulf of Mexico remains fresh in the mind of the public. Ensuring the integrity of hundreds of offshore oil and gas rigs and their associated infrastructure is a major corporate stewardship responsibility. The offshore oil and gas industry has used available technology to ensure the integrity of their platforms. But as the OCS program drives the construction of new wells, current technology may not be up to the task of providing for routine inspections of older and newer platforms.

Platform operators depend on divers and small remotely operated vehicles (ROVs) of various types to perform these inspections. The process is slow and tedious, fails to leverage the capabilities of current ROVs, and puts these divers at excessive risk. Several companies have proposed technology solutions that can provide faster and more thorough inspections of these expensive platforms and ensure against not only catastrophic disasters like Deepwater Horizon and Ixtoc 1 (the second largest marine oil spill in history, also in the Gulf of Mexico), but also more common issues like wear and tear of underwater components – to say nothing of potential sabotage of these rigs by terrorists or environmental activists.

Maritime Tactical Systems, Inc. (MARTAC), a Florida-based manufacturer of unmanned surface vehicles (USVs), has fielded a family of low-cost MANTAS USVs built on a catamaran hull which have been used in a number of military exercises, experiments and demonstrations in both near-

MANTAS T12 heading out into the Atlantic Ocean on an ISR mission. (Photo courtesy of Jack Rowley)

shore and open-ocean operations, as well as for civilian missions as diverse as port and harbor security, commercial canal and dam hydrography and commercial power plant inspections. The hundreds of MANTAS operating hours have resulted in invaluable operator feedback and the vehicle has been upgraded to adapt it for new and evolving missions.

Various size (8-foot and 12-foot) MANTAS USVs have been equipped with a variety of surface and below-surface sensors such as the SeaFLIR-230 Gyro-stabilized High Definition EO/IR zoom camera with laser tracking, FLIR M232 thermal camera, FLIR Duo EO camera, Teledyne RESON T20 high resolution multi-beam sonar, Teledyne BlueView M900 single-beam echo-sounder and Norbit iWBMS STX multi-beam sonar. The modular construction of MANTAS enables rapid switching of sensors as mission needs change.

This off-the-shelf technology can be used today to undertake more effective and efficient inspections of offshore oil and gas rigs along with their surrounding bottom mounted pipelines, valves and sensors, while dramatically decreasing the need for human divers. Under this operating concept, a MANTAS USV would be controlled by one operator in the Rig Command Center. This inspection can be part of scheduled, routine checks or be done on-demand to investigate something out of the ordinary discovered by watchstanders.

While there are numerous ways that a rig operator would use a MANTAS, three missions that come immediately to mind include surface investigation, underwater imaging of the rig and its associated infrastructure, and monitoring and sampling of the water surrounding the rig. Each mission is worth explaining a bit further.

For surface investigation, which would include day and nighttime surface contact monitoring, area security, external rig structure investigation and other missions that a USV like a 12-foot MANTAS is ideally suited for, the MANTAS could be equipped with a SeaFLIR-230 Gyro-stabilized High Definition EO/IR zoom camera, or FLIR M400, or M500.


MANTAS T12 performing bridge/structure sentry mission (Photo courtesy of Jack Rowley)

For underwater imaging, the MANTAS could be equipped with Norbit iWBMS STX multi-beam sonar, a forward-looking sonar, side-scan sonar, or other commercial-off-the-shelf underwater sensors that can image underwater piping and bottom structures. This technology is in high demand to inspect commercial dams, energy plants, canals and other structures.

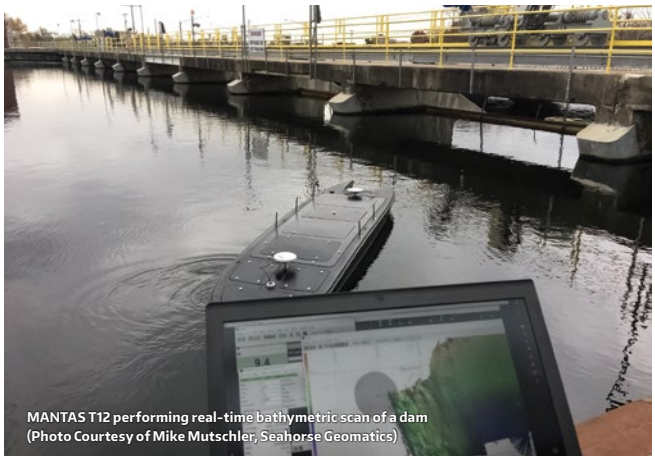
One of the early indicators of material failure of rig components is oil and other material from seeping into the surrounding water. To provide this critical early warning, the MANTAS USV can be equipped with water-monitoring sensors to include Doppler Velocity Logs, (DVL) sensors, Acoustic Doppler Current Profilers (ADCP), Current-Temperature Depth (CTD) sensors, flourometers and other devices to detect changes in the water quality in the immediate vicinity of the rig.

While the operators in the Rig Command Center can control the MANTAS remotely and direct its mission manually, they can also configure the USV to operate in an autonomous or semi-autonomous mode to search along a pre-determined course through the use of pre-programmed waypoints. Video and sonar imaging from the MANTAS can be sent to the Rig Command Center in real-time, providing immediate notification of what the USV discovers and enabling operators and management to make time-sensitive decisions.

Anticipating near-term demand from the offshore oil and gas industry, MARTAC is developing concepts of operations (CONOPS) for how MANTAS would be used to help ensure rig security. For example, an operator in the Rig Command Center might have a MANTAS on patrol on a predictable pattern inspecting the rig above and below water. If the USV discovers an anomaly, the operator will be alerted, can switch to remote manual control, and can command the MANTAS to conduct finer-grained analysis. If this investigation uncovers an area of concern, then an ROV or diver can be deployed to make a repair. This CONOPS will secure the integrity of the rig while also dramatically reducing the false alarms generated of other methods and, most importantly, not putting divers into harm's way unnecessarily.

The enormous investment America's energy companies have made in our offshore oil and gas rigs is one that these companies must protect against failure, sabotage, or other hazards. Current means of inspecting these rigs are slow, expensive and hazardous. Employing commercial-off-the-shelf USVs that can be rapidly reconfigured with a diverse range of sensors can ensure a more comprehensive inspection of rigs and all fittings and pipelines while saving time and money, all while not endangering human divers.

The same USV technology that is poised to assist the oil and gas industry is already being used to inspect critical infrastructure such harbors, ports, inland waterways, dams, levees, canals, bridges and other infrastructure that cannot be safely or effectively inspected by humans. For example,



MANTAS T12 performing real-time bathymetric scan of a dam (Photo Courtesy of Mike Mutschler, Seahorse Geomatics)

MANTAS T12 accelerating to on-plane during ISR mission. (Photo Courtesy of Jack Rowley)

a MANTAS USV was used to conduct inspections of the Keokuk dam and energy center, the Bagnell energy center, the Elkhart hydro dam, the Central Arizona Project canal and other infrastructure.

Additionally, these USVs were used in a U.S. Army Mobile Ocean Terminal Concept Demonstration as well as in a Port of Los Angeles Demonstration to examine the feasibility of unmanned surface vehicles to provide 24/7 security to vulnerable harbors and ports. These demonstrations were conducted using a 12-foot MANTAS and while successful, also revealed the need to have a larger USV in place to perform this mission.

As a result of this military and commercial impetus, MARTAC is formulating designs for a 24-foot, 38-foot and 50-foot USV. Plans for these larger vessels have been requested as they will better meet expressed operator needs to provide port and harbor security. For example, the 38-foot MANTAS can carry a payload of 4,500 pounds, has a cruising range of 1200 nautical miles at 25 knots (with a burst speed of 80 knots) and can carry a wide variety of surface and underwater sensors.

The future of USVs in service to the energy and infrastructure industry has never been brighter. Readers of ROV Planet will undoubtedly be at the forefront of devising even more missions for these capable platforms.

INSPECTOR 125

ECA GROUP UNVEILS ITS NEW UNSINKABLE UNMANNED SURFACE VEHICLE (USV)

ECA GROUP, in collaboration with its naval architecture subsidiary MAURIC has integrated a new USV – (Unmanned Surface Vehicle) into its range of naval drones' systems. The result is the new INSPECTOR 125 a USV based on an operational platform designed for high seas operations.

Combining a sea-proven platform from MAURIC with a dronization kit included in the other USVs in the ECA GROUP range, the INSPECTOR 125 benefits from the latest technologies, with unrivalled performances in the naval surface drone market. Designed to be unsinkable and highly shock-resistant, this USV has important payload and towing capabilities. This new generation naval surface drone is dedicated to defence and security missions such as Mine Counter Measures (MCM), anti-submarine warfare (ASW), Intelligence / Surveillance / Reconnaissance (ISR), and Forces support and protection (FSP).

INSPECTOR 125: DESIGNED ON A SEA PROVEN BASIS – MAURIC V2 NG SEARCH AND RESCUE CRAFTS FOR SNSM

The INSPECTOR 125 is the result of a joint development between ECA and its subsidiary MAURIC. The platform is based on the V2 NG rescue boats designed by MAURIC for the S.N.S.M (Association of French Sea Rescuers). Originally developed in 2008 and modified in 2014, this craft – which was produced in more than 20 units – has proved its efficiency during search and rescue operations in the most difficult environmental conditions. Being robust and powerful, the V2 NG is particularly suitable for a new naval surface drone design.

'The choice of the design of the boat was made in response to our extremely high requirements on the survivability of the boat which must be able to intervene at all times, and to ensure the safety of the crew and the rescued people even after a possible damage.' says Jean-Christophe Noureau, Technical Director of S.N.S.M. 'Thus, the unsinkability of the boat even after damage; her resilience gives her a high level of performance.

Courtesy of ECA Group

'In addition, the hull – propelled by 2x410hp engines – ensures speed and sea-keeping performance unequalled in this range of boats regarding rescue missions at sea; it's a highly important boat in our fleet. In 2019, we will build 4 new boats of this type.'

The naval architects of MAURIC and the engineers of ECA GROUP have developed this robust and sea proven platform to integrate a dronization kit featuring autonomous navigation capabilities, as well as several launch and recovery systems (LARS) for the various drones of ECA GROUP. These include Autonomous Underwater Vehicles (AUVs), towed sonars (TSSS or TSAS), inspection and destruction, remotely operated vehicles (ROVs) provided by ECA GROUP or equipment from other manufacturers.

'For us, this alliance of our respective know-how in robotics and naval architecture has been particularly fruitful for designing the INSPECTOR 125.' says Pascal Lemesle, General Manager of MAURIC. 'We innovated each one in our field to obtain a new generation of naval surface drone. It is more resistant and enduring, more powerful, more autonomous, and more modular.'

HIGH CARRYING CAPACITY AND RECONFIGURATION, ASSETS FOR A COMPLETE 'TOOLBOX'

With a length of 12.3m and an overall width of 4.2m, the INSPECTOR 125 can carry up to 3 tons of payload. In the standard version it's equipped with two hydrojets allowing a top speed of over 25 knots at full load displacement. However, it's also available with two shaft lines and propellers to meet specific towing requirements. Its large rear deck, its mast and underwater pole allow carrying many payloads and sensors specific to the missions of surveillance, oceanographic survey, or mine counter measures.

The INSPECTOR 125 has an impressive range of capabilities. It's able to launch and recover in rough seas and can integrate on board or on its hull additional sensors useful for oceanographic monitoring missions when operating in 'manned' mode. It can also carry identification and/or neutralization ROVs such as the SEASCAN Identification ROV and the K-STER C neutralization ROV; it can carry on its main deck up to 2 SEASCAN and 6 K-STER simultaneously.

Get 7 years of extra peace of mind.

Building upon the extensive track record of successful subsea operations conducted thanks to our AHRS and INS, we are happy to announce that all new purchase of iXblue inertial subsea products will include a 7-year warranty*

*From now and until April 11th, 2019.
Note that the warranty does not cover connectors and/or water ingress.

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