ROV PLANET

The magazine of choice for Subsea
Construction and ROV Professionals

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With 7000 email distributions and 2000 printed copies delivered to the offices of ROV & subsea construction related companies, oil majors and also distributed at trade shows – ROV Planet aims to become the leading publication, online news portal, and forum of the ROV & subsea construction industries.

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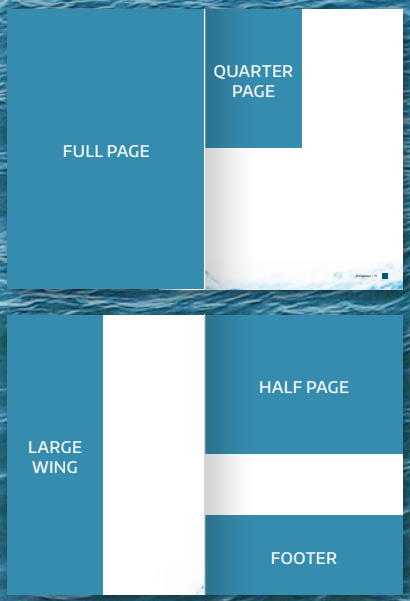

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WELCOME TO ROV PLANET

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

Hello!

Once again we have a fantastic line-up of features, news, and editorials covering all things ROV. As the price of oil drops below $30/bbl, Westwood Douglas gives us an analysis of the expected work class ROV expenditure in the next 4 years, focusing on drilling and construction support, IRM markets, and regional variations. We also take a look at Nautilus Minerals' pioneering Solwara project; they've recently began testing their custom-made new subsea mining vehicles. We're very excited for this one as in the not-so-distant future subsea mining will become an industry where ROV support operations will be badly needed.

We'll also be looking at the AVM technology developed by JAMSTEC and Nissan, in order to allow ROV pilots to control seabed crawlers from a bird's eye view, making obstacle avoidance and navigation even easier.

Then we will give you a tour of the Oceaneering ROV Center in Batam, Indonesia and Liz Corbin reports on a highly eventful Oceans'15 conference and exhibition held in Washington, DC.

Finally, we have some good news on the horizon: in spite of these turbulent times a new ROV company, Oceana Subsea, has been formed. They tell us why they're so enthusiastic about the future.

We've got a lot to look forward to, so sit back and enjoy our sixth issue!
Best regards,
Richie Enzmann

UPCOMING EVENTS

03-05th February, 2016 – Subsea Expo – Aberdeen, UK
The World's largest annual subsea exhibition and conference.

23-25th February, 2016 – Underwater Intervention – New Orleans, USA
The World's premier event for diving contractors, ROVs, and manned submersibles.

15-17th March, 2016 – Oceanology International – London, UK
The World's premier event for marine science and ocean technology.

05-07th April, 2016 – MCE Deepwater Development – Pau, France
World-class technical discussions focusing on the technology, innovation and experience.

11-14th April, 2016 – MTS/IEEE Oceans'16 – Shanghai, China
World-class technical discussions focusing on the technology, innovation and experience.

26-28th April, 2016 – Offshore Well Intervention Conference – Aberdeen, UK
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UI 2016

FEBRUARY 23-25, NEW ORLEANS

The world's premier event for Commercial Diving Contractors, Remotely Operated Vehicles, Manned Submersibles, and all other aspects of the Underwater Operations Industry will take place at the Morial Convention Center in New Orleans, LA., February 23-25, 2016.

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2015-2019

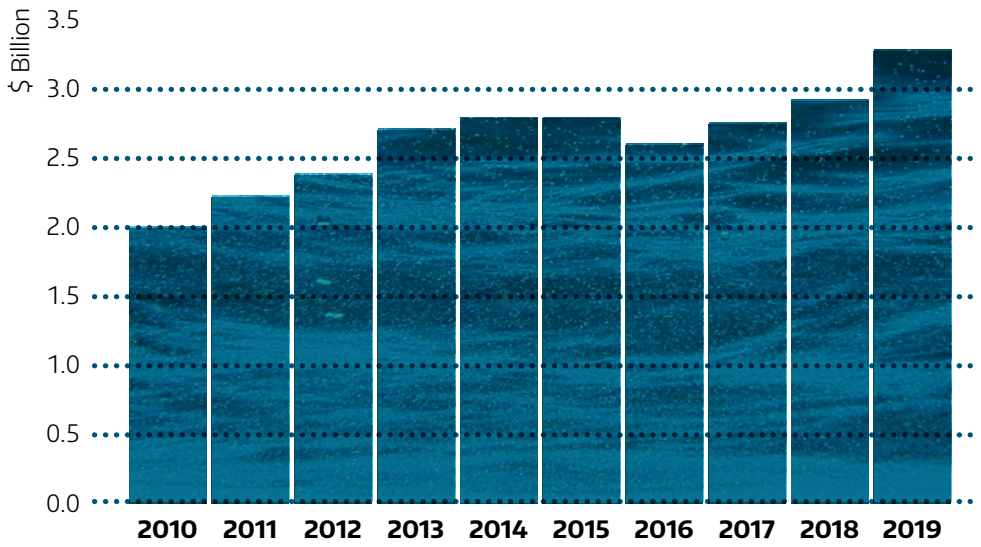
GLOBAL WORK-CLASS ROV EXPENDITURE TO GROW BY 19%

By Ben Wilby, Iva Brkic and Hannah Lewendon, Douglas-Westwood

I. INTRODUCTION

In the latest edition of their 'World ROV Operations Market Forecast', Douglas-Westwood (DW) expects annual expenditure on work-class remotely operated vehicle (ROV) operations to increase from $2.7 billion (bn) in 2015 to $3.3bn in 2019, at a compound annual growth rate (CAGR) of 4.3%. The market is expected to total $14.2bn over the forecast period, a growth of 19% over the previous five-year period.

ROV contracted days are used as a measure of market volume. Expenditure (market value) is expected to increase at a slower pace than these operational days (market volume) due to the oil price downturn which is likely to increase pricing pressure on ROV operators over the 2015-2016 period. DW anticipates a slight recovery in value terms by 2017, as a result of some upwards movement in oil prices.



Global Work-Class ROV Expenditure 2010-2019
Source: Douglas-Westwood 'World ROV Operations Market Forecast 2015-2019'

II. DRILLING SUPPORT MARKET

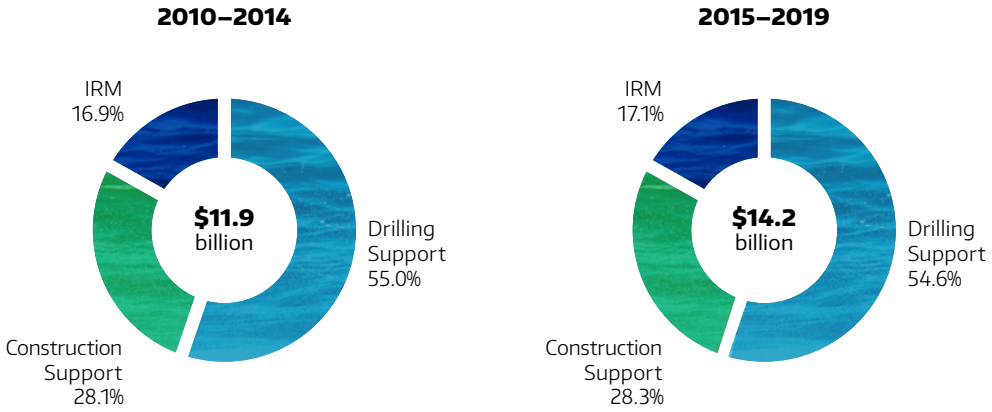
Drilling support is the main driver of demand for ROVs, with related expenditure expected to increase by around $334 million over 2015-2019. Deployed from rigs or vessels, ROVs are used to support offshore drilling activities. Development wells will predominantly drive drilling support ROV days, accounting for 77% of volume growth.

III. CONSTRUCTION SUPPORT MARKET

Construction support accounts for nearly $100 million of the increase in ROV expenditure over the forecast period. Growth is more volatile and ultimately slower in this market segment (2.8% CAGR in value terms). This is due to the slowdown in subsea construction expected over 2016-2018, following a record year of orders in 2013-2014 sustaining 2015 expenditure. In this segment, work-class ROVs are mostly used to install and connect subsea items, predominantly TMFJ (templates, manifolds, flowlines and jumpers), SURF (subsea umbilicals, risers and flowlines) and pipelines/trunklines.

IV. INSPECTION, REPAIR & MAINTENANCE (IRM) MARKET

IRM is the smallest segment with 17% of the market value in 2015. However, it is also the most stable year-on-year and is expected to see growth at a 3.8% CAGR to 2019. ROVs dedicated to IRM activities need to be versatile, although work-class vehicles are rather used for repair and maintenance tasks, as inspection activities can be performed by inspection-class units.



Total Work-Class ROV Expenditure by Segment, 2010-2014 versus 2015-2019
Source: Douglas-Westwood 'World ROV Operations Market Forecast 2015-2019'

V. REGIONAL OBSERVATIONS

As of 2015, ROV demand is rather evenly split regionally, dominated by Latin America, Asia, Western Europe and North America. Significant growth in volume is anticipated in Africa and Asia to 2019. The Middle East, North America and Latin America are to follow as key growth contributors, while demand seems to stagnate in Western Europe. Emerging ROV markets Australasia and Eastern Europe & FSU are to experience double-digit growth rates. The Middle East is expected to be the most resilient region during the oil price downturn with no significant expenditure drop over the forecast period.

Established markets are development drilling oriented, while construction is stronger in emerging ones. Strong IRM potential exists in North America due to its vast platform population.

VI. GLOBAL ROV SUPPLY

The current ROV supply is highly concentrated on both the operating and manufacturing sides of the business. As of the end of 2014, DW's global fleet count of work-class ROVs consists of 973 units, roughly split as follows:

- 60% owned by the top three operators;
- 22% owned by the next four companies operating more than 50 vehicles each;
- 18% remaining spread across ten other smaller size ROV operators.

Arguably, the manufacturing side of the industry is even more concentrated. As the top three operators have integrated most of this process, three independent manufacturers are left to supply most of the other ROV operators, while some small companies cover local niche markets.

VII. CONCLUSIONS

Although new applications are emerging such as military, offshore wind and nuclear IRM, work-class ROVs remain predominantly designed and deployed for the oil & gas sector. Robust long-term demand for oil & gas is the main underlying driver behind offshore production, and thus ROV demand. However, the oil & gas outlook is clouding in the near-term. Driven by global oversupply and concerns over emerging demand, the oil price has dropped from $115/bbl in July 2014 to nearly $30/bbl as at the time of writing. Consequently, the ROV industry is currently impacted by various market trends:

- Increasing pricing pressure which applies throughout the supply chain, from operators looking to cut costs, to EPC companies and offshore drillers, and finally to ROV operators and manufacturers.
- High level of concentration in the global ROV market.
- More stringent safety requirements post-Macondo, pushing forward the need for higher specification units.
- Oil & gas companies are increasingly looking at efficiency, autonomy and fast-deployment over raw power and depth rating as key purchasing criteria.

The ROV business undoubtedly faces both short-term economic challenges and longer-term technology and design challenges, some of which are conflicting and require careful compromise. However, the underlying need for continued development of offshore hydrocarbons and the dominance of ROV technology in the installation and intervention of subsea equipment make for a very positive outlook for the sector in the medium- and long-term.

THE AUTHORS

BEN WILBY

Ben is an Analyst in Douglas-Westwood's Research team and having joined DW in 2013, he primarily works on the continual updating of the Offshore Oil & Gas Database. Ben has authored the 'World Floating Production Market Forecast 2015-2019', 'World Subsea Hardware Market Forecast 2015-2019' and 'World ROV Operations Market Forecast 2015-2019'. He is currently working on DW's new 'North Sea Decommissioning Market Forecast 2016-2040'. Ben graduated from the University of Chichester with a degree in History.

IVA BRKIC

Iva Brkic is an Analyst in Douglas-Westwood's London office. Since joining DW, Iva has worked on a range of bespoke research and advisory projects, including buy-side and sell-side due diligence projects for major investment banks and private equity firms. Prior to DW, Iva worked at the International Atomic Energy Agency at UN HQ in Vienna and CNPC in Beijing. Iva was one of the authors of the 'World ROV Operations Market Forecast 2015-2019'. Iva holds a BSc degree in Economics and MA in East Asian Economy and Society from the University of Vienna.

HANNAH LEWENDON

Hannah is the Research Team Leader at Douglas-Westwood and is responsible for the production of DW's energy publications and the maintenance of in-house models and data. In her time at DW, Hannah has authored reports in the areas of floating production and oilfield services and was the Assistant Editor of DW's 'World ROV Operations Market Forecast 2015-2019'. On the Consulting side, Hannah has managed projects with teams in the UK and overseas, covering strategy and transactions and a multitude of onshore and offshore oil & gas sectors. Hannah graduated from the University of Southampton with a First Class Honours in Economics and Finance.

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SEA CHANGE

DIVE INTO OPPORTUNITY: THE OCEANS '15 MTS/IEEE WASHINGTON, DC CONFERENCE

Liz Corbin, Publicity Chair

"It was a great week for OCEANS at National Harbor," exclaimed General Co-chairs Rusty Mirick of the Marine Technology Society (MTS) and Jim Barbera of the Oceanic Engineering Society of the Institute of Electrical and Electronics Engineers (IEEE/OES). "There was a lot of energy and excitement, with several standing room only sessions and an exciting atmosphere in the Exhibition Hall. We heard many positive comments from attendees, and that means we met our goal of providing a positive experience for MTS and IEEE/OES members, and the ocean technology and engineering community."

A little over 2,000 people converged on the Gaylord National Resort and Convention Center from October 19th–22nd for OCEANS '15 MTS/IEEE held in Washington, DC. The attendees comprised a wide variety of technical professionals, researchers, industry leaders, educators, policy makers, and students. All those in attendance were interested in sharing the latest information on how marine technology and ocean engineering can support exploring, monitoring, protecting, and wisely using the world's ocean resources.

The Conference was honored to have Congressman Sam Farr, co-chair of the House Oceans Caucus and Dr. Rick Spinrad, Chief Scientist of the National Oceanic and Atmospheric Administration (NOAA), as the Honorary Co-chairs. We were very fortunate to have Rear Admiral Tim Gallaudet – Oceanographer of the Navy, – join Dr. Spinrad as the featured speakers for the Plenary Session. The speakers produced fantastic presentations on the role of oceanography and its underlying technology in supporting Naval operations, and the potential market for tailored information products to support the Blue Economy and mitigate coastal threats. Anyone interested in catching said presentations can view them on the conference website at **www.oceans15mtsieeewashington.org**, along with comments by IEEE/OES President René Garello and MTS President Ray Toll.

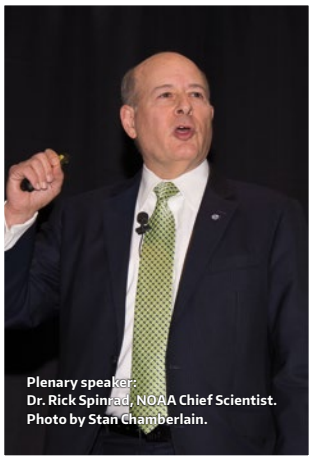
At the end of the Plenary Session, Mirick and Barbera led a VIP Tour of the Exhibition Hall including stops at the Student Poster Contest supported by the Office of Naval Research. Here Spinrad and Gallaudet – two PhD ocean scientists – could easily have spent the entire day discussing the excellent work of the contest finalists.

The tour also took in the sponsoring society booths, as well as exhibits from OCEANS '15 Patrons. These included the Government of Newfoundland and Labrador who organized the Atlantic Canada Pavilion, Kongsberg Underwater Technology, Inc., and NOAA. At the NOAA booths, the U.S. Integrated Ocean Observing System unveiled their new logo.

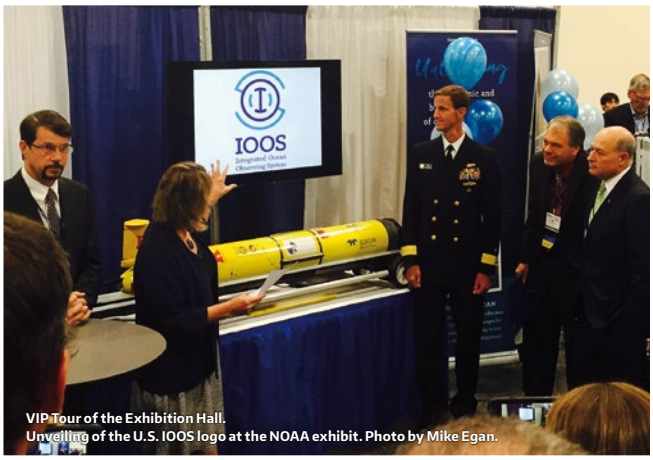
At the heart of every OCEANS conference is the Technical Program and OCEANS '15 Washington, DC upheld the tradition of providing a valuable opportunity for exchanging high quality technical information. Of the 644 abstracts submitted, 488 were accepted into the final program. They were organized into 106 sessions in 11 parallel tracks from Tuesday afternoon through Thursday.

Special Session: Ignite! A Lightning Round of Innovations, Discoveries, and Applications in Blue Tech! Organized by U.S. IOOS and The Maritime Alliance. Photo by Stan Chamberlain.

Plenary speaker:
Rear Admiral Tim Gallaudet, USN,
Oceanographer of the Navy.
Photo by Stan Chamberlain.



Plenary speaker:
Dr. Rick Spinrad, NOAA Chief Scientist.
Photo by Stan Chamberlain.



VIP Tour of the Exhibition Hall.
Unveiling of the U.S. IOOS logo at the NOAA exhibit. Photo by Mike Egan.

Integrated into the Technical Program were a number of Special Sessions, Town Halls, and Panels. These group and interactive sessions have grown in popularity and several were Standing Room Only. NOAA's IOOS program was especially active, partnering with The Maritime Alliance to organize "Ignite! A Lightning Round of Innovations, Discoveries, and Applications in Blue Tech!" and a "Town Hall Session on Marine Technology and Services in the Blue Economy." The Blue Economy theme was continued in the Town Hall on "Promoting OceanSTEM and Blue Economy Work Force Development," which was kicked off by opening remarks from Congressman Farr.

A very popular session called "OCEANS '25 (and beyond) – Envisioning the Future of Marine Technology and Ocean Engineering," was moderated by Dr. Spinrad, and included a strong panel of leaders sharing their insights on future needs and trends and what we'll be seeing at OCEANS conferences in the future. The webcast of this intriguing session is available on the conference web site.

The Technical Program was also complemented by six tutorials and four workshops on Monday, preceding the formal opening of the conference. The tutorials were intensive half or full day programs focused on the fundamental elements of a technology or the rudiments of a subject in a classroom setting, and earned participants Continuing Education certificates. The workshops provided a format for like-minded individuals to spend an extended period of time discussing a topic, such as the all-day XPRIZE workshop on "Catalyzing Ocean Services in a World of Abundant Data."

A lot was going on in the Exhibition Hall at OCEANS '15. In addition to the 169 booths where 129 companies, institutions and projects were featuring the latest innovations in products, services, and programs, a new program was launched. The Product Theater provided exhibitors the opportunity to expand on their latest innovations in a 30-minute presentation, away from the traffic and noise of the exhibit aisles. The 12 presentations were scheduled to occur during the breaks in the technical sessions to provide maximum exposure.

As mentioned earlier, the Exhibition Hall was also home to the Student Poster Contest (SPC). The posters were displayed along one wall of the hall with the students present to discuss their work during published times. The Awards Ceremony on Thursday suffered a bit from a malfunctioning sound system, but that didn't dim the enthusiastic response from the crowd. Before the results were revealed, MTS President Ray Toll and IEEE/OES President René Garello presented a commemorative plaque honoring Norman Miller to Dr. Ellen Livingston of the Office of Naval Research, the long-time sponsor of the contest. The SPC was initiated and championed by Mr. Miller who passed away in July.

Before the Opening Ceremony and Plenary Session. L-R: Jim Barbera, Ray Toll, Rear Adm. Tim Gallaudet, Dr. Rick Spinrad, Rene Garello, Rusty Mirick. Photo by Stan Chamberlain.


The Gaylord National Resort and Convention Center, National Harbor. Photo by Liz Corbin.


First place winner of the Student Poster Contest, Jeffrey Ellen, with Phillipe Courmontagne and Dr. Ellen Livingston. Photo by Liz Corbin.

The winners were announced by Liesl Hotaling, MTS Vice President for Education and Research and Philippe Courmontagne, IEEE/OES Student Activities Committee Chair. Dr.Livingston presented the awards: First Place was awarded to Jeffrey Ellen who led a team from the University of California, San Diego; Second Place went to Luke Rumbaugh, who represented his team from Clarkson University in New York; and Third Place was given to Jie Li and a team from the University of Michigan.

A major focus was also placed on the next generation of the Blue Economy during the K-12 Teachers Workshop held on the preceding Saturday. The free, full-day workshop provided a hands-on approach to learning and classroom resources on the following topics: ROVs, water quality sensors, buoys, and deep sea exploration. On Monday, a Career Panel acquainted students with some of the many career options in the oceans field.

As with all OCEANS conferences, there were plenty of opportunities to network and socialize throughout the week, starting off with the Ice Breaker reception on Monday night, including the Exhibitor Reception on Tuesday evening, and topped off by the Capital Casino Night Gala Dinner on Wednesday, where attendees enthusiastically tried their luck at Texas Hold'em, Blackjack, Roulette, and Craps. The IEEE/OES and MTS Awards Luncheons provided members with a recap of Society activities and the opportunity to honor their outstanding leaders.

As we predicted when we chose the conference theme, **"Sea Change: Dive into Opportunity,"** the week's activities shone a bright light on some of the most critical issues the world faces today, and how our community can help society develop solutions to address their impacts and benefit from new opportunities. MTS and IEEE/OES are extremely proud to have sponsored this successful event. Now it's on to OCEANS '16 Shanghai and OCEANS '16 Monterey, where we of course hope to see you all!


Congressman Sam Farr arriving for a tour of the Exhibition Hall prior to delivering opening remarks at the OceanSTEM Town Hall. Photo by Liz Corbin.


Presentation of the Norman Miller commemorative plaque, L-R: Rene Garello, Dr. Ellen Livingston, Ray Toll. Photo by Liz Corbin.


Bob Wernli enjoying the "no risk" gambling during Capital Casino night. Photo by Stan Chamberlain.

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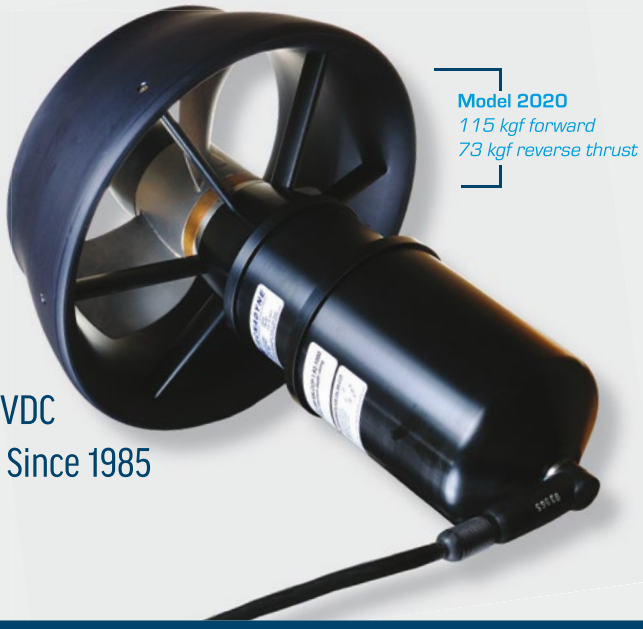

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PRODUCT FOCUS: TECHNOLOGY FOR UNDERWATER TARGET TRACKING AND DP REFERENCE

By Edward Moller, Business Development Manager, Construction Survey, Sonardyne

RANGER 2 USBL ON TRACK AROUND THE WORLD

From navigating deepwater exploration ROVs, to helping dive support vessels maintain a reliable position, Sonardyne's Ranger 2 USBL acoustic technology is proven to reduce risk, save time and extend operational capability. We will take a closer look at how three very different organisations are benefiting from the investment they have made in this technology.

Courtesy of CCC: Four multi-purpose vessels make up CCC's fleet, including here the CCC Pioneer and two new 65 metre vessels rated for Class 2 operations.

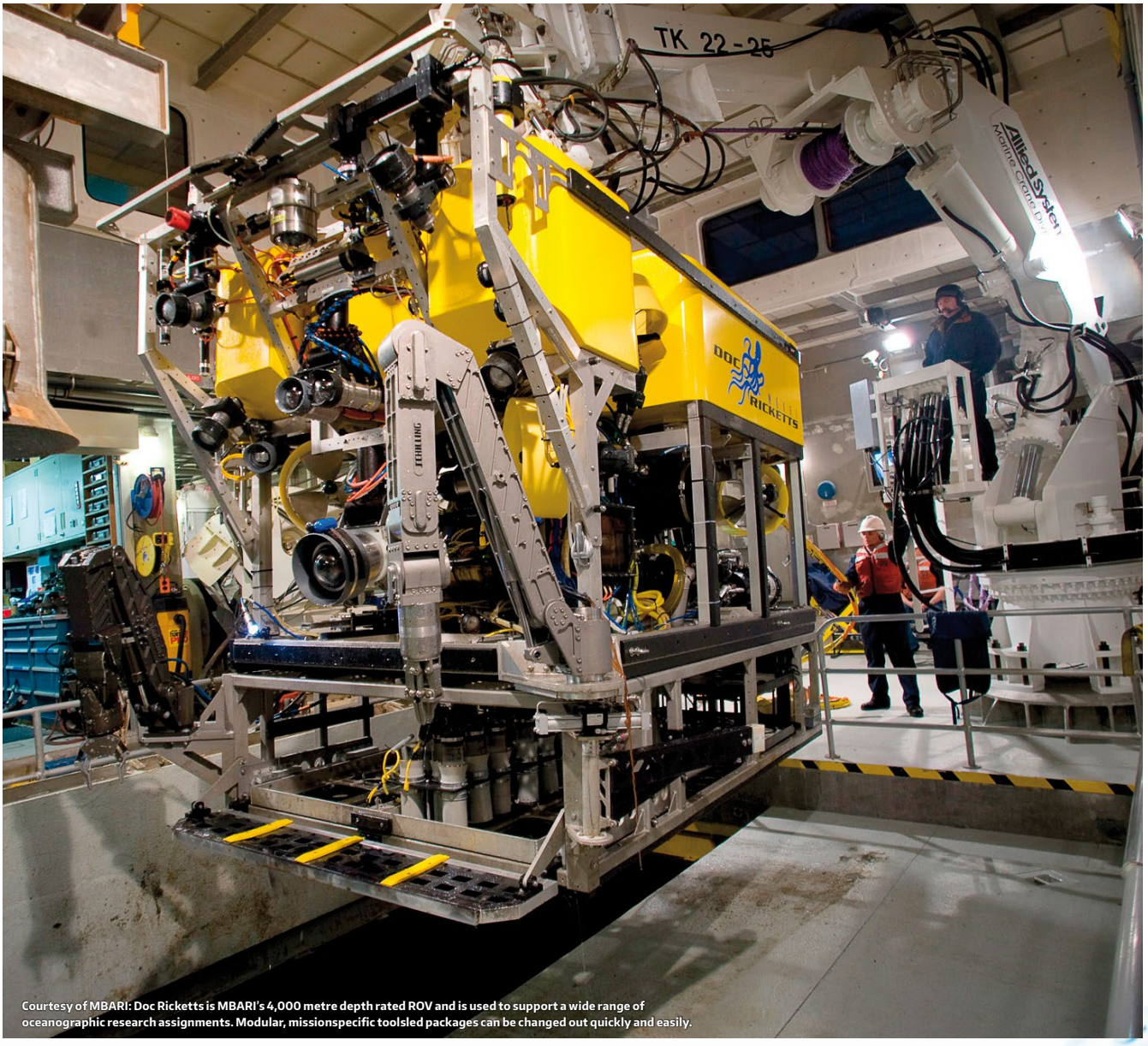
GOING DEEP WITH MBARI

Located in Moss Landing, California, the Monterey Bay Aquarium Research Institute (MBARI) is recognised as a world centre for advanced research and education in ocean science and technology. To support its work, it has at its disposal a wide range of marine technology and assets including; research vessels, deep rated ROVs, several AUVs and a large inventory of scientific instruments.

Over the past 15 years, Sonardyne's original Ranger 1 USBL technology has supported many of MBARI's expeditions off the California coast where water depths rapidly reach beyond 13,000 feet. However, it was noted that on occasions, multipath signals reflecting off their twin hulled research vessel, Western Flyer and noise from ROV thrusters, were interfering with transponder signals coming from great depths.

"Challenging conditions like these are exactly why we developed 6G – our sixth generation acoustic positioning platform," said Kim Swords, Senior Applications Engineer with Sonardyne. "6G systems like Ranger 2 use Wideband 2 digital signal architecture to provide robust navigation, greater precision and fast position updates in all scenarios, deep or shallow and on all types of vessel. We were confident that by upgrading the Western Flyer to the latest 6G standard, MBARI's deep water vehicle operations would be faster, more accurate and more efficient."

As part of the upgrade, theWestern Flyer was fitted with Sonardyne's deep water optimised HPT 7000 USBL transceiver. Co-located with it on the vessel's deployment pole was Lodestar, Sonardyne's premium grade motion sensor – a configuration referred to as Optimised USBL. This integration achieves a tightly compensated solution and allows the positioning accuracy obtainable from Ranger 2 to be maximised. For MBARI, proof of Ranger 2's capabilities came during a recent expedition that ran in April this year to study deep sea hy-



Courtesy of MBARI: Doc Ricketts is MBARI's 4,000 metre depth rated ROV and is used to support a wide range of oceanographic research assignments. Modular, missionspecific toolsled packages can be changed out quickly and easily.

drothermal vents recently discovered in the Gulf of California. Tethered to the Western Flyer, their ROV Doc Ricketts repeatedly dived down 12,500 feet (3,800 metres) to the seafloor and flew around the Pescadero Basin vent field, collecting video and samples for analysis. Despite the challenging conditions created by the vents spewing out super-heated seawater and suspended solids, the positioning repeatability of the Ranger 2 was shown to be just a few metres, performance that enabled MBARI's ROV pilots to save time by flying directly to points of interest.

Commenting on the success of the project, Knute Brekke, Chief ROV Pilot for MBARI said, "During the entire length of the project in the Pescadero Basin, our acoustic tracking enabled us to return to scientific sites of interest repeatedly with three-meter accuracy, well within visual range of the ROV cameras using Sonardyne's Ranger 2 USBL system." He went on to say, "Even though we are a relatively small organisation, we appreciate the support and advice that we have received from Sonardyne on the systems we have purchased to date, and the projects we have used them for.

UPGRADING CCC'S FLEET

Deep water tracking of ROVs is just one of the many applications for Ranger 2. It's equally effective and capable as an acoustic reference sensor for dynamically positioning systems and is installed on a global fleet of vessels. One such fleet is operated by CCC (Underwater Engineering) S.A.L, leading providers of offshore construction and subsea services in the Middle East and India.

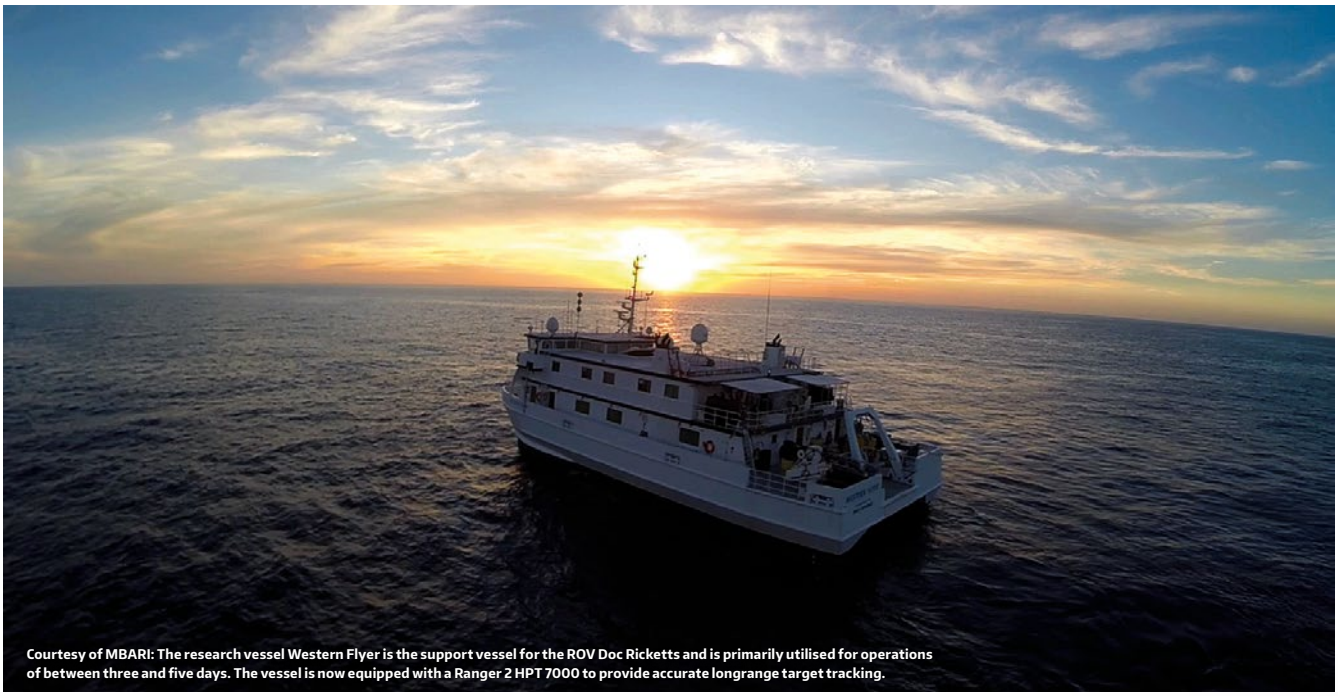
Four multi-purpose vessels make up CCC's fleet, including two new 65 metre vessels rated for Class 2 operations. All are fitted with DP systems from GE, with their two 90 metre Dive Support Vessels, the CCC Pioneer and the new build Said Alethia, equipped with dual redundant Ranger 2 Pro systems – the highest specification available. This capability has allowed CCC to utilise their vessels on survey projects where maintaining a reliable position is a critical operational requirement.

For all of its Ranger 2 installations, CCC additionally specified Sonardyne's Optimised USBL configuration. Here, Sonardyne's premium grade Attitude and Heading Reference System (AHRS) Lodestar is interfaced directly with the Ranger 2 acoustic transceiver allowing raw range, bearing and attitude data to be simultaneously processed. This integration achieves a tightly compensated solution and allows users to meet the positioning specifications of a wide range of subsea construction and survey projects.

Captain Derrick Green, Marine Operations Manager at CCC said, "Our vessel fleet is geared up to support all manner of complex underwater projects. Ranger 2 meets our needs in every respect, offering stable and precise positioning for DP, reliable tracking in any water depth and hardware that is easy for our crews to set up and use. We could not be happier with the results we are seeing back from the field."

HORIZON SAVES TIME WITH GYROUSBL

Setting up a USBL system can be time consuming, often requiring several hours of calibration checks to determine the alignment of the ship's motion sensors to the acoustic transceiver prior to use. That's why Sonardyne developed GyroUSBL, a transceiver that can be made operationally ready in 60 minutes from out of the box to survey use. Following its introduction, UAE-based Horizon Geosciences, were quick to realise its potential, ordering Ranger 2 systems configured with GyroUSBL for their operations. Now, after taking delivery of an additional two systems to complement those already in their inventory, Horizon is the largest user of the technology in the region.



Courtesy of MBARI: The research vessel Western Flyer is the support vessel for the ROV Doc Ricketts and is primarily utilised for operations of between three and five days. The vessel is now equipped with a Ranger 2 HPT 7000 to provide accurate longrange target tracking.

Courtesy of Horizon: Horizon noticed performance and operational gains soon after acquiring GyroUSBL. The speed with which it can be mobilised benefits their vessel operations.

The secret of GyroUSBL's success comes from the integration of Sonardyne's sixth generation acoustic transceiver technology and high grade inertial navigation sensor, Lodestar, in the same mechanical assembly. This unique combination removes many sources of USBL error including lever arm offsets, pole bending and ship flexing. It has also been proven to exceed accuracy and precision expectations, even when deployed on a temporary pole arrangement over the side of a vessel.

"We provide precise positioning for numerous activities offshore and often have to mobilise personnel and positioning equipment at short notice. GyroUSBL fits in perfectly with the unpredictable nature of our operations without compromising standards," said Lance Hanson, Survey Projects Director at Horizon Geosciences. He went on to say, "We witnessed performance and operational gains soon after we began using GyroUSBL, so we decided to expand our deployment of the technology."

Ranger 2 USBL: Reasons to invest Not all USBLs are the same – something that will be noticeable the moment you begin using Ranger 2 for the first time. If offers high performance for all applications and is packed with advanced features that come as standard. So if you're looking to reduce risk, save time and extend your operational capability, take a closer look at Ranger 2. Search Ranger 2 USBL for more information.

OCEANEERING'S ROV CENTRE IN BATAM:

KEEPING THE INDUSTRY MOVING FORWARD

Situated in the Singapore Strait – one of the busiest shipping lanes in the world – Batam is less than an hour away by shuttle boat from the bustling hub of the city-state itself. While Singapore is undoubtedly the beating heart of South East Asia's financial sector, Batam is one of the leaders in the region when it comes to another of the region's burgeoning industries: manufacturing. This is why in the midst of this hectic waterway you will find the Oceaneering International, Inc.'s ROV Centre. As one of the world leaders in ROV manufacturing and piloting, Oceaneering decided to open their ROV training centre in Batam, Indonesia. As you enter the Sekupang ferry terminal to cross the border into Indonesia, you are engulfed by the fecundity of palm trees and lush, tropical vegetation. We're informed on our arrival that the industrial estate where the training centre is situated is just a short drive away from here.

When we reach Oceaneering's Batam base, we were greeted by Alistair Parley, General Manager, and Stewart Elder, Training Manager. These gentlemen are responsible for turning the Indonesian outpost into a world class facility that is capable of both refurbishing and actively supporting ROV systems. They enthusiastically inform us of the base's new role as a training centre: one which – at the end of last year – conducted an ROV Pilot Training Program made open for non-employees, similar to the kinds run by other ROV companies. As of October last year, Oceaneering now offers an 'Introduction to ROV Course' on a monthly basis to fee paying students. The course is 26 days in duration, with a demanding curriculum of classes being held seven days per week. Course sizes, we're informed, are limited to 12 students to ensure a high instructor /student ratio. The course has been formulated to provide a basic understanding of how to safely perform operations and maintenance on an ROV system, and includes individually assessed modules such as Health, Safety, Environmental, and Quality; Introduction to ROV Hydraulics, Manipulators, and Tooling; and ROV Tether and Umbilical Terminations.

Courses include:

- Health, Safety, Environmental & Quality
- Working at heights
- Electrical Safety and Awareness
- Use of test equipment
- Ground Fault Systems
- Electrical Power Flow
- Telemetry and Fibre Optic Systems Overview
- ROV Hydraulics
- ROV Manipulators
- ROV Tooling
- ROV Pre and Post Dives Checks
- Launch and Recovery (Winches and A-frames)
- ROV Tether Terminations (Copper and Fibre)
- ROV Umbilical Termination, Electrical and Fibre Optic
- ROV Umbilical Termination (Mechanical)
- Wiring, soldering and cabling (Signal and Power)
- Piloting, Co-Piloting and Navigation

First, we're shown a health and safety video before we can embark on our tour, which is followed by a general overview and history of the base. After the induction, we begin our tour of the workshop facilities. Here, we're introduced to a group of techs who are in the process of mobilizing a Millennium ROV to be sent out on a local job.

After meeting the techs and seeing some of their fine work, we get our first look at the bases' training facilities. We are shown the classrooms, of which there are four, the space


Courtesy of Oceaneering: Dual ROV simulator room.

in each being regularly utilized for a range of practical and theoretical lessons. These are complemented by the centre's practical training area: an expansive 4,000 ft² used to carry out the range of practical lessons and assessments that make up 50% of the ROV training course.
The centre's focus on recreating an applicable, as-near-to-real-world environment within the confines of one facility is made clear to us the further that we venture into this fascinating place. Our next stop on the tour is the ROV Launch and Recovery (LARS) area. Here an entire additional ROV system – with a fully operational winch and A Frame – has been constructed to emulate the look and feel of an offshore location. The launch and recovery sequence has even been fully animated to demonstrate the operation and interaction between the winch and A Frame.

The centre even boasts not one but two ROV simulator rooms, which – as our guides explain – are utilized to teach a wide range of piloting, navigation, and co-piloting skills. The instructor is able to monitor the operation of both ROV's simultaneously. In addition, variable sea current and visibility conditions can be added to the missions, making the piloting experience as real and challenging as possible. The duration of the basic piloting and navigation course is five days which includes a comprehensive exam designed to test and hone operators' newly acquired skills.

After being shown the staggering array of technologies available for aspiring operators who are hoping to gain a place with Oceaneering, we are shown to a workshop where the trainees are currently working on different exercises. In one of the classes they build up the ROV control system and then practice troubleshooting it. As we watch the trainees' moving through their work with laser-like focus, we're informed of what it takes to make it into one of their coveted positions. To align with IMCA guidelines, any candidate must have a relevant electrical, electronic, or mechanical qualification and /or experience. Also, an interview and knowledge test are conducted beforehand to ensure suitability.

In order to match the high standard of the technical and hands-on aspects of the course, the bar is set high for both the selection process and personal requirements. Stewart explains how

Courtesy of Oceaneering: Fully functional Magnum Plus ROV System

since the very beginning of these training courses, there has been a lot of outside interest. This was especially true, he says, of the self-funded candidates, who tended to show more focus, dedication, and enthusiasm than their previous counterparts. The purpose of this training course is to find candidates that can commit to the company long term, and this, Stewart clarifies, is why Oceaneering doesn't accept all applicants onto the course, instead preferring those who already have some mechanical, hydraulic, and electrical experience.

Only those with a real passion and drive to succeed even make it on to this demanding course. However, for those who make it and go on to graduate, the rewards are quite considerable. Formal assessment and interviews for these are held at the end of each course, allowing the opportunity for successful graduates being offered full-time, long-term employment, with an industry leading company that will continue to develop and nurture their skills throughout their working careers. And even those who aren't offered a paid position still receive a course certificate, a competency book, and a written assessment of their performance during the course, which they can then use to court other potential employers.

As we leave the base into the humid warmth of our tropical surroundings, I can't help but feel a sense of both awe and respect for the training facility and the hopeful candidates making their way through its rigorous demands. It was surprising to see the array of tools and facilities at their disposal: stunning in both their range and quality. But more than that, I felt like I had a refreshed sense of optimism for both Oceaneering and the ROV community as a whole. Even in the midst of rather unnerving economic uncertainty for our industry, it's heartening to know that in one of the far flung corners of the world the best and brightest of the field are learning how to do some truly amazing things.

To learn more about Oceaneering and the ROV Centre in Batam, visit: http://www.oceaneering.com/batam-rov-training/


Courtesy of Oceaneering: Training on Launch and Recovery System.


Courtesy of Oceaneering: Atlas Hybrid Manipulator training.

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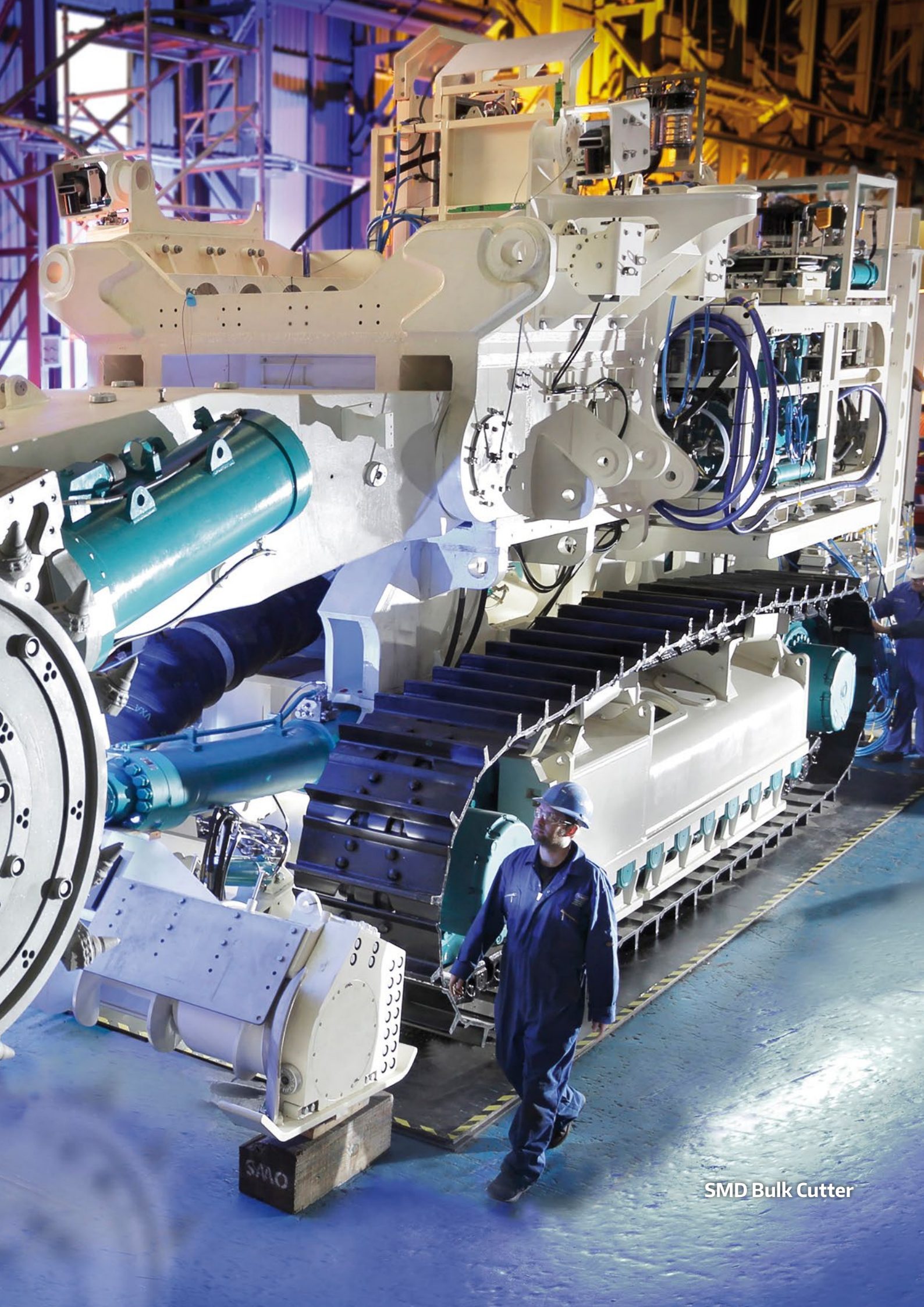
Connect with what's next at **Oceaneering.com/WhatsNext**

Please check out our website on:

www.ROVPlanet.com

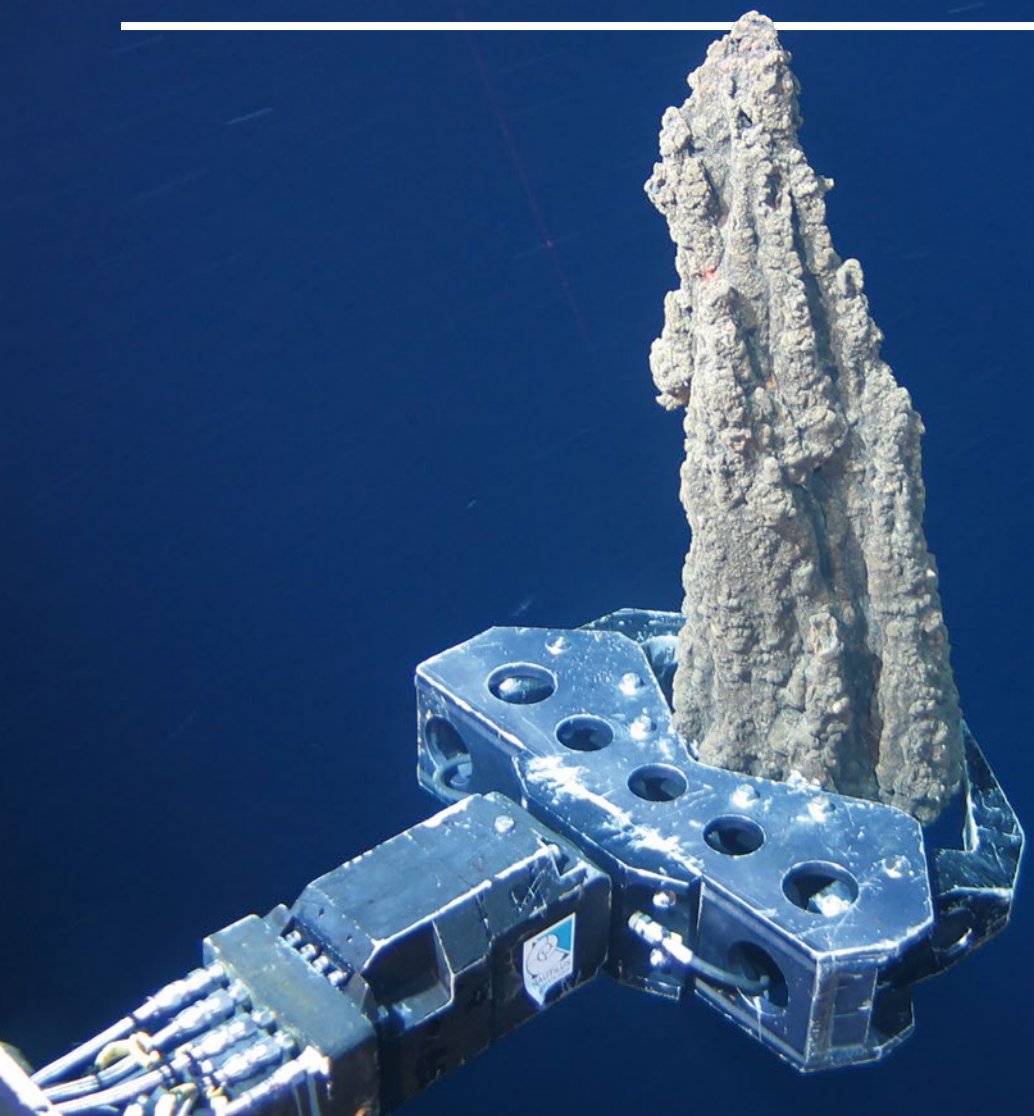

SMD Bulk Cutter

FORGING AHEAD

NAUTILUS AND THE PIONEERING WORLD OF DEEPSEA MINING

By Will Grant

Imagine what it must have been like to be an engineer on one of the first undersea oil exploration missions: working in an emerging industry at a time when tapping some of the world's richest deposits away from land was something that was only theorised. A brand new field waiting to be discovered and you and your colleagues were the ones doing the discovering. Fast forward to today: seafloor mining could be about to do the same thing for the metal and mineral industries as offshore oil and gas did for the energy sector decades ago. And the company at the forefront of this pioneering work is Nautilus.



Courtesy of Nautilus Minerals:
ROV in the process of taking chimney sample.

Courtesy of Nautilus Minerals: Kevin Cain (Project Director, Nautilus), Mike Johnston (CEO, Nautilus), Shontel Norgate (CFO, Nautilus), Andrew Hodgson (CEO, SMD)

EXCITING BEGINNINGS

Nautilus Minerals Inc. is an underwater exploration company headquartered in Toronto, Canada. Ostensibly the work that this group is planning and carrying out is the first of its kind in the world. What Nautilus is primarily interested in are Seafloor Massive Sulphide (SMS) systems: the result of deposits which have filtered down through the seafloor, and been pumped back up through hydrothermal vents to form solid, mineral-enriched cores.

Back in 2007 Nautilus launched the first explorations of what is now known as the Solwara 1 project off the coast of Papua New Guinea, in the Bismarck Sea of New Ireland. The initial findings were encouraging to say the least, and since then they have uncovered incredible copper and gold yields.

How incredible? In any porphyry copper mine on land the average yield will be around 0.6%. In your average gold mine you can expect to recover 2 g of gold per tonne mined. The ore already sampled from Solwara 1 has produced 7% copper and gold deposits of 6 g/tonne on average. The International Seabed Authority has previously published findings saying that there may be more copper on the Earth's seabed than in all the known reserves on land. In fact the local Government of Papua New Guinea is so confident of the initial findings that they have already invested $120 million for a 15% equity stake in the returns from Solwara 1.

And these findings are not unique to this corner of the Pacific; the locations of discovered SMS deposits alone include East Asia, Australasia, all along the west coast of North America, and right up the centre of the North Atlantic. So with these initials findings – in addition to the potential for high yields of zinc, nickel, and other rare polymetallic deposits – you can see why this project and the subsequent technological advances that could spring from it are going to completely change the game.

PRECIOUS NODULES

Nautilus is also interested in harvesting nodules: potato ball-sized chunks of hardened sediment which have filtered through the oceans eco-system to form polymetallic rich deposits on the sea-bed. Such deposits are typically found at depths of 4,000 to 6,000 meters making conventional collection methods impractical. However,

with the potential for high levels of nickel, copper, cobalt, and manganese from each nodule, there could be some very high returns for the company willing to invest in deep water exploration and mining.

With this in mind – and in addition to their Solawara 1 project – Nautilus have entered the early planning stages of mining in the Clarion Clipperton Zone (CCZ) of the Central Pacific. In 2011 – through their 100% owned subsidiary Tonga Offshore Mining Limited (TOML) – Nautilus began initial investigations on the nodule deposits in the CCZ. Like their investigations into SMS deposits at Solwara 1, their findings since then have been very promising. In their annual report the company stated 'Commencing in 2015, Nautilus intends to upgrade a sufficient portion of TOML's inferred resource estimate to an Indicated level of confidence, and progress its mining concept through pre-feasibility upon finding a suitable partner.'

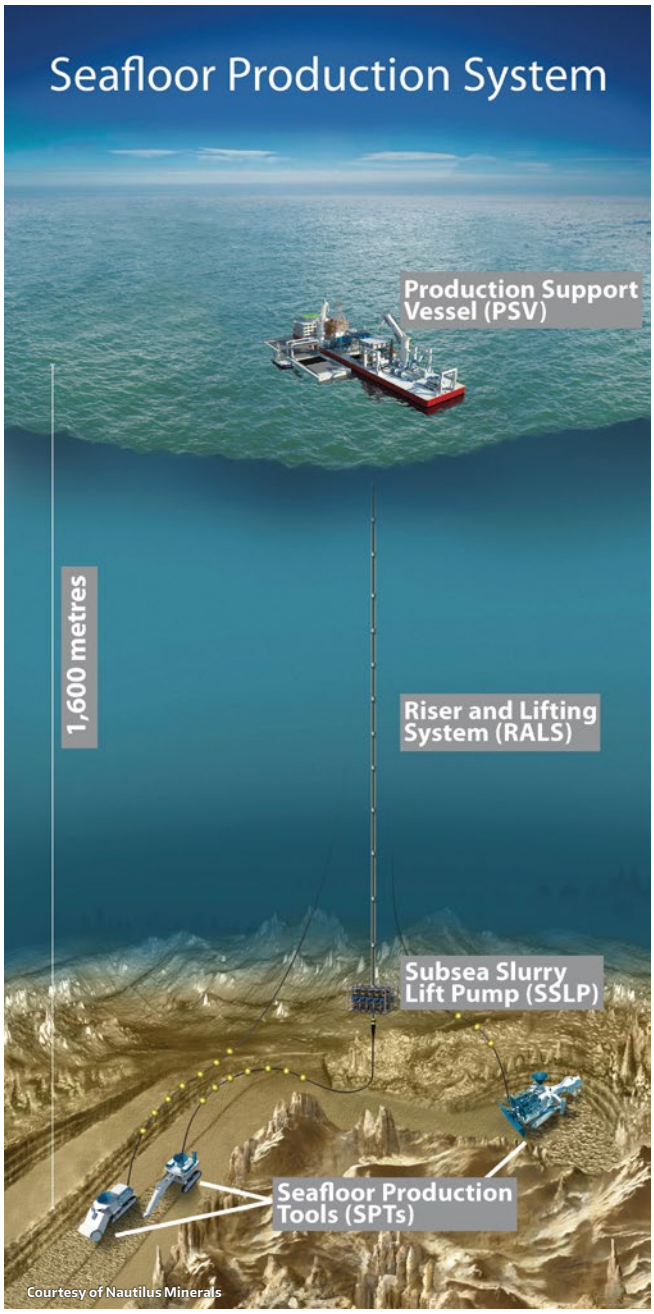
AMAZING MACHINES

So, how do you take the restraints and conventions of an industry that has thus far been confined to terra firma and make them work 1600m below the surface of the Pacific? In this respect Nautilus have borrowed heavily from the oil and gas industry, and combined this with technologies used in rock-cutting and materials handling already being used in land-based mining. However, Nautilus CEO and President Mike Johnston is keen to point out that in this respect too the company is forging its own path. 'There has been a lot of innovation that Nautilus, in partnership with other industry leading companies, has developed and patented which will set the standard for future resource development,' Johnston said. 'While all of these are based on existing technology to varying degrees, they all required various levels of modification and innovation for the deep sea environment and the specific requirements of seafloor mining.'

All of these modifications and enhancements will come into play on the Solwara 1 project. The proposed extraction process for Solwara 1 can be broken down into three major phases: the Seafloor Production Tools (SPT's), the Riser And Lifting System (RALS), and the Production Support Vessel (PSV). In of themselves the design of the SPT's – the work horses of this colossal operation – are amazing, and these machines will be operated remotely from the support vessel above.

Using the SPTs, rock is disaggregated by two large robotic machines that excavate material using a continuous cutting process, similar to coal and other bulk continuous mining machines on land.

All three machines are being designed and manufactured by subsea vehicle engineers Soil Machine Dynamics Ltd. in Newcastle Upon Tyne, UK, and they've all been designed with specific functions in mind. The Auxiliary Cutter (AC) is a preparatory machine that deals with the initial terrain and



creates benches for the other machines to work. It will operate on tracks with spud assistance, has a boom-mounted cutting head for flexibility, and weighs 242 tonnes in air. The second machine, the Bulk Cutter (BC), has a higher cutting capacity than the AC, and will move along the 'working benches' cut by the former. The prefix 'Bulk' is entirely accurate: the BC weighs a whopping 310 tonnes in air. Both machines will leave the cut materials on the seafloor for collection by the Collecting Machine (CM).

The CM is the smallest of the three machines, weighing in at 185 tonnes in air. Using its long, funnel-shaped front piece the CM will collect the cut material by drawing it in as seawater slurry with internal pumps, and pushing it through a flexible pipe to the RALS. All three of the SPT's will be deployed from the support vessel using a lifting

frame, and operated via a power and control umbilical. These machines have all been assembled and are in the process of being commissioned, with wet testing planned for the first half of this year.

The RALS is another integral piece of equipment. It comprises a large pump and rigid riser pipe hanging from a vessel which delivers the slurry to the surface. The seawater/mineralised material will be delivered into the Subsea Slurry Lift Pump (SSLP) at the base of the riser, where it will be pumped to the surface via a gravity tensioned riser suspended from the PSV. The positive displacement pump will be supplied by GE Hydril of Houston, Texas, and the RALS will form a kind of umbilical cord in order to deliver the mineral-rich slurry from the seafloor to the PSV.

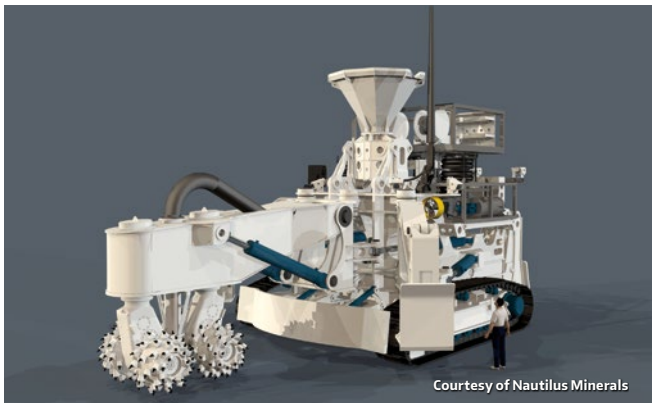
The PSV itself is a substantial vessel designed to cater to this mammoth undertaking. Measuring 220m from bow to stern with a 40m boom, it will be crewed by up to 180 people. It's being constructed by the Dubai-based Marine Assets Corporation (MAC) in the Fujian Mawei shipyard of Fuzhou City, Fujian Province, China. . Unlike a dredging operation, Nautilus will filter the slurry water and pump it back to depth before discharge at 50m from the seafloor (at 1500m). After dewatering aboard the PSV, the mineralised material will be temporarily stored on board the PSV then offloaded to a vessel for transportation to Tongling Nonferrous Metals Group in China for processing.

The Solwara 1 project alone represents a massive undertaking involving a range of different designers, manufacturers, and engineers from around the globe. Mike Johnston explained, 'Nautilus' partnership with industry leading manufacturers is indicative of our approach to set a high standard for seafloor resource production. Industry partnerships include Soil Machine Dynamics in the manufacture of the SPTs, Sandvik for the development of the SPTs' cutting heads, GE Oil and Gas in the development of the subsea pump, (and) GMC for the riser system.

'Already, the order for the main engines (of the PSV), azimuth and thruster packages has been awarded to Rolls Royce Marine, Norway and was the first major package to be awarded by the shipyard, Fujian Mawei Shipbuilding.'

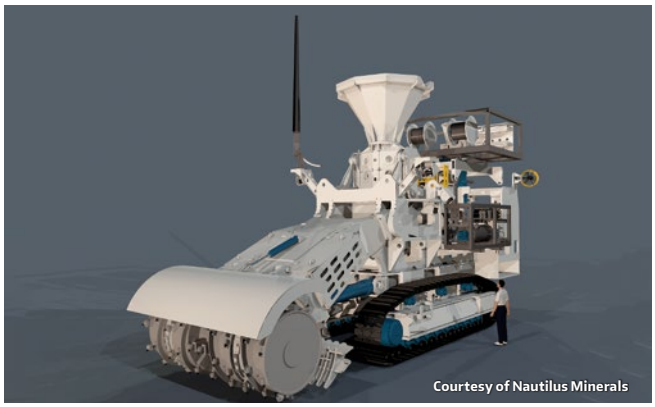
EXPANSION

In a briefing memo concerning the ongoing feasibility of their operations in the Pacific, Nautilus have described the above methods as providing 'a platform for longer term production potential; highly scalable' and a 'small environmental footprint, (and) minimal community impact'. And Nautilus is obviously working with an eye to the long term. The company already holds exploration territory, or tenement applications in the Southwest Pacific and the Central Pacific Ocean, and has secured some of the most promising areas of the seafloor for the potential development of future projects. Previous exploration has already identified 19 mineralised seafloor systems in the Bismarck Sea, and 19 off the coast of Tonga.


Courtesy of Nautilus Minerals

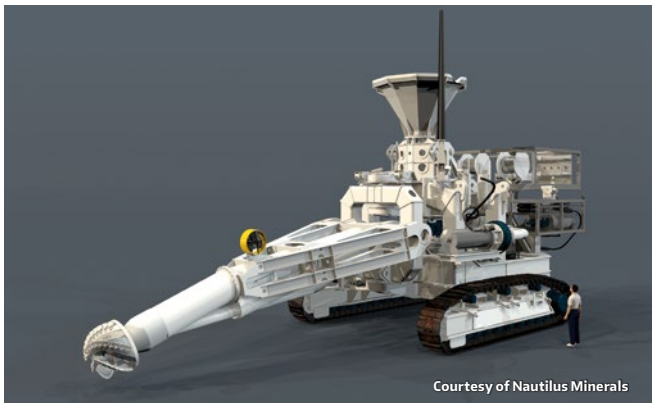
AUXILIARY CUTTER

Length:	**15.8 m**	Boom Swing:	**11.6 m**
Width:	**6.0 m**	Boom Cutting:	**+4 –1.0 m**
Height:	**7.6 m**	Weight:	**250 Te**


Courtesy of Nautilus Minerals

BULK CUTTER

Length:	**14.2 m**	Cutter Width:	**4.2 m**
Width:	**4.2 m**	Cutting Height:	**+4 –0.5 m**
Height:	**6.8 m**	Weight:	**310 Te**


Courtesy of Nautilus Minerals

COLLECTING MACHINE

Length:	**16.5 m**	Collection Range (Height):	**–2 +5 m**
Width:	**6.0 m**	Collection Range (Width):	**±4 m**
Height:	**7.6 m**	Weight:	**200 Te**

Courtesy of Nautilus Minerals: The Collecting Machine

One might be concerned as to the potential ramifications of large scale mining of precious minerals so close to the coastlines of these remote, idyllic island states. However, Nautilus is keen to distance themselves from unscrupulous strip-mining practices that have been seen elsewhere in the past. Johnston highlighted the extensive environmental surveys that have already been carried out. 'Extensive review by the PNG government and outside agencies was then undertaken to ensure that potential impacts will be minimized, and mitigation strategies could be built into on-going designs.' he said. 'These reviews and consultations are on-going and will ensure that Nautilus' environmental practices continue to be recognised as one of the standards for proper deep ocean assessment and resource utilization.' Nautilus is confident that the work that they are carrying out will not only be highly successful, but also help fundamentally determine the shape of this new industry. Whatever happens, deep-sea mining projects like this one are going to increase in size and scope in the very near future and beyond. So for now, watch this space!

Courtesy of Nautilus Minerals: Mike Johnston (CEO, Nautilus) at Bulk Cutter control console.

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JAMSTEC UTILIZING AVM TECHNOLOGY IN UNDERSEA OPERATIONS

OVERVIEW

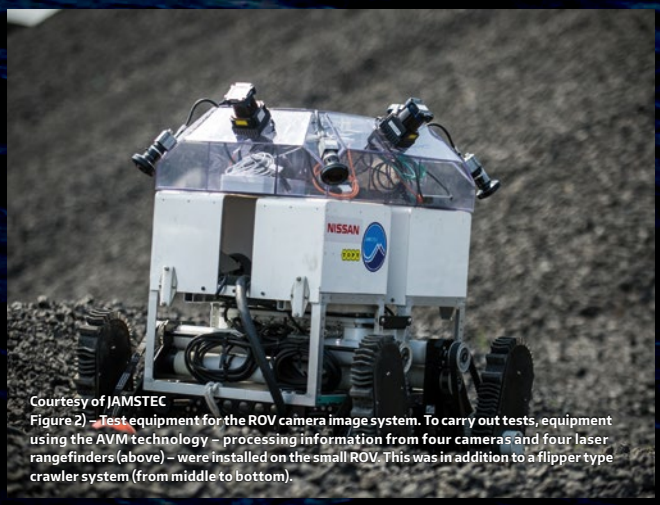
The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) has begun production of an element engineering test machine, based on a joint agreement with Nissan Motor Co., Ltd. and Topy Industries, Ltd.. This pilot project was concluded recently and yielded some very promising results.

One feature of particular note that will be incorporated into the finished machine: Nissan's Around View Monitor (AVM) technology. In this system, a virtual birds-eye view provides appropriate vehicle maneuvering information to assist drivers with easy parking. In 2007, it was first marketed by Nissan Motor Co., Ltd. Its technology is continuing to evolve, including its new Moving Object Detection technology, introduced in 2011. The inclusion of the AVM will help improve the guidance features of the finished vehicle, which will be developed alongside Topy. This exciting advancement represents an essential technology for development of highly efficient subsea operations in the 'Next-generation Technology for Ocean Resources Exploration (Zipangu in the Ocean Plan)', an initiative that is part of the 'Cross-ministerial Strategic Innovation Promotion Program (SIP)' led by the Cabinet Office. SIP was established in 2014 with a five year plan. The Council for Science, Technology, and Innovation (CSTI) takes initiatives in management across government ministries and existing fields, aiming to achieve scientific technological innovation. In the 'Next-generation Ocean Resources Research Technology (Zipangu in the Ocean Plan),' – which is one of the eleven issues set for the program – JAMSTEC is responsible for a number of tasks. These include carrying out scientific research on ocean resource genesis, development of ocean resource exploration technology, and ecosystem research, with its long-term monitoring technology. The plan thus far is that these technologies will be directly applicable to the private sector.

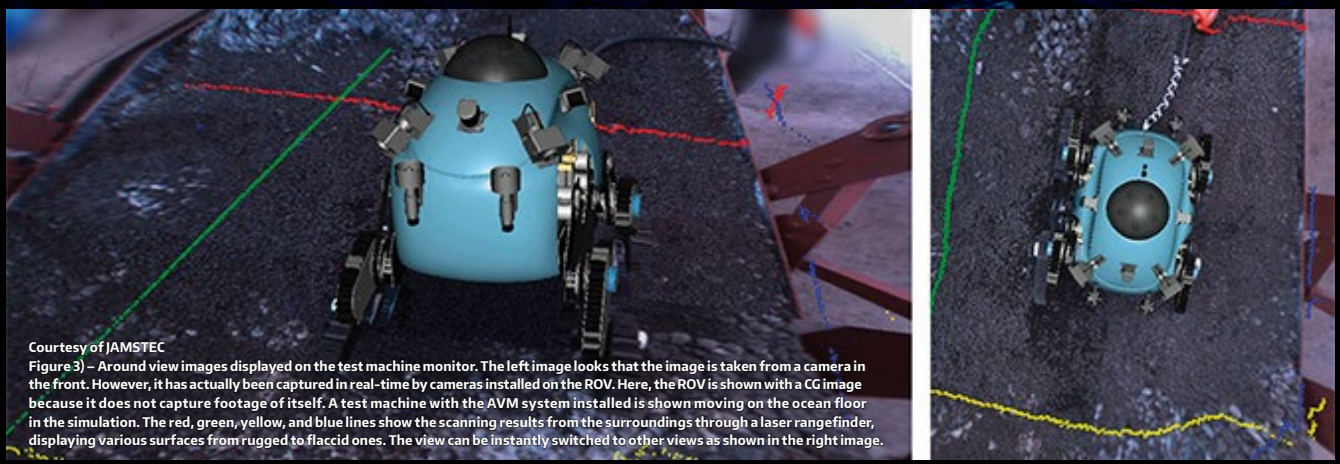
Courtesy of JAMSTEC
Figure 1) – An image of the ROV with highly-efficient subsea operation systems – It will collect core samples across vast areas, which are used for research on mineral deposits and chemical substances contained in minerals under the ocean floor. The system aims to allow private sector manufacturers to introduce it easily when they enter resource research fields.

The project exemplifies how AVM know-how is being put to practical use in complex operating environments, and is among the Japanese Cabinet office's Strategic Innovation Promotion Program (SIP), which aims to realize innovation through the promotion of research and development activities across government ministries.

Developments in subsea exploration – such as this one – are important for Japan in particular. Japan's exclusive economic zone (EEZ) is the sixth largest area of its kind in the world. It's also known as an area for high potential marine mineral resources, including submarine hydrothermal deposits. However, the technologies which would be required in order to carry out efficient research covering these vast areas have yet to be developed.



Courtesy of JAMSTEC
Figure 2) – Test equipment for the ROV camera image system. To carry out tests, equipment using the AVM technology – processing information from four cameras and four laser rangefinders (above) – were installed on the small ROV. This was in addition to a flipper type crawler system (from middle to bottom).



Courtesy of JAMSTEC
Figure 3) – Around view images displayed on the test machine monitor. The left image looks that the image is taken from a camera in the front. However, it has actually been captured in real-time by cameras installed on the ROV. Here, the ROV is shown with a CG image because it does not capture footage of itself. A test machine with the AVM system installed is shown moving on the ocean floor in the simulation. The red, green, yellow, and blue lines show the scanning results from the surroundings through a laser rangefinder, displaying various surfaces from rugged to flaccid ones. The view can be instantly switched to other views as shown in the right image.

Courtesy of JAMSTEC

In addressing the 'Next-generation Technologies for Ocean Resources Exploration,' JAMSTEC has been trying to develop highly efficient systems that can be added to its existing ROVs for subsea operations. As part of this effort, JAMSTEC have partnered with Topy Industries – one of the top manufacturers of robot crawlers in Japan (Figure 1) – to develop the crawlers necessary for multi-coring systems. Crawler systems allow us to collect research samples in stable conditions even when subsea surfaces are rugged or flaccid. This comes in very handy, as when the ROV is operated from a control room on the vessel, it is necessary to watch multiple camera images at the same time. In addition, the existing narrow view cameras can't capture rough surfaces of the seafloor around the crawlers.

This is where Nissan's AVM tech comes into play. JAMSTEC have been examining utilization of the Nissan's AVM technology with three-dimensional image processing functions (Figure 2). By combining this technology with sensors that accurately measure distance between the vehicle and obstacles, it will become possible to capture real-time images from a bird's eye view above the vehicle (Figure 3). Operators on the vessel will then be able to obtain a real-time view of the seafloor. It's the hope that this will drastically enhance the efficiency of underwater operations.

After developing these technologies further through field testing, JAMSTEC now aims to put them into practice, with the goal of ocean resource exploration by 2018. Such technologies when developed jointly with the private sector are easily transferred to them. It is expected that this system for ocean resource exploration will be widely used in Japan from an early stage.

Because of the close proximity of their headquarters' locations and their research centers in Kanagawa, JAMSTEC and Nissan have often undertaken joint development programs together. Topy Industries have also previously worked alongside JAMSTEC on technology development. Following the encouraging outcomes witnessed so far, JAMSTEC will continue to promote joint development by partnering with private sector companies. It is our profound hope that we can bring more exciting innovations – such as AVM integration in ROV's – to the field of undersea maintenance and exploration.

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Courtesy of Robert D. Christ
Figure 1: Observation Class ROVs

SMALL ROVS
A BRIEF HISTORY

By Robert L. Wernli Sr.

Where do you start when trying to write a brief history of small or observation class ROVs? During my career I was lucky enough to work at the U.S. Navy's R&D lab in San Diego, a place known by many names but mostly as the Naval Ocean Systems Center. It was here that the foundation for much of today's ROV technology was developed. However, the initial ROVs didn't start out that small.

One of the earliest observation class ROVs that the U.S. Navy developed was the CURV (Cable-controlled Underwater Recovery Vehicle). This early ROV design won its claim to fame during the US Navy's massive search and recovery effort to locate and retrieve a lost atomic bomb. The bomb went missing off the coast of Palomares, Spain in 1966, in 2,850 feet (869 meters) of water: well beyond practical working depths. The bomb was eventually retrieved, and based on that success the U.S. Navy decided to invest in the development of additional ROVs.

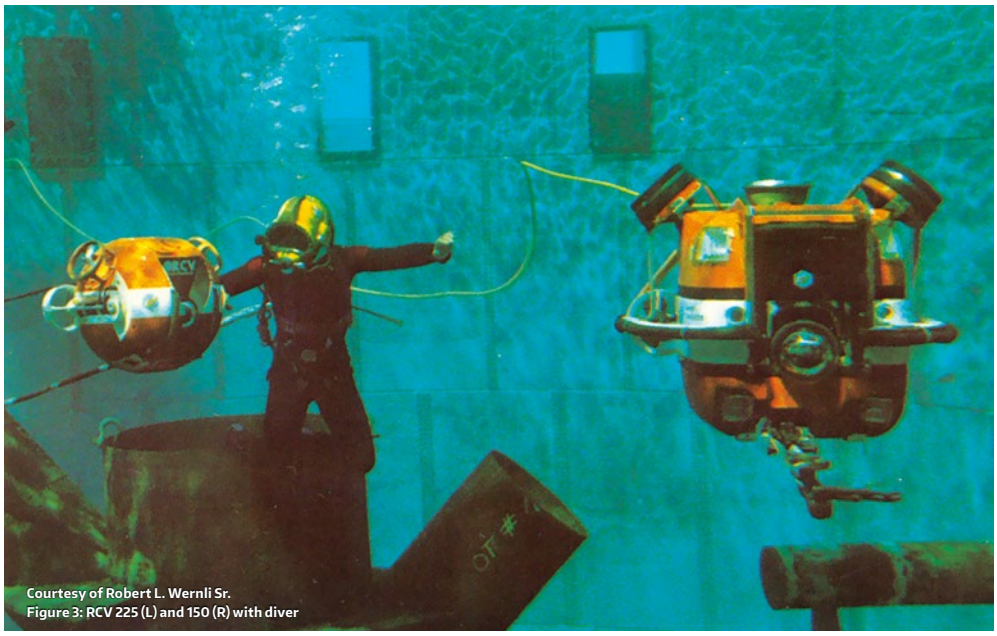
The Navy lab began to develop smaller vehicles for shallow water: SNOOPY (Figure 4) – depth limited due to being hydraulically operated from the surface – was soon followed by the Electric SNOOPY, and a third version, NAVFAC SNOOPY, was developed for operational Navy use.

At the same time and on the commercial side of the industry, U.S.-based Hydro Products was getting a jump on the field with their Navy funded programs: TORTUGA (Figure 2) and ANTHRO. The TORTUGA vehicles were developed to investigate deployment from a submarine, and the systems ranged from small water jet controlled vehicles, to units using propellers for increased maneuvering. In addition, Hydro Products was developing a small, submersible-launched vehicle called the Advanced Maneuverable Underwater Viewing System (AMUVS) for the U.S. Navy.

The technology and understanding of ROV development soon advanced to a point where small, commercial vehicles could be produced. Such miniaturization was exemplified by Hydro Products' "Flying Eyeball": the RCV 125, which hit the currents in 1975. This machine was a spin-off of their earlier TORTUGA, ANTHRO, and AMUVS designs. This was soon followed by the RCV 225, and eventually the RCV 150 (Figure 3). Although the flying eyeballs entered the oil patch slowly – usually as a safety tool for divers – their design was not foolproof. They were often seen bobbing off into the distance, no longer attached to their tether. However, even though a few were lost they slowly became accepted as a valuable tool, especially when the work was beyond diver depth.

Perry Offshore in Florida picked up the US Navy's design of the NAVFAC SNOOPY vehicle and soon had a line of vehicles called RECON on the market.

Courtesy of Robert L. Wernli Sr.
Figure 2: Hydro Products Tortuga



Courtesy of Robert L. Wernli Sr.
Figure 3: RCV 225 (L) and 150 (R) with diver

Worldwide vehicles were being produced, and many new players began to emerge: Canada's International Submarine Engineering (ISE) introduced the DART, Italy's Gay Underwater Instruments unveiled their spherical FILIPPO, Sweden added SUTEC's SEA OWL, and a variety of vehicles were being developed in the UK. Japan was also entering the picture, and soon Mitsui Ocean Development and Engineering Co., Ltd., added their vehicles such as the RTV-100. There were many other small ROVs appearing, including those such as Woods Hole's Jason Jr. ROV that conducted deep ocean operations like the RMS Titanic inspection. There are too many exemplary ROVs to mention, and unfortunately we can't list them all and keep this review short.

Once the ROV technology got to the point that costs could be reduced, the small vehicles began to be referred to as LCROVs: Low Cost ROVs (or VLCROVs: "Very Low Cost"). These LCROVs were originally classified as being under $50K per total system cost (VLCROVs could cost around $10k or less) and were relatively portable. Such terminologys highlight the technological breakthroughs being made across the industry as a whole.

In the 1980's the competition was getting fierce internationally, and I had the pleasure of initiating the first ROV conference in 1983 sponsored by the Marine Technology Society. The theme of the conference was "A Technology Whose Time Has Come". This proved to be something of an understatement.

One example of the heated competition being displayed was at the ROV '85 conference. Three of the just under $30K LCROVs (Deep Ocean Engineering's Phantom 500, Mitsui's RTV-100, and Deep Sea Systems International's MiniRover) got a little 'competitive' during demonstrations in the hotel pool. Let's just say it was a good thing they didn't yet have the miniature cable cutters installed.

Time and terminology march on, and the classification for the smaller vehicles settled on "observation class": ROVs weighing under 200 pounds. This class ranges from small hand-held vehicles to slightly larger systems as shown in Figure 1. This image was taken during a series of tests comparing the capability of the systems shown, and was conducted for the U.S. Coast Guard by Bob Christ of SeaTrepid. These tests initiated discussions regarding the ROV technology between Bob and me, and that led to our co-authoring The ROV Manual, now in its second edition.

The great thing about the miniaturization of electronic and related technologies is their potential application to the miniaturization of ROVs. This has essentially been the case throughout their history, but today it is being taken to extremes. Vehicles such as those developed by VideoRay – with versions under $5K – are providing the low cost and portability envisioned by those who originally developed the VLCROV terminology. It was thought that when you could pick up a small ROV at the checkout stand of your local maritime supply store that the technology really had reached its maturity. Well don't look now, but they're probably hanging there next to the Apple watches and iPhones. I for one can't wait to see what the future will bring.

Courtesy of Robert L. Wernli Sr.
Figure 4: The U.S. Navy's Hydraulic Snoopy

TELEDYNE SEABOTIX VLBV300

Courtesy of NOAA and Teledyne SeaBotix

USED BY NOAA ARCHEOLOGISTS FOR SHIPWRECK DOCUMENTATION NEAR SAN FRANCISCO BAY

By Cyril Poissonnet, Strategic Product Development Manager, SeaBotix, Teledyne Marine

Teledyne SeaBotix is a world leading manufacturer of low cost, low logistics MiniROVs that perform a multitude of tasks including archeology, maritime security, search and recovery, hull and pipeline inspection, hazardous environment intervention, aquaculture, oceanographic research and more.

NOAA'S MISSION AND ROV SELECTION

National Oceanic and Atmospheric Administration (NOAA) archeologist Robert Schwemmer's mission is to document the West Coast region's maritime heritage resources. The recently expanded Greater Farallones National Marine Sanctuary and nearby Golden Gate National Recreation Area is home to nearly 490 ship and aircraft wrecks, including Ituna featured in this article.

On March 13, 1920, a gale struck to the north of the San Francisco Lightship station. Heading from San Francisco to Reedsport, Oregon, the 34-year-old Ituna was caught in the storm. As the sea raged, Ituna's seams split open and the forward hold flooded, plunging the ship bow first to the bottom of the ocean. It took only ten minutes for the ship to sink. Twelve of the fourteen crew members escaped, struggling for hours to keep their lifeboat afloat on the harrowing trip to the San Francisco Lightship. Two crew members, trapped in their bunks, went down with the ship.

Courtesy of NOAA and Teledyne SeaBotix – Anchor next to ship hull looking towards the stern

Courtesy of NOAA and Teledyne SeaBotix – Steering helm head close up

Courtesy of NOAA and Teledyne SeaBotix

Based on historical research and the help of multibeam and side scan sonar expert Gary Fabian, Robert Schwemmer was fairly confident he had found Ituna resting in approximately one hundred meters of water. But he needed to verify his assumptions with concrete evidence and document the site. Schwemmer organized an expedition aboard NOAA's research vessel Fulmar. The team of archeologists selected a Teledyne SeaBotix vLBV300 for the job. The ROV's small size would allow the team to safely penetrate the wreck and document the inside of the ship. NOAA typically uses larger ROVs to handle the swell and currents found in the coastal Pacific Ocean, but a larger ROV would have a high risk of damage and entanglement inside the shipwreck.

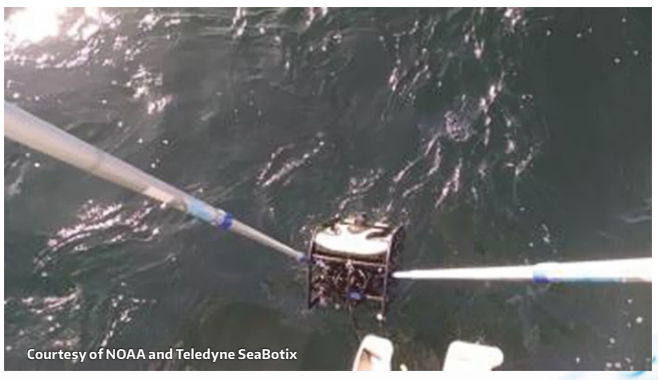
The vLBV's powerful vectored thrust was more than sufficient to handle the one to two knot tidal current in the area without the need for a cumbersome clump weight, which simplified the operation of the vehicle. The ROV was deployed and retrieved manually using simple boat hooks, eliminating the need for powered winches or A-frames.

ROV SETUP ABOARD THE RESEARCH VESSEL

Inside the research vessel's dry lab, the ROV pilot was able to follow directions from the archeologists while looking at real time HD video from a DEEPSEA Power and Light Multi SeaCam camera mounted on the ROV. The work area was carefully prepared for a successful operation. The pilot navigated the ROV while communicating with a VHF radio to the Captain, who was free-boating above the wreck. A deckhand managed the tether. A Tritech MicronNav ultra-short baseline positioning system (USBL) was used to track the ROV position with respect to the wreck, as well as the ship's position with respect to the ROV. The visualization and recording software, SeanetPro, displayed the relevant information on an overlay of the ship's drawing.

This screen was made available to the Captain to keep the research vessel at a proper location and orientation to avoid damage to the tether. In this configuration, the amount of tether subjected to the current was minimized by having the research vessel free-boat as directly as possible above the ROV. The tension in the tether catenary tends to pull the ROV up, so the vLBV300's two vertical thrusters worked constantly to keep the ROV on the wreck.

Meanwhile, in another area of the research vessel, archeologists were taking notes while looking at the real time HD video feed from the ROV on a large flat screen monitor.



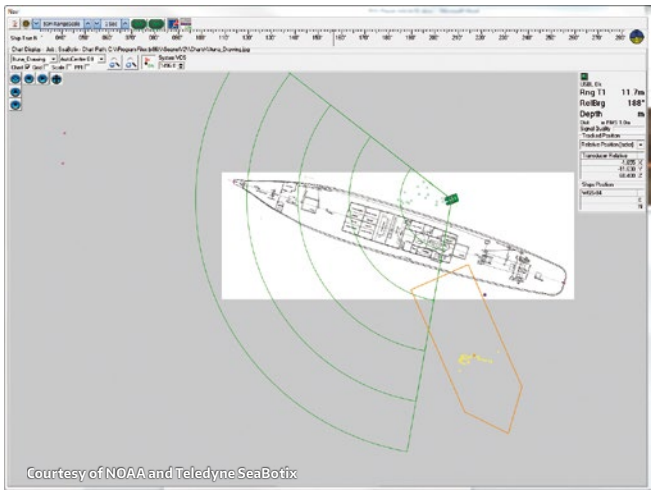
Courtesy of NOAA and Teledyne SeaBotix

DATA COLLECTION

The main sensor on the ROV was the HD video camera. HD video offers the best detail when visibility cooperates. The vLBV was reconfigured several times during the expedition to change the sensor payload. Imaging sonars mounted on the vLBV were used to measure the beam and length of the shipwreck and other construction features that archeologists then matched against the ship design drawings as identification evidence.

A dual frequency M900-2250 sonar from Teledyne BlueView provided details within ten meters range. A Kongsberg Mesotech M3 sonar was used at longer range to measure the overall length of the ship, and a Tritech Gemini imaging sonar provided general navigation and orientation. The ROV itself contains internal sensors such as water temperature, depth, magnetic heading, pitch and roll angles, camera tilt angle, light intensity, thruster RPM, etc. All the data is centralized and recorded synchronously along with the ROV, the ship position, and the main video feed. This allows all information to be available when reviewing a single recording.

In addition to the main ROV camera, a GoPro® camera was mounted looking straight down. The GoPro camera insured that the area in the blind spot below the ROV was recorded. Often, key artifacts or features can be found while reviewing the footage from the secondary camera that were missed by the main camera.


Courtesy of NOAA and Teledyne SeaBotix

ABOVE AND AROUND THE WRECK

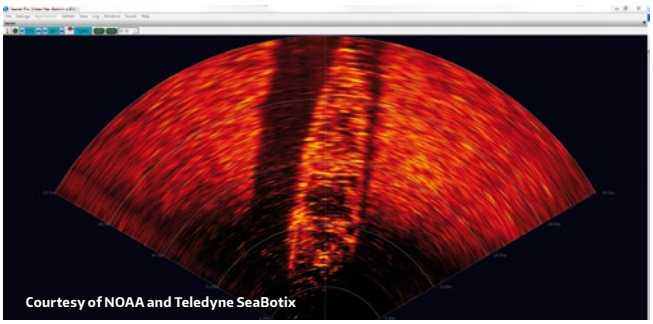
Flying the ROV above and around the shipwreck revealed the diverse marine life that now occupies the habitat created by the wreck. Large features of the ship could also be seen and identified. Features such as the Ituna's signature ship bow, its triple expansion steam engine, and its elliptic stern and rudder were all visible.

WRECK PENETRATION

After nearly 100 years underwater, shipwreck artifacts and features had become camouflaged. Flying above the wreck revealed a dull pile of disorganized debris. The only way to extract more information was to penetrate the hull and get close to the artifacts. Below deck, with proper lighting, the nimble


Courtesy of NOAA and Teledyne SeaBotix

Courtesy of NOAA and Teledyne SeaBotix


Courtesy of NOAA and Teledyne SeaBotix

vLBV was able to follow the engine room ladder and provide close up imagery of the cargo, which happened to be bags of concrete. When the ship sank, the concrete set. Over time the bags decomposed, but the concrete still held its original shape. Even the bronze steering helm, found in remarkably good condition, was invisible when looking from above deck.

CONCLUSIONS

NOAA's archeologists capitalized on the small size, speed and maneuverability of the Teledyne SeaBotix vLBV300 to capture real time high definition video of the inside of the 129 year old shipwreck Ituna. The operation was completed quickly and allowed a maximum amount of dive time due to the ease of deployment while free-boating without the use of a powered winch, cumbersome A-frames, or clump weights. USBL tracking of the ROV with respect to the deployment vessel and the overlay drawing of the ship were critical elements of the successful operation. The research vessel's Captain and ROV pilot were able to position the vessel, ROV, and tether appropriately for safe shipwreck penetration with low risk of entanglements.

The shipwreck was positively identified with HD video and sonar imagery through the Ituna's unique hull features. Several artifacts inside the shipwreck were documented in detail because the ROV could safely get through structures and debris below deck.

Throughout the expedition, the ROV was reconfigured several times with the most appropriate sensors for each mission, highlighting the capability and adaptability of the MiniROV system.


Courtesy of NOAA and Teledyne SeaBotix – Stern starboard profile view from seabed


Courtesy of NOAA and Teledyne SeaBotix


Courtesy of NOAA and Teledyne SeaBotix – Ladder going down to the engine room


Courtesy of NOAA and Teledyne SeaBotix – Cooking Pan rear view


Courtesy of NOAA and Teledyne SeaBotix – Trawl cable reels loaded with cable

OCEANA SUBSEA

REMOTELY OPERATED VEHICLE OPERATIONS

PROFILE

By Scott Freeland, Director, Oceana Subsea Ltd and Gad Habiby, Director, Oceana Subsea Ltd

It's an auspicious occasion: we are very proud to announce the news that Oceana Subsea Ltd – a newly formed ROV operating company – is open and ready for business. Oceana is currently offering a wide range of products and services, including ROV operations, personnel, tooling, survey equipment, and project management to our clients. However this list of services shall no doubt grow as the company evolves.

Oceana was founded with the aim of providing personal, responsive and cost effective solutions to our clients. The long term vision for the company is very simple: we want to provide all of our clients with commercially attractive equipment, fully furnished to accommodate each specific project's requirements.

Furthermore, we competently carry out any and all aspects of the job, no matter how large or small, or where in the world we are required to be. We work with skilled personnel, a positive attitude and offer a direct line of communication with senior management. Also, we passionately believe that by providing these services we can deliver a client-orientated and personalised service. This enables us to make decisions in line with critical project operations and timelines.

What's more, we can offer certified industry expertise. Oceana Subsea Ltd is owned, managed, and operated by former ROV operations and survey personnel. Each of the directors has over 20 years of industry knowledge, working both on and offshore. With this knowledge we are well equipped to provide support and an intimate understanding of all ongoing projects to each of our clients. We fully understand the day-to-day challenges faced by both our clients and the main contractors, and it is always our aim to provide additional support services to all of our associates whilst undertaking projects in challenging environments.


Courtesy of Oceana Subsea.


Courtesy of Oceana Subsea.


Courtesy of Oceana Subsea.

Courtesy of Oceana Subsea.

Because of these challenges – and our deep experience in the industry – Oceana has a very pragmatic approach to its contracting principles, and we will always endeavour to ensure that our contracts work for our clients as well as for ourselves. We apply as much detail in the provision of the contract -to ensure that it's correct for both parties – as we do to the delivery of the project itself.

Of course, in order to deliver such a high standard of work we need to incorporate the best tools. For this reason Oceana is utilising the highly successful Triton XL as our main workclass ROV system. We currently have our first system ready for mobilisation on our maiden project, which will take place in January of this year. This shall include a suite of survey sensors and tooling equipment. In conjunction with this mobilisation, we are also working on a second system which will follow shortly thereafter.

Within the next 18 months Oceana Subsea Ltd is actively pursuing options to purchase new equipment. This will be done with support from our suppliers, and in conjunction with the needs and requirements of our clients. We intend to grow the company with a view to long term sustainability. We want all of our current and future clients to know and understand that Oceana is in the industry for the long haul, and we are not here just to make a quick buck.

With this is mind, we hope to become known for our open, honest, and transparent approach to business, and firmly believe that with this attitude we shall attract new customers while maintaining our existing client base. Together we will grow, adjust, and further enhance our working relationships.

For further information please contact either Scott Freeland or Gad Habiby:
scott@oceanasubsea.com
gad@oceanasubsea.com

2016 MATE ROV COMPETITION

FROM THE GULF OF MEXICO TO JUPITER'S MOON EUROPA: ROV ENCOUNTERS IN OUTER *(AND INNER)* SPACE

As part of the ROV Competition MATE CENTER has issued a request for proposals (RFP) for a first-of-its-kind, dual purpose and single launch remotely operated vehicle that can operate in the harsh environments of both the deep ocean and outer space. MATE CENTER is looking for a machine that can cover a range of operations including a mission to Jupiter's Europa, recovery of critical equipment from the seabed off the Gulf of Mexico, and testing the health of deepwater corals.* Specifically, scientists and engineers at these organizations are in need of a robot that can 1) survive transport to Jupiter's moon Europa and operate in the ocean under its ice sheet to collect data and deploy instrumentation; 2) find and recover critical equipment that sank in the Gulf of Mexico after a recent series of testing programs; 3) collect samples and analyze data from oil mats located in the northern Gulf of Mexico to determine their origin ; 4) photograph and collect samples of deep-water corals to assess their health post-Deepwater Horizon oil spill; and 5) prepare a wellhead for decommission and conversion into an artificial reef.
Before launch and operations in inner and outer space, the robot must complete a series of 'product demonstrations' staged in the 6.2-million gallon, 40-foot deep Neutral Buoyancy Lab (NBL). (Depth requirements vary depending on robot class; see specs below.) Companies that successfully complete the product demonstrations and deliver exceptional engineering and communication components – technical documentation, technical sales presentations, and marketing displays – will be awarded the contract.

DESIGN BRIEF

Below is a summary of the product demonstrations organized by competition class. Unlike 2015, the product demonstrations will not be separated into different runs; all five product demonstrations will be accomplished in one product demonstration run. Successful applicants will need to present ROVs which can perform the following tasks:

EXPLORER Outer Space: Mission to Europa

- Measure the temperature of venting fluid;
- Determine the thickness of the ice crust using pressure measurements;
- Determine the depth of the ocean under the ice using pressure measurements;
- Connect the Environmental Sample Processor (ESP) to the power and communications hub;
- Retrieve the ESP's cable connector from the elevator;
- Lay the ESP cable through three waypoints;
- Open the door to the port on the power and communications hub;
- Insert the cable connector into the port on the power and communications hub.

Inner Space: Mission-critical equipment recovery

- Survey the seafloor to find and identify mission-critical NASA equipment;
- Place the equipment in a collection basket for retrieval by a crane at the surface.

Inner Space: Forensic Fingerprinting

- Collect and return two oil samples to the surface;
- Analyze a gas chromatograph of each sample to determine its origin.

Inner Space: Deepwater Coral Study

- Photograph corals and compare the images to previous years to assess their condition;
- Collect coral samples and return them to the surface for analysis.

Inner Space: Rigs to reefs

- Attach a flange to the top of the wellhead;
- Secure the flange to the wellhead with two bolts;
- Install a cap over the flange;
- Secure the cap to the flange with four bolts.

On behalf of ROV Planet we'd like to communicate how excited we are to see this year's entries, and the potential applications of your hard work into real-life scenarios, where ingenuity and proven solutions are sorely needed. We look forward to seeing the final submissions, and best of luck for the 2016 MATE ROV Competition!

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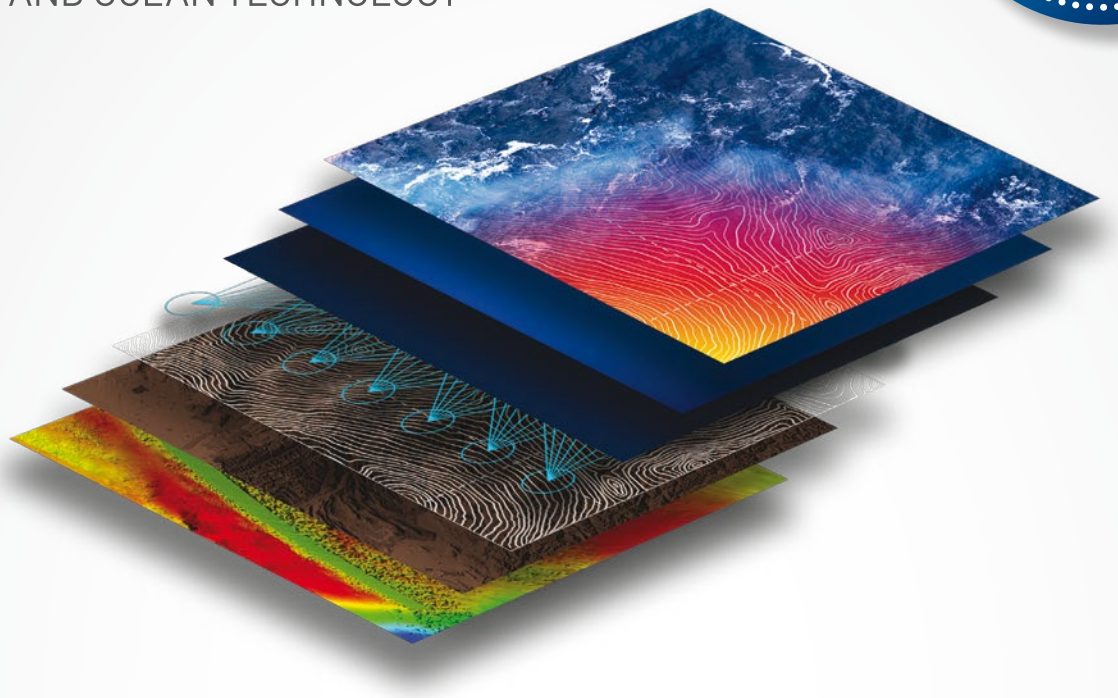

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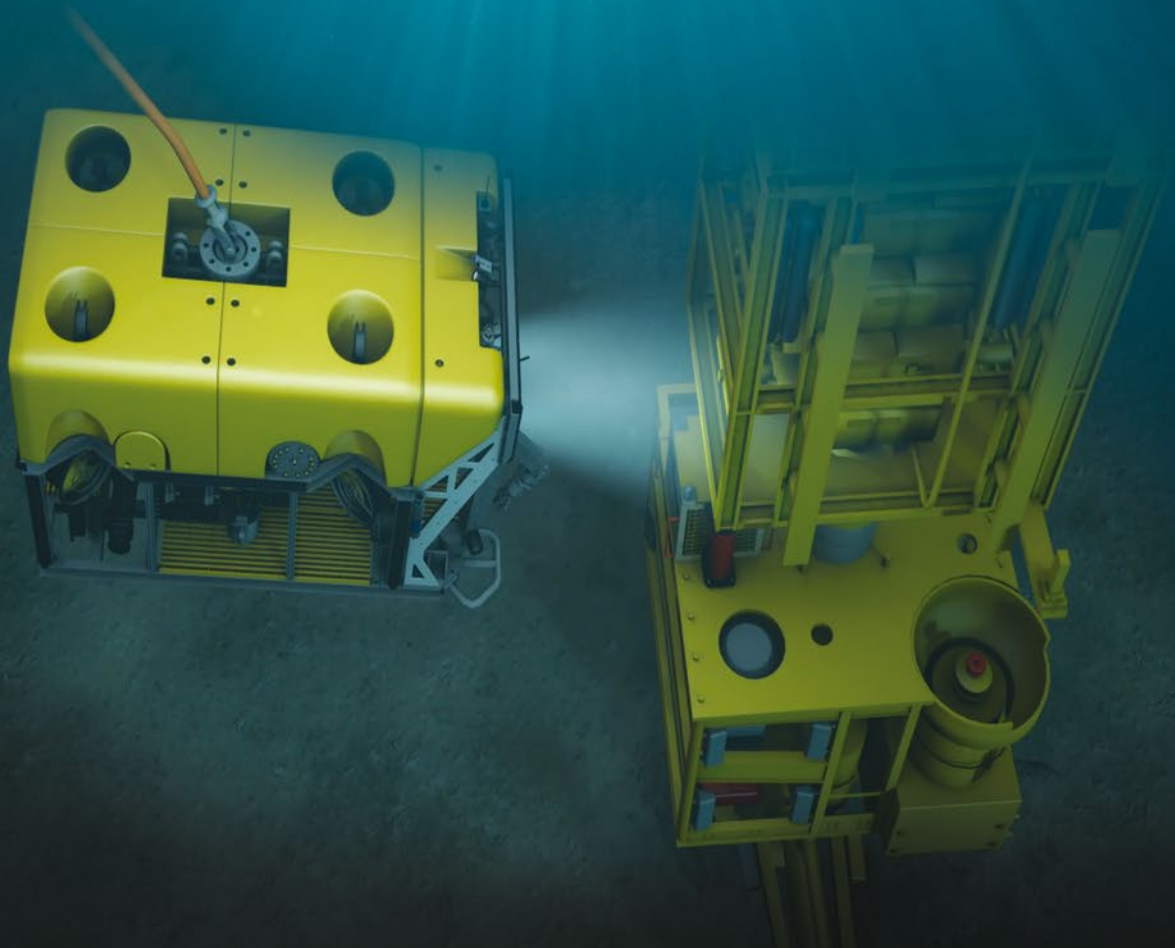

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