MARINE TECHNOLOGY REPORTER

January/February 2015 www.marinetechnologynews.com

Unmanned Vehicles

Arctic
Efficient Under Ice

AUVs
Autonomy Grows

ROVs
Evolving Missions

Floating Production Systems
Impact of $50 Oil

100+ Industry Applications

22 Available ROV Accessories

5,000+ Accessory Combinations

3,000+ Owners & Operators

15 Years in Business

1 Choice

VideoRay

CONFIDENCE UNDERWATER

www.videoray.com

The World's Cold-Ocean Laboratory™

Ocean observation! Remote sensing! Ice surveillance! Communications and navigational systems! Autonomous underwater vehicles! Marine simulation...

These are just some of our areas of expertise and why Newfoundland and Labrador is *The World's Cold-Ocean Laboratory*.

We are also home to:

- One of only two full-motion bridge simulators in the world;
- An offshore engineering basin that can create waves up to three-feet high, houses a 200 meter tow tank and has the world's longest ice tank; and,
- An ocean and naval architectural engineering program which is rated among the best in North America and is the only cooperative program.

Our expertise in ocean technology is making waves globally and why we have been chosen to host some of the world's premier oceans and Arctic conferences -- including the 2016 Arctic Technology Conference.

Come join us in Denmark as we set the stage to host ATC 2016 on *Canada's Eastern Edge™*. For more information email: Oceantech@gov.nl.ca or online at BTCRD.gov.nl.ca

Newfoundland Labrador
CANADA

January/February 2015

Contents

Volume 58 • Number 1

(Photo Credit: Peter Kimball, WHOI)

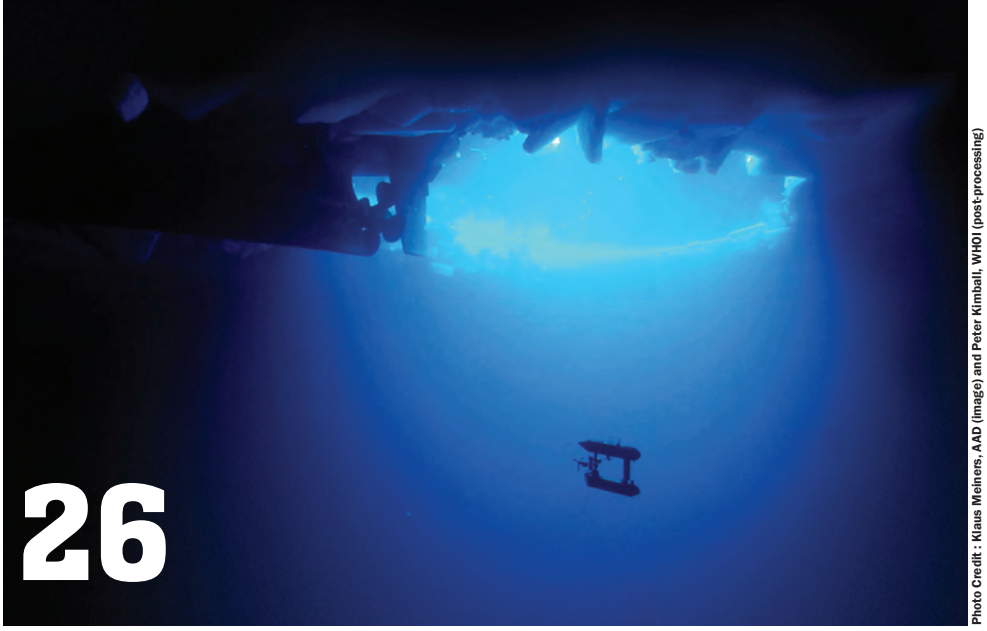


Photo Credit : Klaus Meiners, AAD (image) and Peter Kimball, WHOI (post-processing)

On the Cover

Photo Credit: Kongsberg

Photo Credit: Videoray

Mission-ready?

130 hours spent grant writing
3 man-months spent qualifying your vendors
2 man-years spent designing your underwater vehicle
3 man-years spent building your underwater vehicle
1,187 hours spent testing your underwater vehicle
24 hours spent in silent prayer
6 hours spent steaming to your first deployment

Now is no time to be second-guessing your vehicle's navigation system.

Be fearless with Teledyne RDI!

When it comes to safely navigating the underwater environment, there's simply no substitute for experience. Since 1993, Teledyne RD Instruments has been the industry's leading manufacturer of **Doppler Velocity Logs** (DVLs) for precision navigation on board AUVs, ROVs, and surface vessels around the world.

With over 3000 DVLs delivered to date, and tens of thousands of hours of flawless operation, it's no wonder that Teledyne RDI's DVLs have been specified on over 95% of the world's AUVs that require navigation assistance.

Learn why "The DVL is in the Details" at:
www.rdinstruments.com/dvl-stats

TELEDYNE
RD INSTRUMENTS
Everywhere**you**look™
www.rdinstruments.com

January/February 2015

Contents

Volume 58 • Number 1

Image above: DeepOcean operator preparing a WCROV for IMR operations, courtesy DeepOcean.

Five Minutes with ...

Subsea Construction

Case Study

Region Report: Newfoundland & Labrador

TELEDYNE SEABOTIX

World Leading MiniROV Manufacturer.

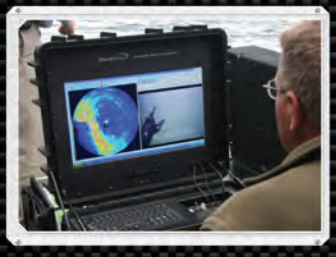
MiniROVs For Professionals

Little Benthic Vehicles

LBV150/200-4 defining portable ROV capability

Environmentally hardened and proven MiniROV system

LBV300-5 versatile dual vertical thruster ROV system



INC - intuitive, fully Integrated Navigational/Control Console

Industry Benchmark

Teledyne SeaBotix, Inc. leads the industry with the most comprehensive and capable MiniROV solutions.

Products range from the shallow water LBV150-4 systems, to the unmatched performance of the vLBV300, to the exceptional stability of the LBC.

A diverse suite of systems for demanding professional applications including military, police, commercial, scientific, aquaculture, hydro and more.

www.SeaBotix.com

(Photo Credit: Peter Kimball, WHOI)

www.marinetechnologynews.com

NEW YORK
118 E. 25th St., New York, NY 10010
Tel: (212) 477-6700; Fax: (212) 254-6271

FLORIDA
215 NW 3rd St., Boynton Beach, FL 33435
Tel: (561) 732-4368; Fax: (561) 732-6984

PUBLISHER
John C. O'Malley
jomalley@marinelink.com

Associate Publisher & Editor
Gregory R. Trauthwein
trauthwein@marinelink.com

Web Editor
Eric Haun
haun@marinelink.com

Contributing Editors
Capt. Edward Lundquist, USN (Ret.)
Claudio Paschoa
William Stoichevski

Production Manager
Irina Tabakina
tabakina@marinelink.com

Production & Graphic Design
Nicole Ventimiglia
nicole@marinelink.com

Sales & Event Coordinator
Michelle Howard
mhoward@marinelink.com

Manager, Public Relations
Mark O'Malley
momalley@marinelink.com

Manager, Information Technology Services
Vladimir Bibik
bibik@marinelink.com

CIRCULATION
Kathleen Hickey
mtrcirc@marinelink.com

ADVERTISING
Vice President, Sales and Marketing
Rob Howard
howard@marinelink.com
Tel: (561) 732-4368 • Fax: (561) 732-6984

Advertising Sales Manager
Lucia M. Annunziata
annunziata@marinelink.com
Tel: (212) 477-6700 • Fax: (212) 254-6271

Mike Kozlowski
kozlowski@marinelink.com
Tel: (561) 733-2477 • Fax: (561) 732-9670

Japan
Katsuhiro Ishii • *amskatsu@ dream.com*
Tel: +81 3 5691 3335 • Fax: + 81 3 5691 3336

Gregory R. Trauthwein
Associate Publisher & Editor
Email: trauthwein@marinelink.com

Hitchin' a Ride

Vehicles. Front to back, top to bottom, this edition revolves around unmanned underwater vehicles, the means and method which allow many of you to work, study and evolve in the underwater world. In this edition we offer fresh perspective from a broad swath of stakeholders that are directly involved in the evolution of UUVs, from those who conceive and create them, to those that use them and continually push the operational envelope of capability.

I am thrilled to welcome **Kira Coley** as a new and regular contributor to our pages, print and electronic. This month Kira was tasked to report on one of the most interesting and challenging areas of subsea exploration: the use of AUVs in and around Polar Science. Her story starts on page 26.

Speaking of Polar Science and the Arctic, we present here a 13-page special section on the companies, the organizations, the scientists and the "Arctic Experts" from what many consider to be the gateway to the Arctic, Newfoundland & Labrador, Canada.

I have a long and strong relationship and affinity for the professionals from Newfoundland & Labrador. Not only are they some of the most hospitable people on the planet, they consistently are forthcoming and available to discuss in detail their various endeavors in the name of science, commerce and defense. The section starts out on page 34 with the feature "The Path to the Arctic."

Finally, a sincere thanks to the executives in the AUV and ROV sectors that took the time to participate in the AUV (p. 14) and ROV (p. 48) "Roundtable" discussions. As nearly everyone in this business is 'global and mobile,' it becomes increasingly difficult to gather leaders together in a meaningful way to discuss the burning topics of the day. Our visit with this cumulative leadership group, I hope, delivers to you some fresh insight on the pace, direction and developments coming soon in the subsea vehicle market.

MARINE TECHNOLOGY REPORTER
www.marinetechnologynews.com
Vol. 58 *No. 1*
ISSN 1559-7415
USPS# 023-276

118 East 25th Street,
New York, NY 10010
tel: (212) 477-6700
fax: (212) 254-6271

Marine Technology Reporter ISSN 1559-7415 is published monthly except for February, August, and December by New Wave Media, 118 E. 25th St., New York, NY 10010-2915. Periodicals Postage at New York, NY and additional mailing offices.

POSTMASTER: Send address changes to Marine Technology Reporter, 850 Montauk Hwy., #867, Bayport, NY 11705
Postmaster send notification (Form 3579) regarding undeliverable magazines to Marine Technology Reporter, 850 Montauk Hwy., #867, Bayport, NY 11705

Publishers are not responsible for the safekeeping or return of editorial material.

Member
BPA WORLDWIDE BUSINESS

Subscription:
To subscribe please visit
www.marinetechnologynews.com

The World's Leading ROV Manufacturer

SEAEYE LEOPARD

- Depth 1000 m / 2000 m / 3000 m
- Forward thrust 493 kgf
- Payload up to 275 kg

See us at:

SSTB Booth 1029

ocean business 15 Stand Q6

www.seaeye.com

SAAB TECHNOLOGIES SAAB

Impact of $50 Oil & Petrobras Implosion

on Contracting in the Floating Production Sector

By Jim McCaul

The drop in oil/gas prices and ongoing implosion in Petrobras have combined to create a perfect storm in the deepwater sector. More than 170 projects involving oil production floaters and 35 floating liquefaction projects are in the planning stage. But oil company capital budgets are being trimmed to offset the downturn in revenue and investment decisions are being deferred until oil pricing rebounds -- and the investigation involving Petrobras is impacting its ability to order new production floaters.

While this perfect storm is clearly causing anxiety throughout the deepwater supply chain, it is a short term event – a bump in the road, in our view

The recent drop in oil prices clearly lowers near term cash flow and impacts the ability to fund capital spending. But investment decisions in major offshore projects are based on a long view of oil and gas prices. No one expects oil and gas prices to remain at the level they have dropped to over the past few months. The futures market, for example, is pricing crude eight years out at $25 more that the current spot price. Demand and supply fundamentals have not really changed. What we have is a short term out-of-balance in supply and demand. This will self-correct. The question is when (not whether) prices will rebound to a higher level.

As for Petrobras, the company will sooner or later resolve its financial and contracting issues. Petrobras is a powerful company with 14 billion barrels of proved oil reserves. It is a technology leader in the deepwater sector. The issues that caused the implosion will be resolved and the company will get back to implementing its business plan to grow oil production over the next five years. For starters, within the next few weeks Petrobras will likely lift the constraints imposed on who can bid for contracts. Prohibiting virtually all of its major local suppliers (plus SBM) from bidding on new contracts is hurting Petrobras as much as (maybe more than) the targeted companies. Common sense dictates it's time to get on with normalizing business.

The perfect storm will also not cause the market in 2015 to come to a standstill – like what happened in 2008/09.

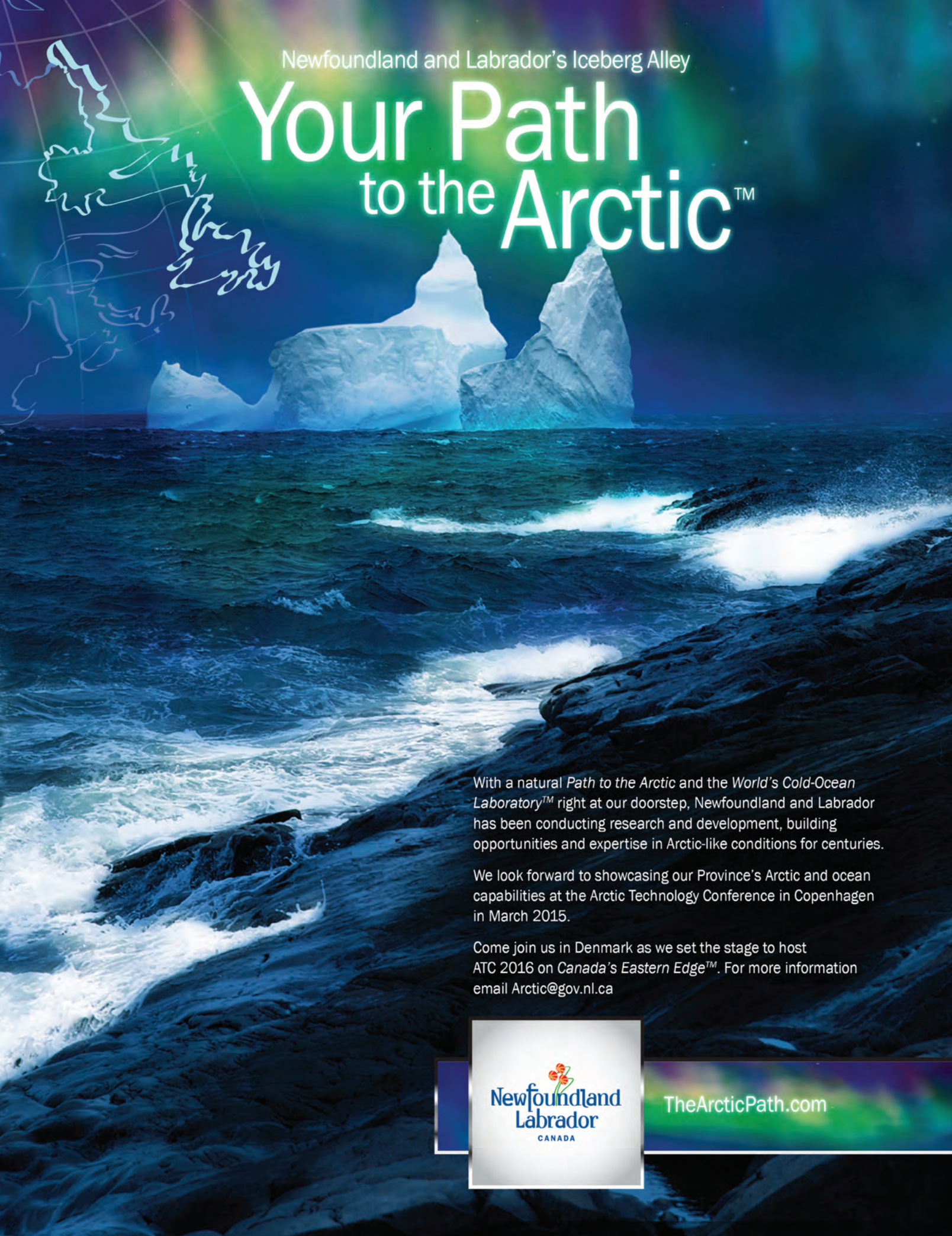
Our analysis indicates that, while the near term market has clearly taken a hit from oil pricing and Petrobras problems, things are not as bad as they appear. Unlike 2008/09, when the financial collapse caused a hiatus of 12 months in orders for floating production equipment, floater contracts during 2015 will not dry up. More than a dozen floating production projects in the advance planning stage have reasonable likelihood to move to EPC contracting for production facilities within this year. These projects are likely to produce orders for 3 to 5 FPSOs in Brazil, 2 FPSOs in Africa, an FLNG in Africa, a production semi in the GOM and several FSOs in SE Asia – all within 2015. Details for 2015 expected orders are in the January IMA/World Energy Report.

But the pressure on reducing project cost will be intense over the next year at all levels of the floater supply chain -- and, as workload slows, the balance in negotiating power in EPC contracts will tilt in favor of field operators. This will force suppliers to be more flexible in pricing, cause profit margins to fall and require expenses to be trimmed wherever possible.

Get the Report

For information about the WER reports please see https://www.worldenergyreports.com/reports.

Or if you would like to discuss this note, please contact Jim McCaul at imaassoc@msn.com.


Newfoundland and Labrador's Iceberg Alley
Your Path to the Arctic™
With a natural *Path to the Arctic* and the *World's Cold-Ocean Laboratory™* right at our doorstep, Newfoundland and Labrador has been conducting research and development, building opportunities and expertise in Arctic-like conditions for centuries.
We look forward to showcasing our Province's Arctic and ocean capabilities at the Arctic Technology Conference in Copenhagen in March 2015.
Come join us in Denmark as we set the stage to host ATC 2016 on *Canada's Eastern Edge™*. For more information email Arctic@gov.nl.ca
Newfoundland Labrador
CANADA
TheArcticPath.com

Tim Taylor, Tiburon Subsea

Tim Taylor is an accomplished ocean explorer, businessman and entrepreneur. He has owned and operated his own companies in the marine industry for 30 years, work which has always included applying innovative diving technologies, and he has developed a reputation for leading underwater expeditions that add to the scientific knowledge in the fields of oceanography, archaeology, biology and geology. His explorations have taken on many forms, but pushing the boundaries with new technology has been a consistent driving force, and the use of Autonomous Underwater Vehicles (AUVs) is a logical path in his underwater exploration. His most recent accomplishment was the discovery, exploration, and documentation of the WWI submarine USS R-12 that was lost in WWII in 600 ft. of water. A Fellow in the Explorers Club, in 2008 he was awarded the clubs prestigious Citation of Merit in recognition of his explorations.

How did you get involved in this industry?

I have been interested in exploration my entire life, and it has been a series of progressive steps from physical exploration taking me to limits and wanting to go further. My role has always been to facilitate the actual exploration. Whether it was for shark biologists, geologist, archaeologist or the film industry we provided the skills and equipment to get on location and accomplish the task. Years of support in underwater operations and explorations aboard my company's research vessels has given us the hands-on field knowledge of a broad base of disciplines. When opportunity was presented to go deeper and use the latest technology, I was always at the front of the line. Managing and mitigating risk while executing the mission on the high seas was my way of life for 30 years. To me, this new company was a logical career progression.

What happened to your research vessel?

The U.S. Navy Warfare Center made me an offer I could not refuse. They needed a good support platform to test AUV's and ROV's. Over the years we totally re-designed and added many special features into the "Tiburon" that turned her into a specialized exploration platform. The work we were performing on the Tiburon was exactly what the Navy was looking to accomplish. She was a tried and true platform. After 18 years of adventures form Cuba, Bahamas, Mexico and extended muli-week expeditions 200 miles offshore I could not think of a better place for her next mission.

What is Tiburon Subsea?

Tiburon Subsea is a new company that is structured to scale and fill the technical equipment needs of the marine industry, with our focus on Autonomous Underwater Vehicles. That means investment and infrastructure that allows the newest technology to finally gain the traction it requires to break

Integrated ROV and USV Solutions

We've got your survey solutions covered from above and below...

Unmanned Surface Vehicles

- Multibeam
- ADCP
- Lidar

- Bathymetry Survey
- Live HD Video
- Realtime Data

- Autonomous or Manually Controlled
- Cost Effective

Remotely Operated Vehicles

- Baseline Site Characterizations
- Ecological Monitoring
- 300m and 1000m Systems

- Integrated ROV Solutions
- Multitude of 3rd Party Options
- Saves Time and Money

Since 1982, Deep Ocean Engineering, Inc. has provided nearly 600 custom vehicle solutions worldwide. DOE's ROV and USV systems have been utilized in a broad range of industry applications and we are the only authorized service and parts provider for the Phantom™ ROV line. Deep Ocean Engineering, Inc. is committed to providing our customers a complete integrated solution to their demanding applications.

DEEP OCEAN ENGINEERING

www.deepocean.com

(Image: Tiburon Subsea)

OceanServer AUV for Tiburon

Tiburon Subsea took delivery of OceanServer IVER3-580 Autonomous Underwater Vehicle (AUV), the first of multiple vehicles being offered for rent to third party operators. Tiburon Subsea is implementing extensive vehicle specific AUV training programs and offering full operator support services with all its AUV rentals. Tiburon Subsea provides global underwater technology rental, training and support services with a focus on AUVs. The IVER3-580 is equipped with L3 Klein 3500 bathymetric/side scan and Marine Magnetics-Explorer magnetometer.

out into the commercial sector. Going beyond military applications and making autonomous equipment available on a timely reliable basis is our focus. With these tools available to marine companies on a reliable basis, the possibilities and advantages will really be evident.

Describe Tiburon's current AUV fleet.

The first vehicle is off the line now; the next five systems are in the pipe line. We expect a total of six high-end 200m bathymetric, side scan with payload options that include magnetometer, camera, side scan sonar and bathymetric sonar by the end of the year. It should be said that every fleet needs operators. We are also developing training and certification programs along with field support that will allow us to put these systems in the hands of engineering companies with qualified personnel.

We understand that you have a plan for making AUV's quickly and easily accessible to an international clientele through your company's rental fleet, training programs and operators.

Client defined vehicles. We keep an open eye on the market needs as well as the businesses that are using our systems. We want to provide the equipment and payloads that the end client needs. In effect, the market will help define the specific equipment that we offer. Our future fleet makeup will be determined in large part by utilization. An example: if post disaster survey of waterways for obstructions is a strong demand, a fleet of smaller AUV's will evolve. Allowing one person/team to launch four to eight vehicles at one time. Think of the area that can be covered in a short time. When disaster strikes the faster a survey can be done, the faster recovery can begin.
Streamlining as much as possible so the marine service provider can focus on the job rather that the many details. No lead time, comprehensive training and continuing education, 24/7 field and technical support, redundancy, international equipment passports (carnets), bonds and insurance already in place are just a few of the benefits of contracting our AUV systems.

By market, what do you see as the big drivers for AUV use today and in the coming years?

Two words: Energy & Enviromental

What technologies do you think have helped to evolve the use and capability of AUVs the most in recent years.

Integration and miniaturization of payloads by third parties. Navigation solutions have allowed the smaller AUV's to evolve into practice tools. Overcoming navigation issues has always been a factor in all underwater robotic endeavors. We have several commercial navigation solutions that will be rolled out in near future that will be included in all our systems. In fact, with this in mind, we are future-proofing our fleet and building all our initial systems with 200m depth ratings and space to accommodate the added systems on the horizon.

TELEDYNE
MARINE INTERCONNECT SOLUTIONS

Making Connections in Harsh Environments

As a team, we provide the broadest range of high performance electrical, optical, and hybrid interconnect capabilities, optimized for use in mission-critical applications.

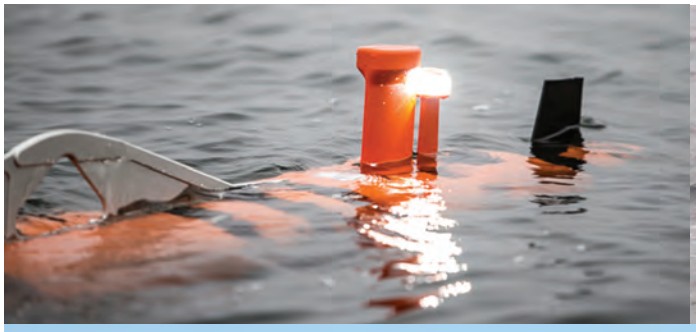
www.teledynemis.com
teledynemis@teledyne.com

DGO IMPULSE ODI PDM STORM CABLE

ROV image courtesy of NOAA Okeanos Explorer Program INDEX-SATAL Rev 02/14

AUV Roundtable

Autonomy Takes Off Underwater



By Greg Trauthwein, Editor

When it comes to autonomous operations, the underwater environment is arguably the most hazardous on the planet. To begin, there is simply a dearth of information regarding the world's oceans, a factor which naturally raises risk prospects. In addition, the effects of exposure of equipment to the harsh saltwater environment, varying pressures and uncertain weather raises the peril level even further.

Enter the Autonomous Underwater Vehicle manufacturers, a group of companies and professionals dedicated to delivering AUV technology that are intent on making the work on and below our oceans safer and more efficient. For insights on recently developments in the AUV sector, *MTR* reached out to several leading executives, including: **Rear Admiral Fred Byus**, USN (Ret.), Battelle; **Richard Mills**, Product Sales Manager for AUVs, Kongsberg Maritime AS; **Stefan Reynisson**, General Manager, Teledyne Gavia, and **Graham Lester**, VP Sales & Marketing, Hydroid Inc. for their insights.

Briefly describe your company's offering to the AUV market.

Reynisson, Teledyne Gavia

Teledyne Gavia provides turnkey solutions to customers undertaking a variety of tasks for military, commercial and scientific applications. The Gavia AUV can carry an array of sensors and custom payload modules that make it perfect for any research, monitoring or surveillance task where autonomy, cost and ease of deployment matters. Its modular design allows for rapid sensor reconfiguration and battery replacement.

Mills, Kongsberg

The Kongsberg Maritime AUV portfolio includes the HUGIN and MUNIN vehicles manufactured in Norway; the REMUS vehicles produced by Hydroid, a Kongsberg Maritime subsidiary in Massachusetts, and the Seaglider made by Kongsberg Underwater Technology Inc. based in Lynnwood, Washington. The HUGIN AUV System is renowned as the most successful and capable commercial AUV available to-

Image Credits: (starting top, rotating clockwise): Hydroid, Bluefin, Teledyne Gavia, Kongsberg.

Seeing is Believing.

Laser Data

Camera Data - Buoyancy Collar

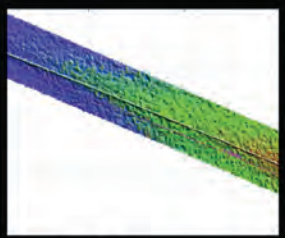
And, we'll make a believer out of you with C & C's AUV laser and mag capabilities.

For your total field development needs — from hazard surveys to as-laid survey and through your pipeline inspection needs — nobody provides a clearer picture of your pipeline than **C & C Technologies**.

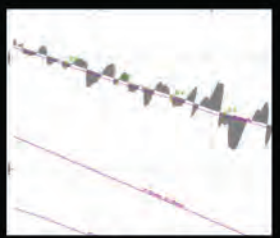
Now, with its **C-Surveyor**™ high resolution laser AUV and **C-Inspection**™ services, C & C provides the highest definition data available from an AUV — 29 profiles per second yielding over 40,000 data points per second at a resolution of 5mm x 5mm. C & C has the only AUV with laser and magnetic data technology. The AUV benefits are:

- Camera with photo mosaicking capabilities for analysis of pipe casing events, spanning and corrosion.
- GeoChemical suite for detection of CH4, CO_2, and PAH.
- Laser and Bathymetry systems for pipe-spanning and straightness measurements.
- Portability – to support your worldwide need.

From the water's edge to 10,000 feet subsea, **C & C Technologies** provides seafloor and infrastructure inspection services worldwide, with cutting edge technology that saves both time and money with unparalleled data quality.



Multibeam Data



Mag Data - Pipe Anomaly

C&C Technologies
SURVEY SERVICES

www.cctechnol.com/laser_auv

"For all three market segments, commercial, research and defense, the top three technologies driving the AUV market are autonomy, autonomy and autonomy."

Richard Mills, Product Sales Manager for AUVs, Kongsberg Maritime AS

KONGSBERG

All images to the left: Kongsberg Maritime

day. It has seen operations with survey companies and navies around the world, covering more than 700,000 line km of contracted commercial survey.

MUNIN is the latest offering from Kongsberg Maritime, combining the success and modularity of most body sections from Hydroid, with the proven positioning, control and payload sensor integration from the HUGIN system. One of the key benefits of MUNIN is the navigation and payload section that houses all of the key sensors and equipment. This enables operators to mobilize the vehicle without the need for calibration on site, as it is sent from the factory all set up and ready to go. The result is a compact AUV capable of a full range of commercial survey tasks including pipe tracking.

Byus, Bluefin

Bluefin Robotics is known for leveraging its mature vehicle technologies to provide customized autonomous underwater vehicles that solve our customers' unique challenges. Primar-

ily serving the global defense and commercial market sectors, Bluefin offers both survey class and inspection class AUVs of varying sizes, and works with its clients to identify and integrate application specific sensors onto its broad array of highly portable autonomous platforms to provide mobile and effective solutions. Bluefin is also growing its subsea power business, wherein we offer pressure compensated subsea power systems for everything from underwater sensors to subsea installations.

Lester, Hydroid

A subsidiary of Kongsberg Maritime, Hydroid is a customer-focused, engineering-based manufacturer of innovative, mature commercial underwater systems. We have extensive experience in the design, manufacturing and shipboard integration of AUV systems. REMUS AUVs provide innovative and reliable full picture systems for the marine research, defense, hydrographic and offshore/energy markets. Hydroid has experienced significant growth since its inception in 2001. With our growth, our product offerings have also expanded significantly. Not only do we offer the REMUS 100 AUV system - a robust, man-portable AUV for shallow water operation and the only combat proven AUV on the market - we also offer the REMUS 600, Remus 6000, launch and recovery systems, docking systems and support equipment. The REMUS 600 is the mid-range solution for rapid mobilization from vessels of opportunity and the REMUS 6000 is a deep ocean workhorse.

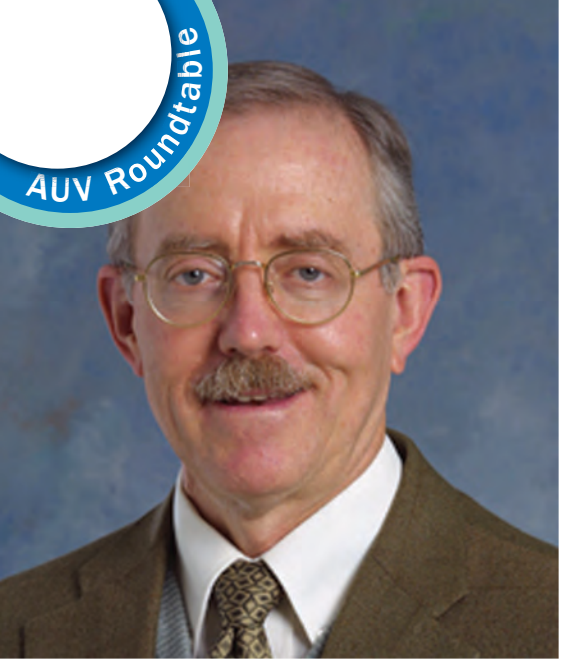
Describe the trajectory of AUV use over the past five years.

Byus, Bluefin

Broadly speaking, we are seeing a maturing demand signal from traditional application areas such as Mine Counter Measures or Geophysical Survey which would tend to indicate market acceptance of the technology as the business norm and therefore translate into higher vehicle counts as mainstream players enter those markets. On the other hand, we are also seeing an increasing number of adjacent market inquiries that are poised to drive innovation and new uses for our robots for many more years to come.

Lester, Hydroid

During the past five years, we have seen an acceptance of AUVs as standard tools rather than experimental curiosities. The use of AUVs by Navies for mine countermeasure operations is now commonplace throughout the globe. In the offshore survey industry, there has been an increasing acceptance



"Broadly speaking, we are seeing a maturing demand signal from traditional application areas such as Mine Counter Measures or Geophysical Survey which would tend to indicate market acceptance of the technology as the business norm and therefore translate into higher vehicle counts as mainstream players enter those markets."

Rear Admiral Fred Byus, USN (Ret.), Battelle

BLUEFIN ROBOTICS
A BATTELLE COMPANY

of AUV data for both survey and inspection operations. Oil company specifications are now requiring the use of AUVs for deepwater pipeline inspection – this was previously the preserve of ROVs. The scientific research community has also benefited from these vehicles. Precious and expensive vessel time can now be maximized for increased data gathering. Also, the first AUV underwater docking systems for Ocean Observatories are now a reality and allow for a sustained vehicle presence for many months.

Reynisson, Teledyne Gavia

The use of small, man portable AUVs in the Oil & Gas market has increased significantly over the past five years. AUV technology and its applications have been accepted and proven, as numerous offshore survey companies continue to have success in varying mission types, such as pipeline inspections, platform inspections, bathymetric surveys, as well as search and rescue operations. Use of the AUV in the Oil & Gas sector has expanded substantially. More and more applications have been tested and implemented using the AUV, providing an alternative to traditional methods such as ROV and towed systems.

Small, man portable systems in the defense industry continue to be on the rise. Use of AUVs for Mine Countermeasure missions, as well as Search and Rescue operations, has been widely accepted as the preferred method of operating in high risk waters. AUVs are also becoming more common for surveillance purposes.

Use of small, man portable systems in the scientific field is increasing in popularity. Hydrographic surveying, topography and under ice surveying are all areas in which AUV use has increased in the last five years. International partnerships and collaborations for scientific study increases each year, giving more researchers more access to AUVs, as well as hands-on experience. Deep water, as well as under ice water and terrain, were previously inaccessible for researchers.

researchers.

How would you describe the maturity of the AUV market today?

Lester, Hydroid

The AUV market has now passed its infancy and the expectations of customers are now focused on increased capabilities and payloads.

Reynisson, Teledyne Gavia

While the technology is improving at a very fast rate, the market is still in the growth phase of the maturity curve. The AUV market is predicted to see continued growth in upcoming years, and is not expected to saturate the market within the next decade. Utilization of underwater equipment for underwater exploration will continue to grow, with AUV technology serving as a primary driver in the expansion.

In your opinion what are the top technologies that are driving the AUV market further, faster, today?

Lester, Hydroid

The main drivers in the use of AUVs is greater persistence, increased autonomy and robotic perception, and the ability to launch and recover systems.

Byus, Bluefin

AUV's are a means to an end; the end, traditionally being data. Therefore the key to driving the market further lies in the sensors that are available in the market, and our ability to quickly and efficiently integrate new sensors and capabilities onto our platforms. While collecting the right data is essential, making the process robust and repeatable is also critical; hence Bluefin is working on a number of innovations within the field of autonomy to improve the efficiency of the man-machine workflow.

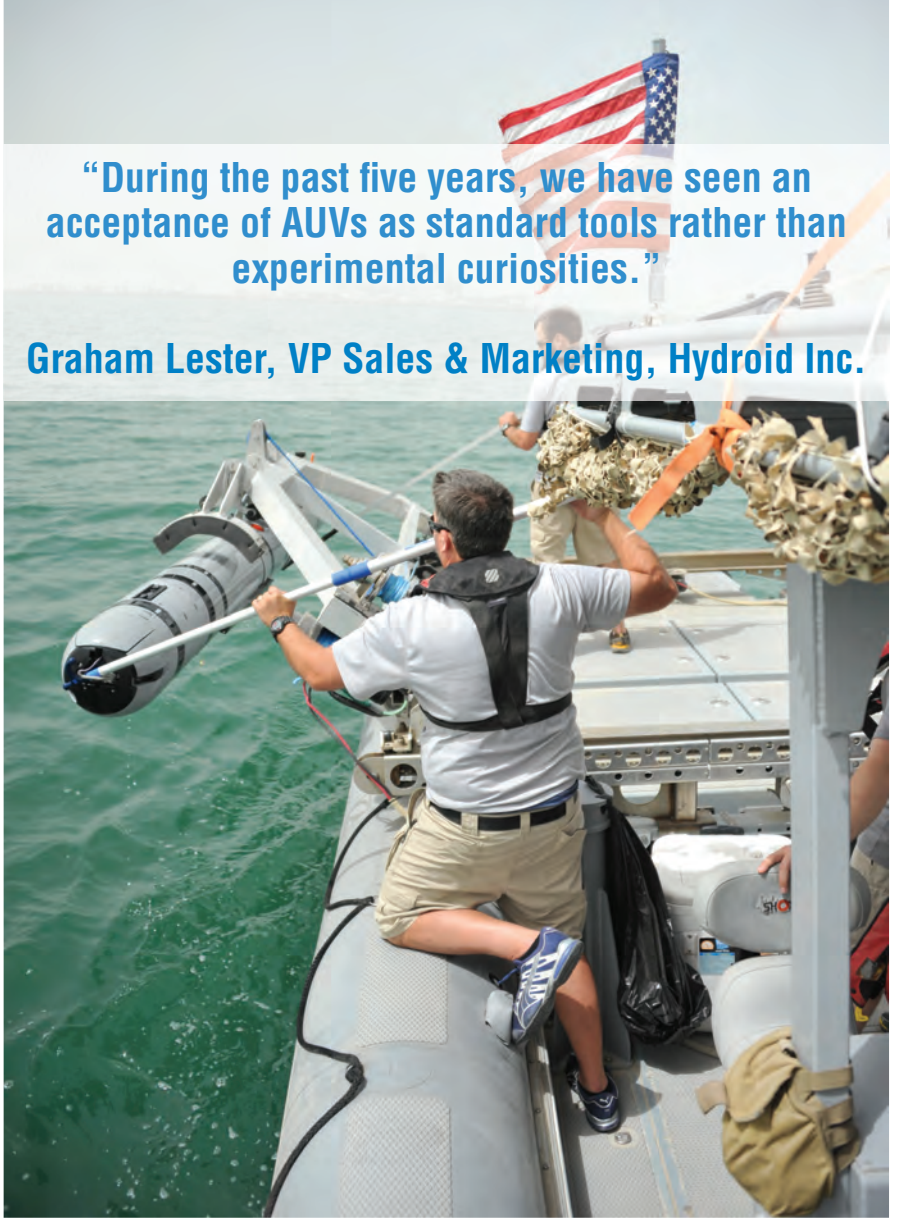
Mills, Kongsberg

For all three market segments, commercial, research and defense, the top three technologies driving the AUV market are autonomy, autonomy and autonomy.

New levels of autonomy are enabling AUVs to track pipes and collect data in real time. The vehicle controller reacts to inputs from the sidescan sonar or synthetic aperture sonar to track alongside the pipe. It also uses multibeam data to track overhead the pipe at very low altitude enabling the camera to capture images of the entire pipeline.

New levels of autonomy are enabling AUVs to travel to areas outside of areas where supervision can be guaranteed. For example, subsea residency requires an AUV to find and dock with a structure without interaction with an operator, with a 100% success rate.

New levels of autonomy are enabling



HYDROID
A KONGSBERG COMPANY

mission. The HUGIN AUV can be equipped with HISAS synthetic aperture sonar with automatic target recognition algorithms. The HISAS data is processed in real time on board the AUV and the ATR program detects and classifies mine-like objects. This data is then fed back into the mission controller, which autonomously re-plans the dive to photograph objects of interest providing visual identification for operators.

Reynisson, Teledyne Gavia

Modularity of sensors will be a key driver for the AUV market as new technology is coming at very fast rate as a complement to the growing underwater market. The modularity of the Gavia AUV allows for the incorporation of new technologies and sensors without having to procure a new AUV for incorporation, allowing the market users to upgrade to the latest and greatest technology as soon as it is commercially available. Increased positional accuracy that allows for improved data quality and better usage of the AUV in trying underwater conditions. New sonar technology is being applied to the smaller AUV market, allowing for a greater, more rapid expansion.

When we discuss ROVs & AUVs, we often discuss "getting the diver out of the water." From where you sit, what are the main market uses for AUVs today, and how (or is) that changing.

Lester, Hydroid

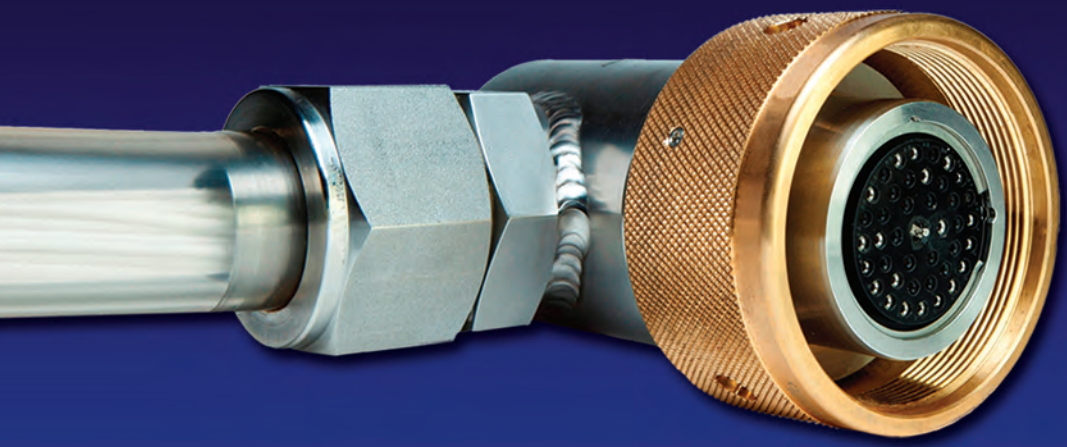
Both AUVs and ROVs provide safer, more reliable ways of performing underwater tasks than divers - releasing them from dull, dirty and often dangerous tasks to focus more specific, localized tasks.

Mills, Kongsberg

ROVs are most commonly used for tasks such as drilling support, pipe lay and inspection and life of field IRM functions. AUV operators compete for some traditional ROV work by offering lower cost and faster surveys. One example of this is pipeline survey.

The HUGIN and MUNIN AUVs can autonomously track a pipe in real time using sidescan sonar and multibeam echosounder. Elements of the data collected can be transmitted in real time to the operator via an acoustic link providing real

High Performance . . .
Under Pressure®



The new BIRNS Primum™ series is precision-engineered for the heaviest power, signal, high voltage and electro-mechanical applications, and trusted in some of the most rigorous underwater systems on the planet. Perfect for a wide range of solid cable types, it comes standard with open face pressure resistance to 6km. Pictured here with BIRNS' exclusive advanced electro-hydraulic connector adapter system for oil-filled cables.

BIRNS®

1720 Fiske Place, Oxnard, CA 93033-1863, U.S.A.
T +1.805.487.5393 • F 805.487.0427 • Toll-Free 1.888.BIRNS.88

www.birns.com

BIRNS is NAVSEA PRO-020 Certified;
Our Quality Management System is
ISO 9001:2008 Certified by DNV

"Modularity of sensors will be a key driver for the AUV market as new technology is coming at very fast rate."

Stefan Reynisson, General Manager, Teledyne Gavia

time confidence that the vehicle and sensors are performing properly. HUGIN and MUNIN can provide a comprehensive data set including bathymetry of the pipe trench, sidescan imagery of the surrounding seafloor and a photo-mosaic of the entire pipe length.

There are still tasks that an AUV cannot conduct where ROVs remain the tool of choice. For example, an AUV cannot manipulate a valve with the required level of real time control and supervision to meet legislative requirements.

Big picture, what signs or indicators do you monitor to gauge the future direction of the AUV market? What are those signs/indicators telling you now?

Byus, Bluefin

Operating primarily in the defense and commercial sectors, the short term indicators for our business are signaling some challenging times when we look at shrinking defense budgets and the current price of oil; however the long term viability of the AUV market is undeniable when we look at the global demand for energy and security. As our energy needs drive exploration and production into harsher environments and our security needs drive maritime operations into uncharted waters, AUV's will play an increasingly critical role in reducing the risk to human life, and increasing the efficiency with which we are able to ensure a safe and prosperous future for generations to come.

How is your company investing today in AUV technology?

Mills, Kongsberg

Kongsberg Maritime has a permanent R&D team that is always working on new vehicle behaviors and capabilities. New requirements are being identified by our customers all of the time. Our research and development team implement the commercially necessary new sensors and vehicle equipment. The team also works on future technology and capabilities that the market has not yet identified. The next generation of vehicles is always being dreamt of, along with new levels of autonomy to take AUVs where they have never been before.

Please provide one case study where your AUV system was deployed to complete an operation more safely and/or efficiently.

Mills, Kongsberg

One of our customers is using a HUGIN AUV for autonomous pipeline survey and inspection for an oil company. They have recently been working in very shallow water of about 10 m depth. The HUGIN has been operating completely autonomously, as the water is too shallow for the support ship. The shallow depth creates multipath issues for acoustic positioning and communications systems making it almost impossible to supervise the survey. There is no other way of surveying these particular pipes that would produce a similar data set.

The AUV tracks the pipes autonomously, based on the predicted location of the pipe. Once it has found the pipe using the synthetic aperture sonar, it tracks alongside collecting seabed imagery to detect freespans and visible buckling. It also uses the positioning data from this survey to create an a priori map on-board the AUV. This map is then utilized for the second part of the survey, which is conducted without recovering the AUV.

The second stage involves the HUGIN tracking overhead the pipe using the EM2040 multibeam echosounder. It follows the pipe collecting a photomosaic of the entire length of the tracked pipeline. During this stage it is also using a methane sniffer to help detect any leaks.

Byus, Bluefin

In 2014, the world bore witness to the tragic disappearance of Malaysian Airlines Flight MH370 over the Indian Ocean. The search effort immediately following the incident was critical to increase the chances of finding the airliner along with any potential survivors. The search required a deep diving AUV, and the US Navy called on Phoenix International to mobilize their Bluefin-21 to Australia. The entire Bluefin-21 Survey System was mobilized half way across the world within a matter of days, and set sail to the search area on board the ADV Ocean Shield within 10 days of being called to action. The Bluefin-21 surveyed 870 square km of the ocean floor over the course of 20 operational days and safely returned the data for analysis by the authorities on a consistent basis. Although the search for MH370 is still ongoing, I am proud of the contributions our technology made to the search effort – allowing for a fast, efficient and safe response to an emergency on a global scale.

DeepOcean

Deep Water Operations in Brazil

By Claudio Paschoa

DeepOcean was established in 1999 and is dedicated to subsea services and operations in deep waters, able to take on deep-water assignments anywhere in the world. The company is an integrated service provider for the subsea industry. DeepOcean has a global track record of subsea services including Survey and Seabed-mapping, Subsea Construction and Installation, Seabed Intervention, IMR, and Decommissioning. Since its entry into the Brazilian offshore market, DeepOcean has accumulated extensive experience in deepwater operation, having become a preferred partner to national operator Petrobras, which is one of the few super-majors still awarding long-term contracts for subsea IMR and subsea construction & intervention.

The DeepOcean Group itself was only established in May of 2011, through the merger of the survey, IMR and decommissioning services of DeepOcean, the seabed intervention company CTC Marine Projects and the towing and supply services of Trico Supply. These three divisions provide the company with a set of complementary skills and expertise, which in turn, have positioned DeepOcean Group as a worldwide provider of deep-water subsea construction services and operations.

Now operating as one company under the name DeepOcean, it offers five main service streams including Survey and Seabed-mapping, Subsea Installation, Seabed Intervention, Inspection, Maintenance and Repair (IMR) and Decommissioning. "DeepOcean came down to Brazil in the beginning of 2008 to establish an operational office. Our first challenge was to recruit the team for the offshore operation and the onshore organization. This was a new learning process for us trying to establish a new organization in a foreign country and trying to understand all rules and regulations that applied. But already in May of that year, Trico Marine came in and bought up the company just before the startup of our first contract with Petrobras," said Per Thuestad, Regional Manager for DeepOcean in Brazil.

In 2013 DeepOcean acquired a 50% interest in ADUS to form ADUS DeepOcean Ltd. ADUS DeepOcean's subsea 3D visualizations can be used to provide high quality 3D images of subsea structures such as offshore facilities, wind turbine foundations and seabed architecture. DeepOcean's robust services portfolio, combined with its modern fleet of wholly owned specialized vessels and large number of subsea assets, such as WCROVs and trenchers, have allowed DeepOcean to link important subsea maintenance and deep-water IMR contracts in Brazil. "Subsea operations are important to the group as they allow us to bring in vessels to Brazil which supports the rest of our operations as a local subsea company. DeepOcean has focused into a specialized subsea-centered business, and our experience in deep water has grown a lot in the last five years in offshore Brazil," said Thuestad.

DeepOcean has a number of state-of-the-art subsea service vessels, WCROVs and deep water Module Handling Systems specially set up to perform IMR work in Brazil. The vessels carry experienced offshore crew familiar with IMR operations and the majority of the crewmembers are Brazilians, which is vital to maintain high local content levels, which in turn facilitates securing contracts locally. High local content levels can even be found among shore-based engineers who work with operational planning and engineering of IMR operations. Globally, DeepOcean has more than 10,000 vessel days of IMR type operations, and the company is proficient in handling hundreds of call-offs per year under long- term contracts with oil & gas majors and super-majors in Brazil the North Sea, the GoM, APAC region and West Africa. Offshore Brazil, DeepOcean has been performing various construction and maintenance jobs in addition to typical IMR tasks. This is achieved by flexibly designed DP vessels using powerful Active Heave Compensated cranes, 2 or 3 WCROVs, and large deck spaces suitable for mobilizing the required equipment and products for the job. "All of our operators are Brazilian and it's been a main focus of our company to hire Brazilian staff to work in their own country. We understood that we could not compete in the local market with foreign staff operating our equipment. This meant developing a training program with several experienced instructors to teach our team here how to properly operate the equipment," said Thuestad.

Since 2012, DeepOcean has a contract to repair deep-water flexible risers serving various fields offshore Brazil. The company is providing a vessel equipped with an A-frame and WCROVs to recover to the vessel's deck, risers in need of repair. A team from a specialist riser manufacturer normally goes aboard to implement the repairs. The Norwegian-based contractor is currently bidding to provide further IRM vessels for projects offshore Brazil. Over time, the company hopes to replicate in Brazil, with Petrobras, its current arrangement with Statoil in the Norwegian sector of the North Sea, where it is supplying three vessels for IRM/intervention duty on long-term contracts.

In September 2013 DeepOcean and CBO (Companhia Brasileira Offshore) were awarded two-year contract to conduct subsea IMR on Petrobras' subsea installations offshore Brazil. The work is being managed by DeepOcean and ex-

DeepOcean WCROV in deepwater operations

Photo: DeepOcean


Per Thuestad,
Regional Manager, DeepOcean

Photo: Claudio Paschoa

ecuted by a team of WCROV operators, survey personnel and offshore management. DeepOcean will use the MV CBO Isabella, a multipurpose offshore subsea support vessel for the contract. The vessel will be equipped with two underwater remotely operated vehicles, a WCROV and an OCROV. "This contract award demonstrates that our customers value our high quality subsea services, and prove our company's competitive performance in deep water operations," said Mads Bardsen, President of DeepOcean AS. "DeepOcean has the unique deep water experience and the expertise needed for Brazilian subsea operations. 90 percent of Petrobras's reserves are nestled in deepwater, which is our specialty. In 2007, DeepOcean was awarded its first long-term subsea services contract by Petrobras. In 2012 we won a two-year contract with the flexible repair vessel Deep Endeavour. With the award of this second long term contract with the MV CBO Isabella for Petrobras in Brazil, we are well-positioned to further develop our strong position in this region," Bardsen said.

A New Era of Antarctic Exploration: AUVs in Polar Science

By Kira Coley

The WHOI SeaBED AUV 'Jaguar'
ready for deployment through a very thin layer of Antarctic sea ice. This helped produce the world's first detailed, high-resolution 3-D maps of Antarctic sea ice using an AUV.

Credit: Peter Kimball, WHOI

Expeditions in the early 20th century were the first to combine exploration and scientific discovery in the Antarctic. While the Scientific Committee on Antarctic Research (SCAR) was set up to co-ordinate international activities back in 1958, only in the last few decades have we realized the importance of the Antarctic for marine ecology, ocean circulation and climate change. Given its remoteness, the Antarctic is more accessible than ever. The last several years have seen advancements in polar technology and the introduction of autonomous underwater vehicles (AUVs), making previously inaccessible areas open to scientific investigation and hailing the start of a new era for Antarctic exploration.

The Antarctic is one of Earth's most extreme environments. Ice-winds, active volcanoes, unstable ice-sheets and ever-changing glaciers form the harsh landscape polar scientists must face in order to understand it's role in ocean circulation, ecological processes and the changing climate. According to the British Antarctic Survey (BAS), it is the largest ice mass on Earth covering an area of around 14 million square km (around 58 times the size of the UK) and holds 90% of the world's freshwater.

The annual expansion and contraction of sea ice in the Antarctic represents one of the biggest natural changes in the world.

In colder months, sea ice cover can extend more than one and a half times the size of the Antarctic continent (approximately 20 million square km), playing an important role in reflecting solar energy. In the polar summer, the same region might reduce down to 3 million square km and is a major driver of global ocean overturning circulation. In September 2014, sea ice expanded to its greatest coverage since records began in 1978, adding to the ongoing mystery of the Antarctic ice paradox. Additionally, scientists still know very little about the variations in thickness across the continent, making it a considerable focus in research.

Technologies in Extreme Environments

Traditional measurements made by visual observations on board vessels or drilling holes on the sea ice remain vital for polar data collection missions. However, difficulties in getting access to thicker areas of sea ice leaves gaps in the data.

Remote sensing techniques can be used to overcome these issues by providing observations of the physical environment from instruments mounted on aircraft or satellites. While these observations can be useful for measuring large-scale thickness, snow cover can

make the process of accurately interpreting the data difficult.

Now, with the rise of Autonomous Underwater Vehicles (AUVs) for polar applications, scientists are able to gain access to remote areas previously inaccessible. The AUVs ability to operate autonomously makes them well-suited to the exploration of extreme environments.

Over the last decade, AUVs have been successfully used worldwide for long ranging, open ocean data collection missions. While they would be useful tools for polar scientists, the use of the technology in these environments come with a number of engineering challenges, financial risks and operational difficulties.

"Recovery in open water is pretty straight forward - if there is a problem, send the vehicle to the surface," explains Dr. Guy Williams, of the Institute of Marine and Antarctic Studies. "However, under sea ice, returning to the surface is impossible. In addition, unknown bathymetry, icebergs and ocean currents, are all additional hazards that play on the risk versus reward assessment for AUVs in Polar Regions. In addition, the larger AUV deployments tend to dominate the logistics of any voyage they are participating in. When the long range vehicles are in the water, there is often not a lot of other marine science that can occur until it has safely returned."

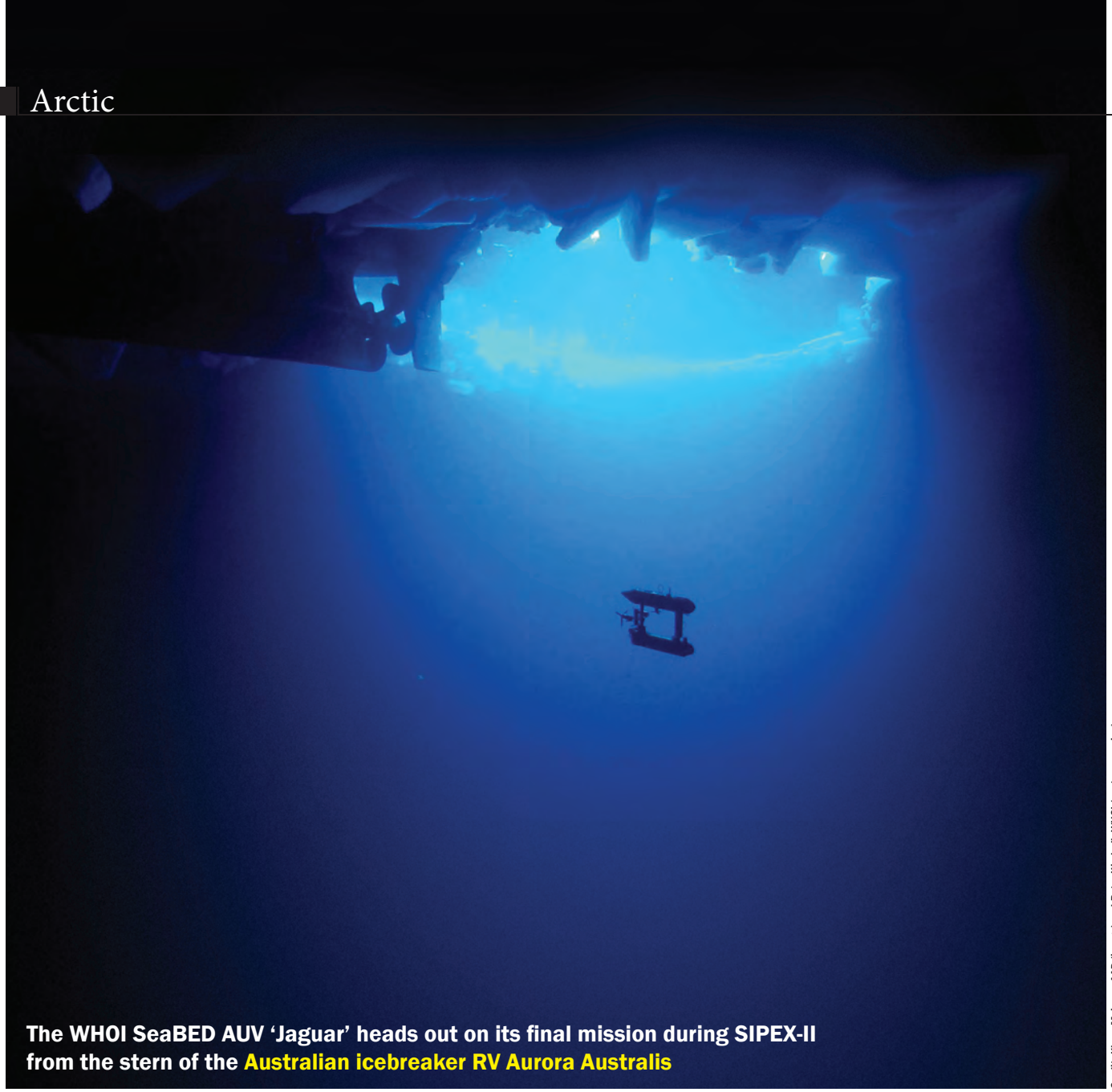
Dr. Williams was part of the international team of polar scientists who successfully produced the world's first detailed, high-resolution 3-D maps of Antarctic sea ice using an AUV developed and operated by the Woods Hole Oceanography Institution (WHOI). While there has been studies mapping ice shelves using AUVs, none before targeting sea-ice. The new technology provided accurate measurements of ice thickness from areas that were previously too difficult to access. The project set the pace of research in the Polar Regions aimed at understanding the dramatic sea ice changes in the context of climate change.

"Previous attempts to estimate the thickness of Antarctic sea ice relied on visual observations and manual drilling - both of which are suspected to be biased to thin ice. The AUV returns the entire thickness distribution for the sea ice floes near the ship - and a richness of data on the morphology of the sea ice in unprecedented detail," said Dr. Williams.

Operating at 20-30m depth, the AUV was fitted with an upward-looking sonar in order to measure and map the underside of sea ice floes. Lines of data in a lawnmower pattern were merged to form high-resolution 3D bathymetric surveys of the underside of the ice. The combination of airborne measurements of sea-ice surface elevation, ice coring surveys, satellite observations and data from the AUV (called Jaguar), vastly improves scientists' estimates of ice thickness and total sea ice volume.

Emperor penguins atop Antarctic sea ice, showing a distinct layer of snow and the presence of submerged features.

Credit: Peter Kimball, WHOI



The WHOI SeaBED AUV 'Jaguar' heads out on its final mission during SIPEX-II from the stern of the Australian icebreaker RV Aurora Australis

Credit: Klaus Meiners, AAD (image) and Peter Kimball, WHOI (post-processing)

The Importance of Internal Collaboration

International collaborations have seen notable funding opportunities for the development of technologies with the objective to significantly progress polar science over the next few years. These technologies are set to provide the resources for data collection beyond past capabilities, paving the way to new discoveries and advanced understandings into the relationship between climate change, the Antarctic and the rest of the world.

In 2014 alone, several partnerships have committed millions for the advancement of Antarctic and Arctic research. The UK's Natural Environment Research Council (NERC) has proposed a new ship worth $300 million, containing on board laboratories capable of analysing polar samples from both Arctic and Antarctic research missions. The latest technology will be available for scientific users, including underwater gliders and robotic submarines. Its robust design outcompetes previous polar research vessels with the ability to advance further through hard ice-covered water and reach areas previously inaccessible by sea.

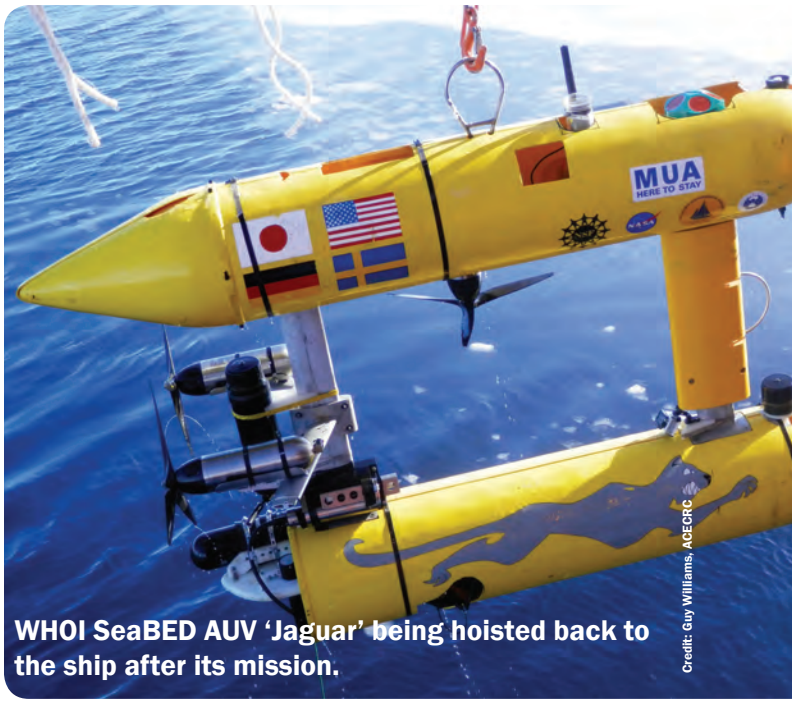
The Australian Antarctic Gateway Partnership announced $24 million Federal grant, part of which will go into developing a marine technology hub to build next generation hybrid autonomous vehicles for measurements within the polar environment.

Dr. Williams explains, "Our study has laid the foundation for this new funding, as it proved not only the value of the data returned from the AUV, but also that the AUV could be operated in the harsh Antarctic environment without loss - a key concern for funding agencies. While this new initiative won't directly advance this particular research (WHOI SeaBED under sea ice), it will look to develop the next 'game-changer' for even more advanced AUV missions, in particular long-range missions beneath Antarctic ice shelves (much deeper and more challenging)."

The grant is funded by the Australian Research Council (ARC) under its Special Research Initiatives scheme and includes the University of Tasmania's Institute for Marine and Antarctic Studies (IMAS) and the Australian Maritime College, the CSIRO's Oceans and Atmosphere Flagship, and the Australian Antarctic Division.

Due to its proximity to Antarctica, Tasmania is an international gateway for both scientific research and logistic support. On some level the different nations are in Antarctica for sovereignty claims, both on land and in the ocean surrounding it. But on a scientific level, Antarctica and the Southern Ocean are critical components of the global climate system. Observational data sets are hard-won and overall there is a paucity of data from this region compared to other parts of the globe.

Dr Alex Forrest from the Australian Maritime College, a Principal Investigator overseeing the team conducting the robotic exploration, explains "Ice is of global significance, playing important roles in ocean circulation and the functioning of polar ecosystems. However, inaccessibility makes it hard to quantify its properties at meaningful spatial scales. AUVs are potentially able to measure horizontal variability in ice prop-



WHOI SeaBED AUV 'Jaguar' being hoisted back to the ship after its mission.

erties at near centimetre resolution along kilometers of trackline, offering a fundamentally new approach to ice research. Our project will develop and apply new AUV instrumentation specifically for estimating particularly important and spatially variable properties of ice, that of the irradiance below, and biomass of algae within the ice."

The collaboration will involve researchers from more than 10 countries and complement the Australia's Antarctic Science Strategic Plan to understand the role of Antarctica and the Southern Ocean in the global climate system.

The Future of Polar Science with AUVs

The development of polar-adapted technologies will help moderate the associated risks with extreme environmental conditions and reduce the difficulties of accessibility. New technologies will be essential to unlocking opportunities for obtaining new data, surveying unexplored locations and advancing scientific discovery.

Firstly, a number of technical challenges for AUV operations in Polar Regions will need to be addressed, including navigation, data telemetry and autonomy. Navigation and telemetry for AUV platforms relies on satellite positioning (GPS) and communications (Iridium, ARGOS). These approaches are poorly suited to polar areas where ice cover restricts access to the sea surface and adds to the risk of AUV missions. Advancements in data telemetry and navigational systems would mitigate the financial risk associated with the loss of a platform, and more importantly, the scientific data stored on board.

Dr. Williams explains, "Greater endurance or battery life will be the key to expanding the scale of these missions, such that we can make the sort of routine measurements necessary to really get to the heart of questions such as 'How thick is the entire Antarctic sea ice zone?' and 'Is that thickness changing?'. Also, greater sophistication in the autonomy of the vehicles, together with the ability for them to work as teams and also work with autonomous vehicles surveying the sea ice from above (Unmanned Aerial Vehicles or drones)."

While deep waters remain a challenge, shallow high latitude shelves can also be resistant to measurement efforts. Ice scouring poses a serious threat to bottom mounted instrumentation and surveying shallow, ice-covered shelves will likely require a combination of methods and the capability of tolerating instrument losses while still providing useful data return. Nevertheless, surveying shallow or narrow under-ice areas is still an area of scientific interest and a focus for some projects.

Dr Forrest explains "One of the main areas of exploration that we will be targeting is under ice-shelf cavities in the marine setting. While these areas have been visited (probably less than the number fingers on one hand), there is still an amazing amount that is unknown. One of the aims of the Gateway project is to investigate the seafloor, the ice ceiling and the water column in between. While we intend to develop a vehicle that has the conventional technology, we intend to make it modular enough that we can develop new capabilities now and into the future."

Over the next decade, these new technologies will steer the course of scientific research in the Antarctic. AUVs that are smaller in size and have a higher endurance with effective data telemetry options will eventually be needed to progress observations through the seasons, in areas which have been less accessible until now.

"While working under-ice is ideally suited for robotic exploration, it poses significant environmental challenges that we try to engineer solutions for. Every time we deploy we have unexpected challenges (e.g. Navigation, sensors, etc.). However, what makes a good team is how they respond and overcome these challenges. It is our hope that this platform will be able to provide new insights into marine ecosystem dynamics in the Antarctic but would also be applicable in other ice-covered scenarios," Dr. Forrest.

The polar environment remains a unique place for scientific discovery and notable advances over the last few years are a result of international collaborations. In the years to come, science in the Antarctic has the potential to lead to major advances in solving vital questions for climate change and ecosystem responses, strengthening predictive models for environmental management and policy reforms.

"Our observations challenge us to explain the world around us and to develop theories that fit these explanations, such that we can predict future behaviour. Any time there is a major advance in our observational capability (new microscope, new telescope, new x-ray machine etc.), there quickly follows dramatic shifts in our understanding/theory and prediction. Measuring is believing and so with so many aspects of the polar environment now accessible by these types of platforms, we can expect a quantum leap forward in our efforts to understand how this vital component of the climate system is responding to change," Dr. Williams.

Credit: Peter Kimball, WHOI

A crevasse-like feature in Antarctic sea ice, where a region of compressed deformation between two floes has re-opened. The AUV revealed a rubble field, with mean draft greater than 12m.

Kira Coley is a freelance writer with a Marine Biology degree from University of Portsmouth and experience as a Field Scientist in various locations including Madagascar, Sicily, and Scotland. She is now a PhD researcher and regularly publishes articles and technical papers discussing key research topics in the marine sciences, oceanography and offshore industry.

Newfoundland and Labrador, Canada:

The Path to the Arctic

When Newfoundland and Labrador is described as the 'path' to the Arctic, it is done so using the fullness of the word, from the province's strategic location to its world-class Arctic-related expertise, infrastructure, and facilities. As Canada's most easterly province, extending north to the edge of the Arctic, Newfoundland and Labrador is ideally located along international shipping lanes and northern sea routes to connect with markets in the Arctic, Canada, the United States, Central and South America, Europe, and Asia.

Surrounded by the North Atlantic Ocean and uniquely positioned along Iceberg Alley, the waters around Newfoundland and Labrador are colder than anywhere else in the world with temperatures south of 60 degrees – colder than waters near Norway and in parts of Alaska, Greenland and Iceland. While the water isn't technically 'in the Arctic,' the existing conditions are Arctic in nature, providing a unique place to develop solutions to arctic challenges.

Newfoundland and Labrador is self-described as the world's cold ocean laboratory, with a vibrant ocean technology sector providing global guidance on all matters Arctic. It is also home to growing sectors such as oil and gas, shipping, education and training, and research and development, as well as traditional sectors such as mining and commercial fisheries.

Newfoundland and Labrador boasts a rich history of ocean exploration and adventure. When Robert Peary set out to ex-

plore the Arctic more than 100 years ago, it was a Newfoundlander he approached to assist him. Brigus-born master mariner Captain Bob Bartlett became Peary's first mate for three Arctic expeditions. Even back then, Newfoundland and Labrador was heralded as a natural path to the Arctic and home to the world's foremost experts when it came to operating in cold, harsh and ice-prone environments.

Arctic Innovation is in their DNA

Generations of the province's hardy people have been raised and nourished by the sea. For countless years, fishing was vital with entire communities sustained by the cold ocean bounty. Along the way, many lessons were learned, respect was earned, and innovations were conceived to make the next saltwater sojourn safer and more efficient.

In time, a new sea-bound bounty began to reveal itself on and off the shore. As abundant as the water was with sea life, so the land and seabed proved to be with natural resources, metals, and minerals.

Onshore, a mining industry has boomed, particularly in Labrador, where mining operations have been ongoing for more than half a century. Today, mining is a multi-billion dollar industry producing nearly half of Canada's iron ore, and more than 10% of its overall mineral production.

Now synonymous with offshore oil and gas operations, Newfoundland and Labrador produces more than 80% of Canada's offshore petroleum and one-third of its light crude. At the base of this operation is the Hibernia gravity base structure, the concrete foundation of which was the first in the world designed to resist the impact of sea ice and icebergs.

Newfoundland and Labrador is home to Canada's deepest oil well, reaching down some 2.6 km. It is this potential for future growth, coupled with vast experience, inherent innovation, industrial infrastructure, and world-renowned expertise in the oil and gas sector that ideally positions Newfoundland and Labrador for future development in the Arctic.

From this solid base, a cluster of companies, academic institutions, and research and development organizations have emerged, and they strive to push the envelope in cold ocean exploration, from sub-sea imaging and radar technology, to aerial and satellite ice management.

Central to this burgeoning brain trust and array of cutting-edge technology is Memorial University, which has its main campus in the provincial capital of St. John's. Memorial, and its Fisheries and Marine Institute (Marine Institute, or MI for short), is a key player within the province's ocean technology cluster, and like its many partners and collaborators in the province, it is casting a keen eye northwards.

"The Arctic is one of the last natural frontiers," said Memorial University's Dr. Claude Daley, of the Faculty of Engineer-

ing and Applied Science.

"We're trying to learn the lessons from research rather than having to learn them by error in the field. We're certainly at the cutting edge of what is happening in the world and we are setting the agenda for Arctic and ice research."

The Marine Institute has the technology to match the expertise, boasting the largest collection of marine simulators in North America. Its iconic Full Mission Ship's Bridge Simulator, a 30-ton ship structure mounted on a hydraulic base in a surround theatre, provides the ability to accurately simulate the sea conditions of anywhere in the world when testing models. MI has sixteen simulators at its disposal, including a new engine room simulator, a tug simulator, ballast control simulators, and small vessel simulators through VMT (Virtual Marine Technology), a local simulation company. A seventeenth is soon to be added in the shape of a deepwater anchor handler simulator.

MI is training the next wave of ocean experts through the School of Ocean Technology and the Center for Applied Ocean Technology. These schools are committed to developing and delivering technology as well as education and training programs to meet the needs of the ocean sector -- all while collaborating with industry in the application of this technology.

MI's Center for Marine Simulation

Across campus, C-CORE (The Center for Cold Oceans Resource Engineering) and the National Research Council (NRC) also have a key presence in the province's ocean technology cluster.

Established in 1975 as a partnership between Memorial University and the oil and gas industry, C-CORE has become internationally recognized for its in-depth knowledge and expertise regarding the behavior and prevalence of sea ice and icebergs in regions where future development may occur, as well as for developing techniques to mitigate risk through satellite-based ice monitoring and physical management of ice.

C-CORE maintains a close and synergistic relationship with Memorial University, fostering effective collaboration on a number of levels, particularly in the creation of a vibrant talent pool, with students able to access leading-edge facilities and resources.

Within C-CORE are two centers of excellence dedicated directly to the Arctic.

The first, CARD (Center for Arctic Resource Development) is the only independent, industry-guided research and development initiative in Canada dedicated to responsible, cost-effective hydrocarbon development in Arctic regions. The second, LOOKNorth (Leading Operational Observations and Knowledge for the North) is a national center of excellence with a focus on remote sensing technology in support of northern resource development, and assists technology companies across Canada - especially in Newfoundland and Labrador - in demonstrating the utility of their creations.

Also located on the campus of Memorial University is the

Oceanic Consulting Limited – Numeric testing in World's Longest Ice Tank.

Ocean, Coastal and River Engineering (OCRE) division of the almost-century old National Research Council of Canada (NRC). NRC-OCRE offers specialized consulting and applied research services in ocean and coastal engineering, water resources management, marine safety, and marine renewable energy technology, particularly for industries operating in harsh environments, supporting clients in offshore oil and gas, marine transportation, and other sectors. They achieve this through a successful combination of world-class expertise, equipment, and facilities, having made substantial investment in the world's longest ice tank, a tow tank, and an offshore engineering basin, along with numerical and model testing systems.

"Without these facilities you can't really play in this area," said NRC-OCRE's Director of Research and Development, Jim Millan. It is the price of entry into world-class research, but just as important is having the experts to effectively utilize the technology."

"This expertise is very specialized and expensive to develop," said Millan. "It isn't about just bricks and mortar, it's about learning how to use the equipment, then going into the field and validating against what you do in the tanks."

As NRC-OCRE General Manager Terry Lindstrom explains, one of their key focuses is OCRE's Arctic program.

Towing an iceberg.

"We have been spending time, money and energy to physically go into the Arctic, to sample the properties of the ice so we can come back here and replicate it in the tank," says Lindstrom. "We have to stay relative to the changing environment. If you're going to design a structure for a harsh environment, you need to understand what that environment is capable of."

Oceanic Consulting Limited (Oceanic) is itself a leader in commercial marine research and development and provides a portal to marine research facilities in Newfoundland and Labrador. Oceanic delivers a broad and sophisticated range of engineering and consulting services in ocean and Arctic engineering.

In 2014, experts from Newfoundland and Labrador – specifically, Kraken Sonar Systems Inc. – were among those invited to be part of a historic search to locate the lost ships of Captain Sir John Franklin's ill-fated Arctic Expedition of 1845. Based in Conception Bay South, NL, Kraken is a developer of Synthetic Aperture Sonar (SAS) and the AquaPix system. Kraken's technology is able to provide ultra-high resolution seabed imaging over long ranges. The company has also created designs that allow for real-time processing and an effective method of removable data storage.

With these institutions and dynamic technology startups keeping tabs on the ocean surface and the depths below, the eyes in the province's skies come largely courtesy of Provincial Aerospace (PAL). PAL has been flying maritime surveillance aircraft for more than 35 years for government, military and industrial clientele.

PAL's evolution in the 1980s from simple visual surveillance to advanced ice management methods owed much to the forward thinking of a PAL owner, Gus Ollerhead, who first had the vision to put an anti-submarine radar on an aircraft, something that had never been attempted before.

"Radars designed to pick up periscopes in the Cold War happened to be very effective for picking up ice and icebergs too," said Jake Trainor, COO, PAL.

This insight set in motion an avalanche of innovation from the company, including a computerized mission management system that not only runs the radar, but also collect the data and provide back-end analysis against reams of historical data, through which analytical and predictive models can be built.

Promoting the Solutions

This abundance of activity and expertise in the province has led to the emergence of multiple associations and cluster organizations to help foster synergy

Center for Arctic Resource Development.

between the various players. Founded in 1977, NOIA (Newfoundland and Labrador Oil and Gas Industries Association) is the largest oil and gas industry association in Canada. Its mission is to promote development of Canada's east coast hydrocarbon resources and facilitate the participation of its more than 600 members in global oil and gas industries.

OceansAdvance was originally established in 2005 and is the voice of the Newfoundland and Labrador ocean technology innovation cluster. Its members include more than 50 export-driven companies; more than 20 research and technology organizations; as well as highly engaged municipal, provincial and federal governments; plus a number of post-secondary academic institutions and trade associations focused on producing the next generation of ocean leaders. This multi-stakeholder technology cluster is underpinned by innovation, commercialization and export, influenced by Newfoundland and Labrador's burgeoning offshore energy, transportation, fishing and aquaculture sectors.

Aerospace advocacy comes courtesy of ADIANL (Aerospace and Defense Industry Association of Newfoundland & Labarador). Established in 2001, ADIANL is now nearly 40 members strong. It seeks to identify opportunities for the outstanding aerospace technologies and expertise in the province, particularly related to harsh environments and emerging Arctic requirements.

Partnership and collaboration with Aboriginal peoples and northern communities also plays a critical role in Newfoundland and Labrador's Arctic endeavors.

Their expansive traditional knowledge and expertise will be invaluable as opportunities in the Arctic are further explored

NRC – Offshore Engineering Basin.

and developed. Forging partnerships and sustaining economic growth in the north, enabling these communities to thrive, is of paramount importance, and the Nunatsiavut Government is already at the table as a key partner in the Province's Arctic Opportunities Initiative.

This initiative is indicative of the high priority the Government of Newfoundland and Labrador has placed on facilitating the province's strong and undeniable trajectory as a landmark location for Arctic opportunities. Through its Arctic Opportunities Initiative, Provincial Government is working with stakeholders to explore areas of opportunity; facilitate relationships and partnerships; demonstrate Newfoundland and Labrador as the path to the Arctic; build capacity; and foster economic growth and business opportunities.

The Arctic Opportunities Initiative seeks to create a collaborative environment conducive to stakeholder success, where northern and Aboriginal communities can thrive and benefit, and that will further attract global industry leaders.

Experts on Ice

Canatec

Whether chiseling it off their windshield or tracking and predicting its movements in the North Atlantic Ocean and beyond, Newfoundlanders and Labradorians know ice. Experts in the province are among the foremost in the world in ice surveillance, monitoring and management.

C-CORE

C-CORE, (Center for Cold Ocean Resource Engineering), has developed tools to forecast iceberg movement and prepare mitigation strategies. It's a simulation-based toolbox, taking into consideration factors like iceberg location and size, number of icebergs, what tow vessels are available in the field, and potential impact on any other facilities in the area. "You can't deflect until you detect," said Dr. Charles Randell, C-CORE President and CEO. "With a satellite, you can look at areas well north of the area you're interested in. You can detect and track an iceberg as it approaches your platform and implement ice management protocols."

One such innovation, an iceberg net, is used to tow away icebergs that might be on a collision course with an offshore facility. It was developed over a decade ago in collaboration with a local company, Extreme East Rigging – a supplier of ocean rigging and lifting products. Now in common industry use, the iceberg net stands as one of C-CORE's many success stories. C-CORE is also home to one of the largest centrifuges in the world, able to simulate Arctic phenomena. Models ranging from scales of 1:2 to 1:200 are precisely constructed and placed under centrifuge tests that can simulate years of freezing and thawing, and its effects on ocean equipment such as platforms, vessels, and pipelines. Having kept its eyes on ice for decades, C-CORE – located on the campus of Memorial University in St. John's, NL – now also encompasses two centers of excellence: LOOKNorth and CARD. LOOKNorth (Leading Operational Observations and Knowledge for the North) is Canada's only Center of Excellence for commercialization and research dedicated to remote sensing innovation in support of northern resource development. The center uses remote sensing technology and extremely capable satellite radar technology to monitor northern environments and infrastructure to see where ice is moving and predict where it will move to. CARD (Center for Arctic Resource Development) is also unique in Canada as it is the only independent, industry-guided research centre focused on addressing challenges that impede safe and sustainable development of Arctic hydrocarbons.

PAL

Flying maritime surveillance aircraft for over 35 years for government, military, and industry, Provincial Aerospace (PAL) also has a long history of tracking ice movements, having provided such services to operators off Canada's east coast for over twenty years. From its beginnings in visual aerial surveillance, radar technology is now the company's specialty. It has evolved to be what COO Jake Trainor describes as, "a data-driven company that happens to know something about aircraft." PAL provides oil and gas operators with visibility regarding the whereabouts and anticipated movements of sea ice and icebergs that may be a threat to their assets. In addition, PAL creates tailored solutions for clients in sectors as diverse as defense, maritime domain and fisheries enforcement, and search and rescue, putting together the best combination of sensor systems to achieve the desired goal, matching that information with the aircraft that is best suited to the task.

Canatec

Canatec is a relatively new addition to

the St. John's ocean technology cluster, but has deep history and experience in harsh environment surveillance and management. Headquartered in Calgary, Alberta, Canatec has spent 22 years dealing with the challenges of Arctic ice. The St. John's-based Canatec team – a R&D arm of the core company – has taken on a very specific project in the area of marine search and rescue (SAR) operations. The team is aiming to repurpose technology developed in their extensive ice drift tracking pursuits to instead track individuals.

"We're taking the 'search' out of 'search and rescue'," said Dr. Scott Tiffin, Canatec Partner and St. John's Project Manager. "We know at all times where these people are and, with biometrics, we know what state they're in." The project aims to keep workers and SAR personnel safe, and to broaden the operational window for helicopter transportation in offshore oil and gas operations. Another key provider of research and development, based within the Memorial University campus, is a division of Canada's National Research Council (NRC). The Ocean, Coastal and River Engineering (OCRE) division is actively engaged in taking ice samples from the Arctic and bringing them back for replication and analysis in its labs. The division has invested in world-class people and facilities, such as the world's longest ice tank, a tow tank, and an offshore engineering basin, along with complex numerical and model testing systems. A major focus for NRC-OCRE is engineering for Arctic applications.

"The goal in scale modeling – physical or numerical – is to replicate the environment in the most extreme conditions; ice, wave, wind, currents, and then to combine all of this data," said Jim Millan, Director of Research and Development. "Our tools and expertise in engineering design and performance evaluation enable NRC-OCRE to mitigate risk – be it environmental, financial, or health and safety – in offshore projects."

NRC-OCRE employs roughly 65 technical staff to provide what General Manager Terry Lindstrom describes as a full toolbox of numerical modeling, physical modeling, and full-scale testing.

"Having that full toolbox allows us to complete the full-scale project and then go back to the early, less expensive approach to validate the data we now have in the field," said Lindstrom. "There are very few organizations in the world that provide support at all three levels."

Arctic Smarts

Newfoundland and Labrador is preparing the next wave of ocean technology experts

When it comes to the Arctic, the world still has a lot to learn.

With just 10% of its vast expanse having been charted to date and much about its environment still unknown, the Arctic remains one of the most mysterious places on Earth. As a new frontier with natural resource potential, the Arctic is also an area of increasing international interest and economic activity.

As activity in the Arctic increases and new opportunities emerge, Newfoundland and Labrador's academic and training institutions are poised to respond to the rising demand for innovative technology solutions, information, and highly skilled workers. With a successful history of exploring new frontiers, including the Arctic, Newfoundland and Labrador is leading the way in Arctic education and training that will prepare the next generation of innovators and explorers, and that will enable northern communities and Aboriginal peoples to benefit from emerging opportunities.

At the forefront of this grand undertaking are the Arctic academics, and the best of them can be found on – and off – Newfoundland and Labrador's shores. Memorial University and its Fisheries and Marine Institute (Marine Institute or MI for short) is home to world-leading cold ocean experts, facilities, and education programs.

"The Marine Institute is unique in Canada," says Memorial University Vice President (Marine Institute) Glenn Blackwood. "It is Canada's Marine Institute. We produce about 70% of all English-speaking seafarers in the country."

The Marine Institute, currently celebrating its 50th anniversary, is essentially a polytechnic within Memorial University, offering Diploma, Degree and Masters Degree programs, emphasizing applied research and development and advances in ocean technology, and collaborating with industry and others on the development and application of ocean technology products for all sectors of the maritime community.

MI is home to the School of Ocean Technology (SOT), Center for Applied Ocean Technology (CTec), Center for Marine Simulation, Center for Sustainable Aquatic Resources, Safety and Emergency Response Training Center, as well as the Offshore Safety and Survival Center.

"We're at the early stages of oil and gas development in the province," says Blackwood. "Especially going deeper in the ocean and further north, which will be largely driven by our ability to access and utilize those resources."

This capacity grows day by day, thanks to leading-edge research and development being led by some of the world's foremost marine technology experts, using some of the world's most advanced equipment and facilities. MI is home to the largest collection of marine simulators in North America (and perhaps, the world) – 16 in total, including the iconic Full Mission Ship's Bridge simulator and a seventeenth soon to be

added – a deepwater anchor handler simulator.

Also adding to this growing capacity are ocean technology experts at OCRE (Ocean, Coastal and River Engineering), a division of NRC (National Research Council of Canada). NRC-OCRE is home to world-leading expertise, equipment and facilities, including the world's longest ice tank, a tow tank, and an offshore engineering basin, along with complex numerical and model testing systems.

"We're physically located on the campus of Memorial University, so we draw a lot of our expertise from Memorial," explains NRC-OCRE General Manager, Terry Lindstrom, who says that it is this access to qualified people and the facilities in which to nurture them that allows the relatively small province to punch well above its weight in the ocean technology arena.

"We have a very small footprint, but we have the capabilities, tools, educational background, and the physical bricks and mortar of world-class facilities."

With these and other education and training entities operating within the province, collaboration is of the utmost importance. This applies not only to academic institutions, but also extends to government, which plays a key role in facilitating and promoting the province's advancements, and to industry, where these advancements are utilized.

"I see it as a propeller with three blades…it doesn't work without the three of them," says Glen Blackwood.

"Industry supports us in many, many ways, through scholarships for students, with a piece of equipment, or a problem we're working on jointly with them. But the collaborative piece is with government and industry."

The Province is very much a part of this combined effort. Through its Arctic Opportunities Initiative (AOI) launched in 2010, the Government of Newfoundland and Labrador is working with local stakeholders and those in other northern jurisdictions to facilitate partnerships and promote collaboration, environmental responsibility, sustainability and respect, with an overall goal of creating an environment in which all stakeholders can benefit from emerging opportunities in the Arctic, northern communities can thrive, and that will further attract global industry leaders.

Industry and academia should – and will – continue to take the lead when it comes to progressing interests in the Arctic, while the Provincial Government seeks to provide support, improve international awareness, and facilitate relationships and partnerships.

Newfoundland and Labrador's Research and Development Corporation (RDC) is another key asset, working at an arm's length from Government to assist private enterprise in developing and expanding new technologies for operating in the world's harshest environments. Through leadership, strategic focus, and investment, and working with R&D stakeholders in business, academia, and government departments and agencies, RDC seeks to strengthen and improve the research system throughout the province. It serves as a catalyst for innovation with the goal of creating economic growth in Newfoundland and Labrador for future generations.

Deep Thinkers

Newfoundland and Labrador innovators are taking underwater technology to exciting new levels

Newfoundland and Labrador has been front and center on some of the world's paradigm shifting ocean-based research and development achievements.

Autonomous Oceans Systems Laboratory (AOSL) is a research facility within Memorial University's Faculty of Engineering and Applied Science, focused on the advancement of persistent unmanned systems technology in harsh environments. Masters and Doctoral students from the university play a key role in driving AOSL's research and development, including exploring new and innovative ways to utilize autonomous underwater vehicles (AUVs), unmanned surface craft (USC) and unmanned aerial vehicles (UAVs) in cold and harsh environments with sea ice and icebergs. Working together, these vehicles can feed algorithms and other important data back and forth.

"Autonomous vehicles don't complain about the temperatures being minus-ten and the wind being 70 knots, but that's exactly when you need to make the measurements," said Dr. Brad de Young, Department Head of Physics and Physical Oceanography, explaining that it is critical to understand the most extreme conditions that will be present when considering ventures into the Arctic.

AOSL researchers are developing technology that will extend the mission duration of AUVs, and use bathymetry and GPS to accurately track their location. AOSL is also focused on mapping icebergs above and under water, 3-D modeling of icebergs, navigation of AUVs under ice in areas without GPS, and acoustic measurement of sea ice thickness.

A number of dynamic Newfoundland and Labrador ocean technology companies are leading the way in underwater visual technologies.

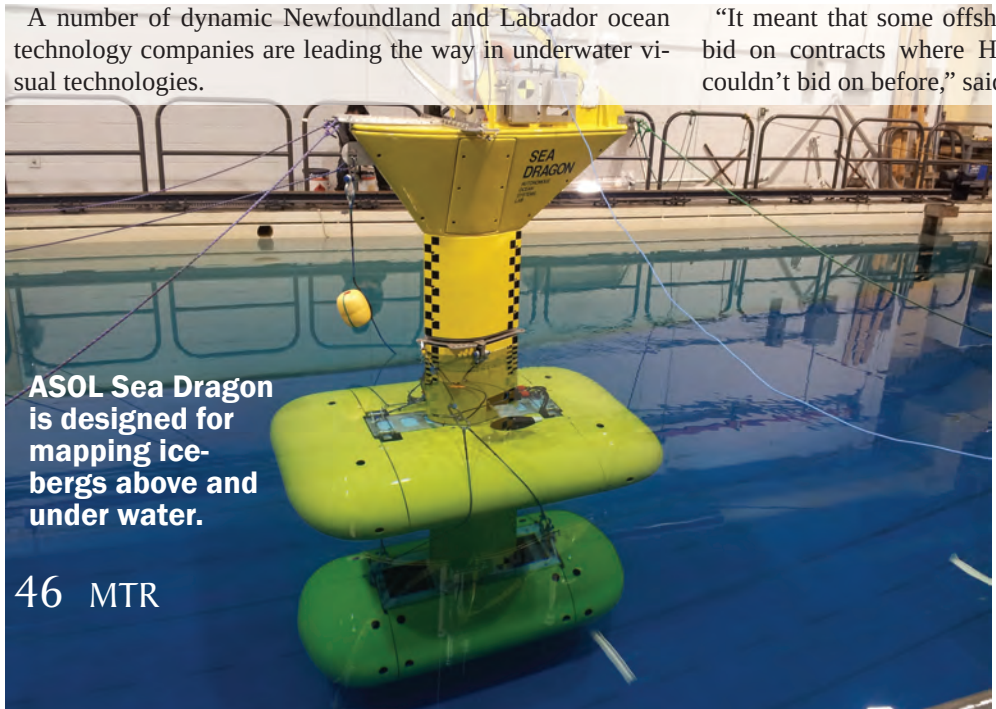
Headquartered in Conception Bay South, NL, Kraken Sonar Systems Inc. is a developer of the Synthetic Aperture Sonar (SAS). Kraken's AquaPix system uses unique beam-forming software that is designed to provide extremely high resolution up to very long ranges. Other benefits include real-time, onboard processing; faster code, reducing time to see images; and removable data storage, all of which helps to reduce the cost of their system while improving quality and efficiencies.

David Shea, Kraken Engineering Manager, was recently invited to take this technology on a successful Arctic mission to locate the HMS Erebus, one of the long-lost vessels of the ill-fated Franklin expedition, but major applications lie in the defense and offshore oil and gas sectors.

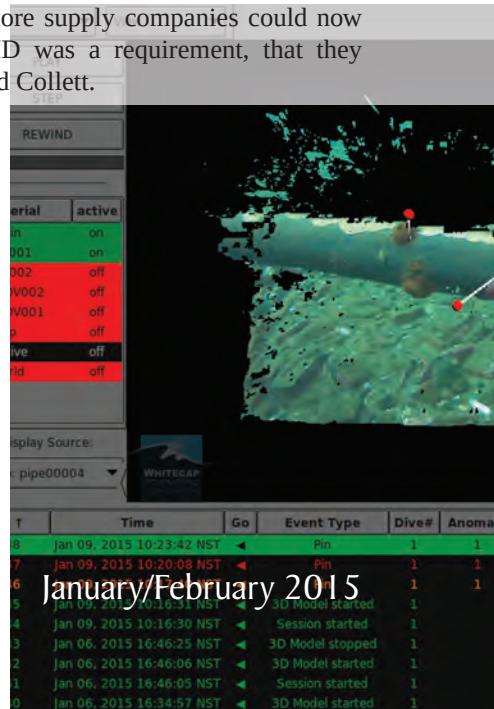
"We are the only company in the world that can do full-resolution, onboard, real-time processing," says Shea, adding that their agility as a smaller team allows them to work with clients to create custom solutions for the technology's varying end applications.

Since its 2010 inception, Clarenville, NL-based Sub-C Imaging has grown to become a leader in underwater camera technology, producing both innovative hardware and intuitive software. Chad Collett, Co-owner and CEO, was an offshore oil and gas project manager inspired to improve the capabilities of underwater cameras and lights being used in the sector. Sub-C's first camera was a game changer, enabling ROV pilots to upload standard definition video through existing cables while high definition imagery was recorded to the camera itself.

"It meant that some offshore supply companies could now bid on contracts where HD was a requirement, that they couldn't bid on before," said Collett.



ASOL Sea Dragon is designed for mapping icebergs above and under water.



Co-owner and VP, Adam Rowe said that a commitment to software development has enabled Sub-C to create truly comprehensive and intuitive hardware-software packages for their clients. “We have a 4k camera in development, but what’s different about what we do is that, instead of just releasing a camera, we’ll have an entire package,” says Rowe. “We’ll have the 4k camera, we’ll have the 4k DVR, and we’ll have integrated software to control it all.”

Also leading innovation in underwater imaging is St. John’s-based Whitecap Scientific. If Kraken and Sub C are the eyes, then Whitecap Scientific is the extremely detailed, 3-D memory.

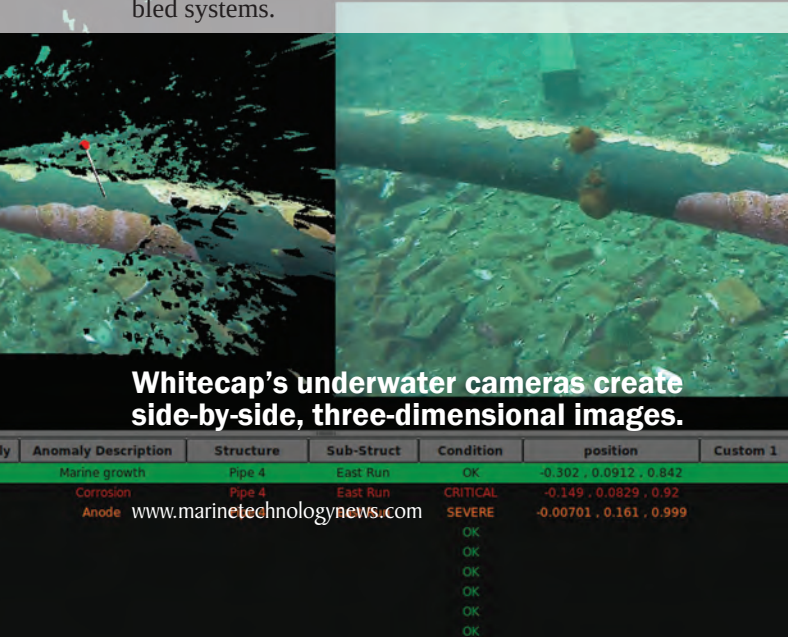
By placing two cameras side-by-side, a three-dimensional image of an undersea site can be created. As Whitecap Co-Founder and Managing Director, Dr. Sam Bromley explains, “We turn underwater cameras into live 3D underwater scanners, bringing 3D spatial awareness to ROV pilots.” Pilots are also able to place “pins” in areas of interest that can later be explored and examined with complete and highly detailed textures of the full 3D image created.

This technology is “the pilots’ window into the remote world,” said Dr. Bromley. “They can see the areas they’ve already recorded, the shape of the model, and they can zoom in on a certain point of interest in more detail.”

Providing power to electronics in cold ocean conditions is a constant challenge; one that MUN-based SEAformatics is meeting with a novel solution in the shape of a 20 ft. high, 1400 lb. pod with a 6-ft., floating horizontal-axis turbine. A flexible member allows it to orient with water flow while resisting twist, tethering the power-harvesting turbine to an 8 ft.-wide base, which sits weighted to the ocean floor.

“So it’s able to harvest power from basically any direction,” said SEAformatics Project Manager and Co-founder, Andrew Cook, who adds that they are targeting up to two-year deployments for the pods, which are retrievable thanks to a sonar-activated release system that allows the floating turbine to rise back to the surface.

Possible applications range from marine science and oceanography to offshore oil and gas equipment monitoring, and they can be deployed individually or as an array to cover much wider areas, potentially negating the need for expensive cabled systems.



Whitecap’s underwater cameras create side-by-side, three-dimensional images.

ROV Roundtable:

The evolution of capable Remotely Operated Vehicles (ROVs) moves in tandem with a burgeoning array of missions available. This month MTR spoke with Matt Bates of Saab Seaeye, Chris Gibson of Videoray, and Alasdair Murrie and Peter Ranelli from Teledyne Marine Systems for their insights on the market moving forward.

By Greg Trauthwein, Editor

Describe the trajectory of ROV use over the past five years.

Bates, Saab Seaeye We have found a growing demand amongst operators in the oil and gas industry for ROVs with greater work and survey capability. This has led us to extend our range into larger and more powerful work-capable electric ROV systems that can undertake a wider range of tasks. Another trend is the growing use of ROVs in sectors such as renewables, marine science, defense and hydro – all of which are attracted by the technological sophistication of today's underwater vehicles and their potential for customization and ability to undertake a wide range of complex and demanding tasks.

Gibson, Videoray When we created the microROV market starting about 15 years ago, almost everyone in the industry was convinced that a vehicle as small at a VideoRay could not be useful in "real" work. It is very similar to personal computers, which were maligned by those using mainframes as "toys," incapable of real contributions to business computing needs.

Along with our competitors we've proven that this was not only wrong, but micro-sized ROVS could not only replace larger vehicles – they could outperform them in rough sea conditions and delicate inspection tasks. We see most of our customers using VideoRays to keep people as safe as possible, whether protecting divers from entering dangerous or challenging environments, or monitoring and inspecting harbors, infrastructure, and vessels. ROVs – especially those with additional capabilities such as sonar, additional cameras, positioning systems, and autonomous control – collect information that helps people understand and learn more about what is going on underwater.

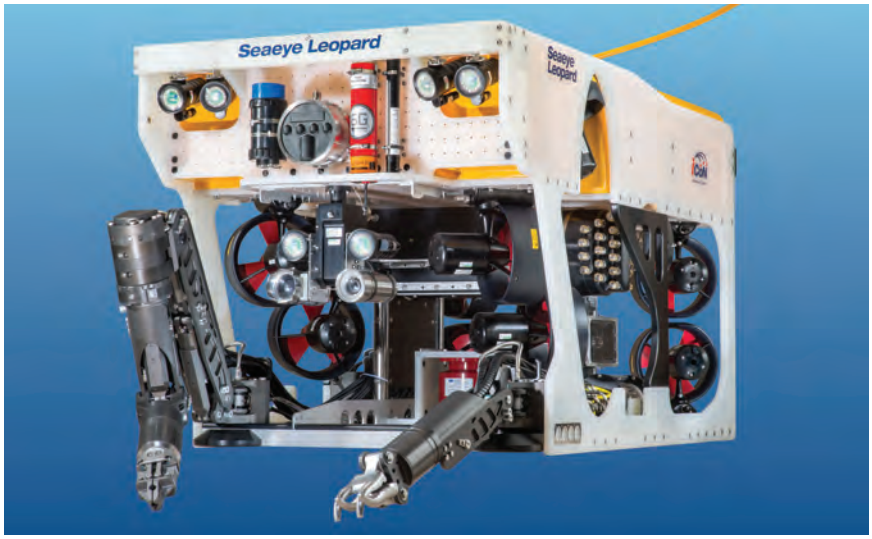
A recent JIP with oil majors has determined that VideoRay ROVs can be used to inspect oil tanker ballast tanks, an environment known for being especially dangerous for manned inspections. Ports and harbors can monitor and inspect every vessel that comes in to make sure that nothing suspicious is entering unannounced. Critical infrastructure can be kept up to code with quicker and easier inspections.

The other reason for the industry's success is the significant cost savings of using an ROV as opposed to traditional methods. ROVs have made it less expensive and much easier to conduct regular inspections, which has enabled companies to detect problems earlier and intervene faster before more damage can be done. Oil rigs especially benefit by using ROVs for UWILDs. Instead of learning about necessary repairs while already in drydock, repairs can be determined before the vessel is in port and prices can be negotiated.

Murrie & Ranelli, Teledyne Marine Systems Within Teledyne Marine Systems we focus on compact high performance ROVs. Our man-portable products at SeaBotix have seen strong growth in U.S. Navy use. Our larger systems at Benthos have been growing in infrastructure inspection applications, especially with high resolution sonars provided by Teledyne Blueview. In both lines we see interest in increased utility through advanced user interfaces, positioning and control systems. ROVs are becoming ever more capable and "smarter."

How would you describe the maturity of the ROV market today?

Murrie & Ranelli, Teledyne Marine Systems The ROV market is both mature and still growing. In certain cases the utility of ROVs is well understood. But as offerings become more compact and affordable new users are entering the market. Also new sensors and payloads are making small



Above: With behavior-based iCON architecture and 11 thrusters the new Saab Seaeye Leopard.

Right: Matt Bates, Director, Saab Seaeye

Above: SeaRover with BlueView

Left: Alasdair Murrie, Teledyne Marine Systems.

ROVs more capable of "big" ROV missions that is presenting new opportunities for users who may not have the budget or facility to support a larger work class ROV.

Bates, Saab Seaeye Change is constant in the underwater market so I would not consider it mature. Driving this are changes in market forces, along with challenges posed by new areas of exploration and the emergence of new technologies. All of which continually reshape the design and function of vehicle systems and the expectations of users.

Gibson, Videoray There are many different applications for ROVs and we approach each of them differently. Therefore, you have to look at market maturity vertically by application and even the job task in certain situations. For example, the market for ROVs in the Offshore Oil & Gas market is mature, but there are new applications and capabilities where smaller, inspection class ROVs offer significant cost savings to operators and service companies. Additionally, new markets are forming, ROVs are now being used in offshore to minimize manned entries into confined spaces, specifically for ballast tank inspections.

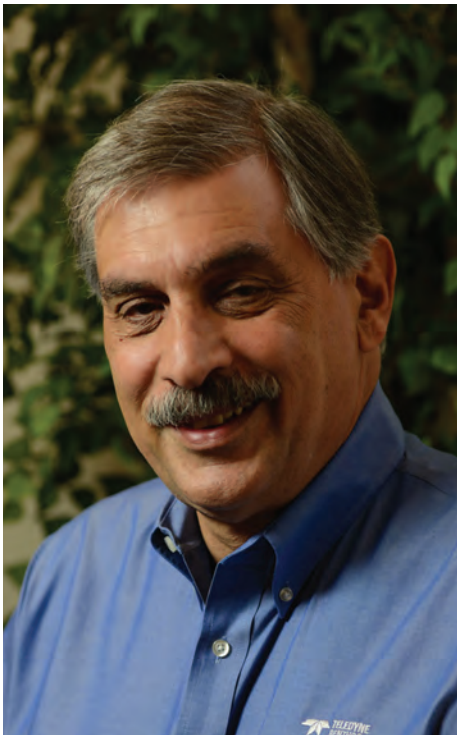
Small inspection-class ROVs outfitted with UT gauges are being used to perform GVI and CVI inspections for special survey class inspections. These type of inspections offer a significant cost savings to the operator because they can be performed while the vessel or asset is in operation. Customers across all markets are evaluating and adopting smaller inspection-class ROVs due to significant cost savings they offer over traditional inspection methods. In many of our markets we are still in the early adopter phase of the product life cycle. We expect significant growth over the next several years as capabilities expand.

In your opinion what are the top one, two or three technologies that are driving the ROV market today?

Bates, Saab Seaeye The market wants their vehicles to be smarter, more versatile and fully capable. The technological challenge is to meet this comprehensive demand with the optimum range of vehicles at the lowest possible real cost. Starting with smarter technology, what an operator wants is intelligent control that keeps a vehicle stable and on station, provides full and meaningful information, is easy to fly and has the best redundancy options possible.

In terms of versatility, operators want powerful vehicles that can undertake more tasks than ever before at the lowest cost. They are increasingly seeking more powerful electric work ROVs to take on the roles of hydraulic work vehicles to save money and offer greater flexibility. They also want vehicles that can meet the new challenges of working in difficult to access areas and in remote places accessible only to electric vehicle systems. Finally, operators want comprehensive capability in a vehicle, with the control architecture, power and stability that will allow them to fit a wide range of sensor systems and tooling options ready to undertake the widest range of tasks in a single vehicle.

Above: The SeaBotix VLBV



Right: Peter Ranelli, Teledyne Marine Systems.

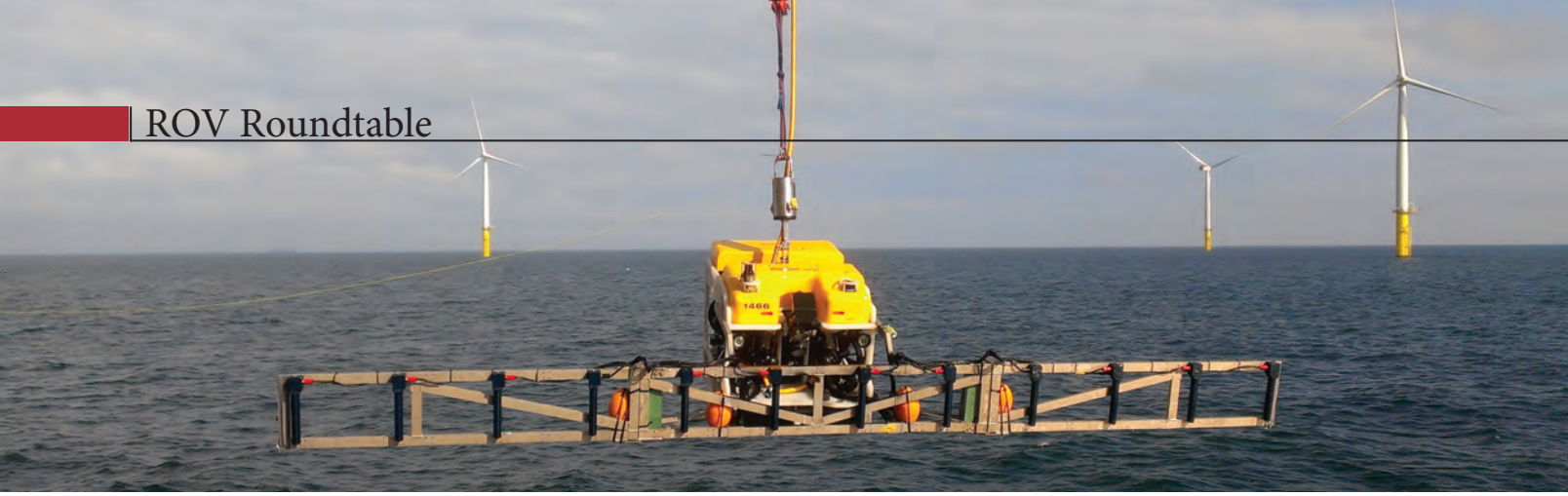
Murrie & Ranelli, Teledyne Marine Systems New sensors, especially high resolution sonars and improved positioning and control systems, are advancing the ROV market.

Gibson, Videoray Two or three years ago I would have discussed, speed, depth, stability, and camera technology. However, we've set standards on all these that are sufficient to exceed most of our customer's requirements. Now, I believe the technology driving the ROV market further and faster is engineering "ease of use" into the system, no matter the size or capability. With the introduction CoPilot, our autonomous control software from SeeByte for our ROVs, we have taken a massive step in the ease of use department. It's easier to make someone successful when they can just point and click to fly to a location or target when they might not be as strong of a traditional joystick ROV pilot.

When we discuss ROVs, we often discuss "getting the diver out of the water." From where you sit, what are the main market uses for ROVs today, and how (or is) that changing?

Murrie & Ranelli, Teledyne Marine Systems ROVs in our segment of the market are well suited to defense and security missions such as port security and explosive ordnance disposal. They are also of utility in infrastructure, such as bridge or dam, inspection and emerging commercial segments such as offshore renewable energy and aquaculture.

Gibson, Videoray Although



Saab Seaeye Cougar XT Compact, fitted with Innovatum's Smartsearch system.

ROVs used to be considered just "eyeballs under the water," they have become a quick, easy, and inexpensive way to collect as much information as possible. As the ROV's capabilities continue to expand to include new sensors, such as sonar, positioning systems, additional cameras, autonomous control, laser scalers, and radiation detectors, the more useful the ROV becomes to its operator. By collecting this information remotely, it reduces the need for divers to get in the water to collect it manually.

We have always felt that an ROV is the perfect complement to a diver and not meant to replace them – except when the situation has potentially fatal consequences. Pre-dive surveys allow divers to get an idea of where they are going and what they need to do, which ultimately reduces the risk that divers face during deployment. Once they are in the water, ROVs can be used to monitor diver activities and ensure their safety in any environment.

One prime example of removing the human element is removing them from internal vessel ballast tank inspections. One look at the inside of these dark and dangerous mazes and you would be puzzled as to how humans could have ever safely inspected these. The VideoRay ROV offers the perfect tool to safely and efficiently perform internal ballast tank structures while the vessel is in service, in a cost effective manner, while remaining in compliance and saving lives.

Bates, Saab Seaeye ROVs play a widely diverse and changing role in the undersea world, with operators constantly discovering new applications that exploit the technology to its utmost, while also adapting vehicles in a unique way to solve new problems. And as electric ROVs become more powerful and the systems become more sophisticated, they are increasingly being used more extensively for survey and work class applications. At Seaeye's traditional end of the market asset inspection and diver support still play a big role, particularly in shallow waters.

How is your company investing today in ROV technology?

Gibson, Videoray We're developing much deeper systems, with more modular configurations. These may be used as fly outs, or on garages.

Bates, Saab Seaeye We have invested in an overarching system we call our Technology Toolbox. The concept distills our core technology across all products into a common architecture to create the lowest number of parts at the least possible cost for the highest possible performance and quality.

Big picture, what signs or indicators do you monitor to gauge the future direction of the ROV market? What are those signs/indicators telling you now?

Gibson, Videoray The indicators we look at are how much is being done (or should be done) underwater, and how much can be done more effectively by our technology. The lower price for oil is generating a considerable interest in getting the tasks that are currently done by work class vehicles done more efficiently and therefore much cheaper. We expect to have a major role in that.

Murrie & Ranelli, Teledyne Marine Systems The ROV market, especially for compact units, is diverse and there is no single indicator that stands out. Oil and gas activity is clearly driven by the price of oil and operator capital spending. Currently the outlook for this sector is mixed. Large projects seem to be at risk but a focus on cost controls present opportunities for low-cost high value offerings to grow. Defense and local government activity can respond to predictable budgets or emergent events. This picture is also mixed, with much defense spending currently focused outside the Naval domain. But global markets, especially in the Pacific, continue to face marine security and management challenges and should provide strong opportunities for the future.

Bates, Saab Seaeye While the oil and gas market is facing challenging times the demand for vehicles to support offshore production and carry out IRM continues. We anticipate investment will focus on economically effective ROV solutions that offer the greatest capability for the lowest real cost. However, in the longer term we see extraction going deeper and into more difficult to access locations, and have we have the technology to meet these challenges.

(Photo Credit: Alex Messenger)

Above (left): VideoRay Under Ice; **Above (right)**: Chris Gibson, VP, Videoray.
Below: VideoRay performed in one of the most historic salvage operations ever; the set-up for the removal of Costa Concordia.

Modern Tech *for a Cold Case*

By Rhonda Moniz, Sales Engineer, Seabotix

In January 1971, a phone rang in the living room of a family in Atlanta, Ga. Lem Nikita, then 19, answered the call which confirmed that his father George Nikita's plane had crashed somewhere over Lake Champlain during a blizzard shortly after takeoff. The elder Nikita was the pilot of a 10-seat Jet Commander owned by Cousins Properties, Inc. It was enroute from Burlington, VT, to Providence, RI, to pick up one of the pilots wives before continuing on to Atlanta.

George Nikita's (above left) plane with four passengers crashed in a blizzard over Lake Champlain in 1971. It took 43 years and a collaboration of modern technology to help solve the mystery. (Top right) The morning briefing; (Bottom right) the Seabotix ROV in action.

Forty-three years later a team of gathered together, equipped with modern underwater technology (Seabotix, OceanServer, Greensea Systems) to re-open this cold case.

Five men were on board. Shortly after take off from Burlington airport, the Aero Commander disappeared from radar. Due to the severity of the weather all rescue attempts were temporarily put on hold. Despite several items washing ashore, the plane was never found, the bodies never recovered.

Forty-three years later a team of investigators gathered together equipped with modern underwater technology to re-open this cold case. Using OceanServer's Autonomous Underwater Vehicle (AUV) with side scan sonar, the team began to search the lake bottom. "We ran transects with the AUV's. Our systems have side scan sonar and are the perfect tool for getting the necessary data in deeper water," said **Jim Kirk, Marketing Director for Ocean Server**. "We can get into those areas of the lake that would be difficult with towed side scan." Once the targets were located, a team from SeaBotix and Greensea Systems then deployed the SeaBotix vLBV ROV with Greensea Systems' SmartFlight software to identify the targets.

A large part of the search area is in several hundred feet of water making the investigation more challenging. Low visibility made locating the jet difficult. Added to that is the unpredictability of the lake itself. Lake Champlain is 490 square miles and lies in the Lake Champlain Valley between Vermont's Green Mountains, and the Adirondack Mountains of New York.

The expedition had two phases. During phase one the team used AUV and side scan sonar technology to run transects in areas along the flight path. Once the side scan sonar data was reviewed by the team, a decision was made to inspect targets that looked promising. Phase two was the dive operations phase. "Our role is to identify targets that have been found during the search phase," said **Ben Kinnaman, CEO of Greensea Systems**. "What we do is take our SeaBotix Remotely Operated Vehicle and put it down on the target site. Because there is no visibility on the bottom and it is very dark, we use sonar and our navigation software SmartFlight to find the object. SmartFlight enables us to punch in the coordinates, both latitude and longitude from the AUV data. The ROV then drives to that position. Once we are at those coordinates, we turn on the lights to see what is down there".

The vLBV300 ROV is rated to 300 meters (984 feet) and has bollard thrust with 18.1-22.5 kgf (40-50 lbf) forward. Dual vertical thrusters offer greater vertical control and roll stabilization. When using the SmartFlight software, the pilot can engage the forward thrusters and the vehicle will drive to the set coordinates. "We provide a lot of autopilot capabilities, so dynamic positioning, auto altitude, auto depth. We also provide high level mission planning. So you can organize your entire mission before you go out and then you can just persecute the targets efficiently. Being in the field can be costly so anything that can make the operation more efficient will save money in the end," explained **Colin Riggs, Software Developer at Greensea Systems**.

Operations on Lake Champlain began late last summer. The family of the lost pilot, George Nikita, waited patiently onshore during field operations. The team located and identified a number of targets, although none of them to date has proven to be the lost aircraft. The search was suspended until next year as the crew regroups over the next several months and looks at plans to bring in other sensors for both the AUV and ROV platforms

Fred Fayette lives on Lake Champlain and was involved in the original side scan search shortly after the plane was lost. All these years later, he is a part of this new crew currently taking up the search. "It is like finding a needle in a haystack. It's a large area we are looking in. We have all this great technology from SeaBotix, OceanServer, and Greensea Systems. The operations so far have gone well. We have had good weather. The ROV functioned well with the SmartFlight. We were able to get on the sites quickly. The problems we ran into on the second investigation were due to changes in the lake since the last time we were out there. There have been several storms causing a large amount of vegetation to head into deeper water. We have surveyed this lake for years and have found over three hundred ship wrecks. We have found two planes, neither of which is this plane. We have found thousands of anomalies that we just do not know what they are. One of those could be our aircraft. It is not an easy job. I always tell people when they ask me why we have never found this particular plane. I always respond the same…the lake you know… she doesn't give up her secrets easily."

Before operations commenced, several vessels gathered on the lake including one with the Nikita's family onboard. A few words of gratitude for the investigators efforts were expressed over the boats radio by family members, including George Nikita's daughter who was three years old when the plane went missing. A wreath was then placed on the surface of Lake Champlain in memory of loved ones lost. Facing a daunting task, the investigative team continues to pour over documents and side scan sonar images hoping that in the near future the lake may finally… give up just one more of her secrets.

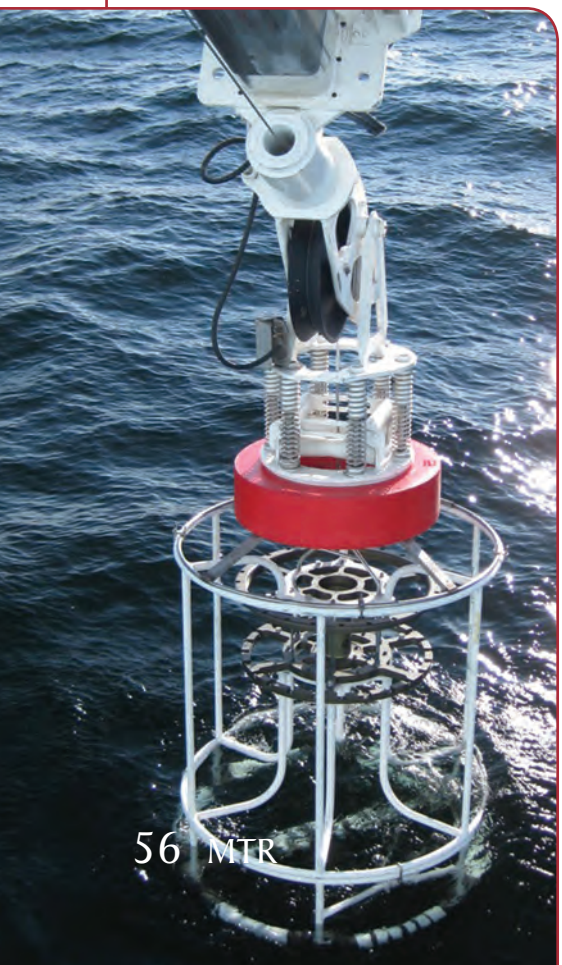
Outfitted for Heavy Lifting

The R/V Sikuliaq, the Alaska Regional Research Vessel (ARRV) operated by the University of Alaska Fairbanks, boasts the latest in cutting edge electric deck machinery that was engineered and manufactured by Rapp Marine. Rapp Marine served as the Scientific Handling Systems Integrator on the ARRV project. In order to effectively operate and conduct surveys in subzero climates, Rapp Marine designed a flexible suite of winches and handling equipment that is designed to lower and raise ROV units deep into the frigid, Arctic waters.

Rapp Marine has also recently supplied newly built equipment for the R/V Investigator in Australia

Baltic Room Over-the-Side Handling Gear

A Load Handling System (LHS) which works together with the CTD and Hydro winches, which are capable of Electric Active Heave Compensation. The LHS System is configured to deploy scientific equipment over-the-side through the Baltic Room door on the starboard side of the vessel and is rated to handle a maximum working load of 11,100 lbs.



Hydrographic\CTD AHC Electric Winches in the Baltic Room

The combined system consists of both Hydrographic and CTD winches. The arrangement will allow both the CTD and Hydro winches to be capable of leading over the side via the Baltic Room System, or to the aft deck via the flag block to starboard at the aft end of the hangar. The primary routing for the CTD will be over the Baltic Room hydroboom and the primary routing for the Hydro winch shall be to the aft deck through the flag block to starboard on the aft end of the hangar. From the flag block, the wires shall be capable of leading to the stern A-frame or to the hanging block on the starboard knuckle-boom crane.

The Hydrographic winch has pull of 11,000 lbs and wire capacity of 33,000 feet of 0.322 EM cable or 26,000 feet of 0.375 EM Cable. A bolted Lebus shell and Rapp electric level wind system that can automatically adjust to the cable diameter without having to change any mechanical component when the drums are changed out shall be provided for the winch

Oceanographic Traction Winch

One electric oceanographic traction winch system with two storage drums, model TRW-4000EB, is installed on the vessel. The traction winch system is capable of handling 0.680-inch diameter electromechanical cable, 0.681-inch fiber-optic cable and 9/16-inch diameter 3 x 19 torque-balanced GEIPS IWRC rope, the storage drums has Lebus sleeve installed. The traction winch has a maximum working load of 25,000 lbs. with minimum retrieval speed of 60 m/min at maximum load.

PTS Pentagon R Computer System

Rapp Marine provided the PTS-Pentagon R computer system for the Oceanographic Traction, Hydrographic, and CTD Winch System. The system monitors and controls the speed, line pull, power/amp and wire length as well as Active Heave Compensation of all winches. Logging of each sequence according to user specification is integrated in the system. Each winch has local controls on the winch as well as controls in the Winch Control Room.

Currently, Rapp Marine is supplying equipment to 8 new research vessel projects.

MacArtney for Chinese Research Vessel

(Photo: Geotek)

MacArtney delivered a MERMAC R40 RA winch to the Hunan University of Science and Technology, Xiangtan, China. The order was realized in cooperation with SeaTech China in its role as exclusive MacArtney product and system representative on the Chinese market for underwater technology. The winch was procured with support from the 863 state high tech research and development plan and will be installed onboard the RV Ke Xue (pictured), an advanced multi-purpose research vessel in China. The supplied MERMAC R40 RA winch is among the first electric driven winch systems with AHC to enter service in China. The purpose of AHC is to keep a load, held by a vessel, motionless with regards to seabed, independent of the wave motion, allowing operators to sustain subsea equipment operation, even during adverse weather conditions and higher sea states. AHC is enabled by using the data from a motion reference unit to detect vessel displacement (heave, pitch and roll). A control unit on the winch system then calculates and executes the actions necessary for the winch system to respond to- and compensate for the movement.

Huisman for Maersk Subsea Vessels

In December 2014, Huisman won a contract from COSCO (Dalian) Shipyard for the delivery of four customized 400mt Rope Luffing Knuckle Boom Cranes and two 100mt Knuckle Boom Cranes onboard four new subsea support vessels (SSVs) for Maersk Supply Service. The first vessels, Marin Teknikk design MT 6027, are scheduled for delivery in Q4 2016.

The contract between COSCO (Dalian) Shipyard and Huisman contains an optional scope for two 400mt Rope Luffing Knuckle Boom Cranes for two additional vessels. Huisman's sister company SMST will deliver the two 100mt Knuckle Boom Cranes with options for four more cranes. The components for the four Rope Luffing Knuckle Boom Cranes will be built at the Huisman facilities in China, the Netherlands as well as in Czech Republic. They will be transported to the COSCO Shipyard in Dalian, China for final installation, commissioning and testing onboard. Huisman said the new patented Rope Luffing Knuckle Boom Crane is especially designed for subsea installations in increasingly deeper water and offshore construction in severe weather conditions. The active heave compensated (AHC) cranes combine the benefits of a normal Rope Luffing Crane and a traditional Knuckle Boom Crane, offering a low overall construction weight, high lifting height and large capacity at outreach.

(Photo: Huisman)

Flexible Control from Rexroth

Rexroth has developed a new control solution that is suitable for both simple and complex winch and crane drives. Designers can generate new systems quickly and flexibly with it. The control system from Rexroth can easily be connected to the customer's system using predefined interfaces. Numerous hardware variants in the form of an extensive modular system allow the designer maximum flexibility and reduce costs and errors during commissioning by means of a simple "plug-and-play" interface. In the software, for example, the designer can access standardized modules for control functions. Integrated security features ensure compliance with the required safety level. The modular structure of the software makes using the control system very flexible, in both simple and complex applications. Modifications, enhancements, and the interface to the customer's system can be tested and adjusted by the designer directly on a test stand provided.

(Photo: Battelle)

New Subsea Camera Integrated with ROV

Battelle's HorizonVue undersea camera was integrated with a ROV as part of a demo in the Quincy Shipyard, home of Battelle's Bluefin Robotics. The new camera allowed operators to see the harbor floor, a nearby hull and navigate through submerged pilings using a 360-degree live video feed. The instrument can operate at the ocean's surface or down to depths of 4,500m, withstanding pressure of 6,575 pounds per square inch. Intended for use by Work Class ROV operators, and the subsea oil and gas industries, the camera provides enhanced situational awareness in areas where keeping track of multiple objects simultaneously is critical. The HorizonVue M360 Deep is designed to reduce the time, effort and expense needed to work in crowded, complex undersea environments. The cameras are available for demonstrations.

www.battelle.org

Fugro's OARS & 'Virtual Surveying'

Now operating in the Gulf of Mexico, OARS (Office Assisted Remote Services) provides virtual surveying services to dive vessels for their self-mooring and positioning needs. It eliminates the requirement for a surveyor to be present onboard vessels, delivering savings in both costs and time. Its remote system set-up requires a client-provided internet connection between the OARS unit onboard the vessel and the experienced survey party chiefs at the OARS Command Center at the Fugro office in Lafayette, LA. Through 24-hour operations, OARS provides survey services for positioning, such as software control and monitoring operations, as well as a hotline for direct communications – replicating a surveyor being present onboard the vessel.

ESS Buoyancy Solutions for Bluefin AUVs

Engineered Syntactic Systems (ESS) provides syntactic buoyancy for Bluefin Robotics AUVs. The Bluefin 21 was designed for extended remote operations in the hostile conditions of the deep sea. At 21 in. in diameter, space for uplift (buoyancy) is limited, but critical. ESS said it worked with Bluefin to engineer a buoyancy solution that would meet their design specifications, providing a syntactic material with the lowest density available for that depth, thereby the most lift.

(Photo: Engineered Syntactic Systems)

(Photo courtesy of JW Fishers)

ROVs Aids Recovery at Air Asia Crash Site

Late last year AirAsia Flight QZ8501 left Surabaya, Indonesia bound for Singapore with 162 people on board. Forty six minutes later, the plane disappeared from radar somewhere over the Java Sea. For three days, 30 ships and 21 aircraft from Indonesia, Australia, Malaysia, Singapore, South Korea and the U.S. scoured the area. When debris and bodies were finally spotted, a team was assembled to recover the victims and find as many pieces of the aircraft as possible. The 100-ft. water depth allows for divers to be used in the recovery work alongside remote operated vehicles (ROV), however strong currents

and high seas are causing delays. The operation was led by Indonesia's national search and rescue agency, Basarnas, who is getting assistance from teams in Singapore, Malaysia and Australia. Basarnas recently acquired several of JW Fishers ROVs and side scan sonars, along with diver-held video systems. It is also equipped with a scanning sonar, which is like radar for underwater use.

www.jwfishers.com

Underwater Metal Thickness Gauge

The Mark 2 Tritex Multigauge 3000 Underwater Thickness Gauge, from U.K.-based Tritex NDT Ltd., uses multiple echo to completely ignore coatings up to 20mm thick, only the metal thickness is measured. All measurements are error checked to ensure only accurate readings are displayed, even on uncoated metal. It has a large bright 10mm display which is designed to be easily read by the diver, even in poor visibility.

(Photo: Tritex)

www.tritexndt.com

SeaView Multiplexer

Communications for Legacy ROV's and Space Constrained Submersibles

While ROV technology is constantly advancing, the data demands of payload sensors and cameras have increased by leaps and bounds. This has created a bandwidth gap between many legacy ROV's and their ability to feed the data they produce back via an umbilical fiber.

Enter SeaView Systems, a leading provider of ROV services, custom vehicles, and hardware, whose OmniData multiplexer stack is designed to breathe new life into legacy ROV platforms hampered by bandwidth constraints.

Many ROV's provide a data backbone that might support 2 or 3 standard definition cameras and some serial data. Managing the demands of multiple HD video streams or applications such as multi-beam sonar, often requires additional cards in vehicles where space is at a premium.

SeaView's multiplexer and data converter suite break through this bottleneck with pin compatible PC-104 form factor replacements for the slower cards designed into numerous existing ROV platforms.

The SeaView multiplexer provides a handy set of video, serial, and Ethernet ports (including RS485-232 conversion) and timing triggers, all on a single card. In the case of especially demanding applications, SeaView's multiplexer can be linked with their Gigabit Ethernet converter and dual channel HD-SDI boards to transmit all this data on one single mode fiber.

An early customer for the product was Tetra Tech, a leading underwater survey company. Their Marine Mapping Group have deployed the SeaView stack as part of their Towed Electromagnetic Array (TEMA), a tow sled that performs undersea surveys targeting activities including detection and mapping of unexploded ordnance, cable and pipeline route surveys and O&M monitoring.

The design restraints of Tetra Tech's TEMA required it to be small enough to be rapidly transported and deployed from a vessel of opportunity while still able to provide a very comprehensive suite of sensors, lights and cameras. The demand for very high bandwidth data transfer, to multiplex up live HD video, still DSLR images, as well as all the data from altimeters, temperature sensors, and electromagnetic systems – all up one single-mode fiber cable, presented Tetra Tech with a challenging engineering problem. SeaView's multiplexer was a perfect fit, according to Richard Funk, Senior Geophysicist for Tetra Tech and designer of the TEMA vehicle.

"The enhanced bandwidth these multiplexers offer provides the flexibility to manage a wide range of sensors," said Matthew Cook, President of SeaView Systems. "Now you'll have the bandwidth to future -proof your existing ROV platform."

Technical Specs

SVS-109 Video and Data Multiplexer:

- 3 channels Standard Definition Video
- 10/100 Ethernet (2 port onboard switch)
- 4 RS-485 channels
- 2 RS-232 channels
- 2 RS-485/RS-232 configurable channels
- 2 High speed triggers for sonar and USBL timing

SVS-209 GigaBit Ethernet to Fiber Converter:

- Auto sensing Gbit Ethernet converter able to support 1000mbps, 100mbps and 10mbps Ethernet data rates.

SVS-309 HD-SDI to Fiber Converter:

- 2 channel video data transmission. Able to support 1080p and lower video formats with zero compression. Available in a range of CWDM frequencies.

Byus

Lewis

(Photo: Nautronix)

Powell

(Photo courtesy of BIRNS)

Nuntavong

(Photo courtesy of BIRNS)

Byus Heads Battelle Maritime Technologies

Battelle announced that its array of maritime technologies will now be housed under one leadership structure lead by Rear Admiral Fred Byus, USN (Ret.). These include for-profit, wholly owned, and autonomous subsidiaries Bluefin Robotics and SeeByte. Byus will be working closely with Rich Leonard, interim CEO of Bluefin Robotics and SeeByte CEO Bob Black.

Lewis Promoted at Nautronix

Cara Lewis, who has been with Nautronix for two years as senior marketing coordinator, has been promoted to marketing manager and will be responsible for managing Nautronix' branding and marketing strategy. Prior to joining Nautronix, Lewis was with DOF Subsea.

Teledyne to Host Workshop

Teledyne Marine will host an expanded users' workshop later this year, building on Teledyne RDI's ADCPs in Action Users Conferences and Teledyne Marine Acoustic Imaging's Underwater Technology Workshops. This new three-day workshop, entitled the Teledyne Marine Technology Workshop, will be hosted in San Diego, from October 4-7, 2015.

teledynemarine.com

BIRNS Expands Sales and Marketing Team

BIRNS, Inc. expanded its sales and marketing force with the addition of Laura Powell as sales associate and Penny Nuntavong as sales and marketing associate. Powell brings more than 25 years of sales experience to the role. Nuntavong has more than nine years of business sales and marketing experience and will support sales efforts for the company's global dealer network, in addition to handling marketing responsibilities including public relations, advertising and social media.

HYPACK Hosts Training Event

More than 250 attendees, 25 exhibitors and 6,000 remote viewers from around the world participated in the HYPACK 2015 Training Event in San Antonio, Texas. HYPACK also unveiled its new version of HYPACK 2015.

hypack.com

Bourbon Expands ROV Fleet

Bourbon commissioned three next-generation Heavy Duty Work ROVs (Remote Operated Vehicles) designed by FMC Technologies Schilling Robotics. Capable of operating at depths of up to 3,000 meters, these underwater vehicles will be deployed on Multipurpose Support Vessels (MPSV) such as the Bourbon Evolution 800 series. Fitted with high-tech equipment: manipulator arms, dynamic positioning, high definition camera, sonar and software; these HD Work ROVs are highly maneuverable. They can carry up to 3,000 kg of special measurement or intervention tools. They are suited for activities such as survey, wellhead installation or asset tie-in.

Polarcus Names Starr CEO

Rod Starr will succeed Rolf Ronningen as Polarcus' next chief executive officer. Starr joins Polarcus from TGS-NOPEC Geophysical Company. He has over 30 years industry experience, starting his career with Unocal where he spent 16 years.

MacArtney Opens Fifth North American Location

The MacArtney Underwater Technology Group has innaugurated its fifth dedicated business unit in North America. Located in Jupiter, Florida, just north of West Palm Beach, the new MacArtney Southeast Operations will cover a six-state area including Tennessee, North Carolina, South Carolina, Alabama, Georgia and Florida. The unit is headed by General Manager, Lou Dennis, a long-serving industry professional who brings in three decades of experience.

ATLAS N.America Acquires Marine Sonic Technology

ATLAS North America LLC. (ANA), a wholly owned subsidiary of Atlas Elektronik GmbH, Germany, has acquired the business of Marine Sonic Technology (MSTL), Ltd., based in Yorktown, Virginia, via an asset deal. Terms of the transaction were not disclosed.

LandScope Buys Teledyne BlueView Scanner

Teledyne BlueView said that UK based Landscope Engineering has purchased its 3D Multibeam Scanner, BV5000 3D.

Michael J. Stewart Retires

When *Marine Technology Reporter* visited the Oceans 2014 exhibition in St. Johns in September we learned that **Michael J. Stewart**, a ubiquitous figure in the subsea sector for more than four decades, will retire from McArtney effective this month. Stewart has been with MacArtney for more than 20 years in a variety of forms, made permanent when MacArtney bought his company MJ Stewart Associates.

"When I first started with the company (MacArtney) we were about $6-7 million (per year) and now we are more than $100 million," said Stewart. "It has been a great run, they are a great company; they do a really good job of understanding the business that they are in. MacArtney sees what the customer needs, and then they aim to become the preferred solution. They spend money to make money: they make the investments that they need to make and I think that's a key why we have grown so fast and stayed profitable."

Stewart began his career in the subsea world after graduating from the United States Merchant Marine Academy (USMMA) in 1965. After sailing with the U.S. merchant marine during the Vietnam War, Stewart was lured ashore courtesy of a request from his wife, and a job with a company that was making marine radio facsimile for weather charts, which led to involvement with the company's sonar products.

Stewart's career has been broad and interesting, including work and personal relationships with some industry luminaries including Bob Ballard, Marty Klein and Charlie Black.

In fact, for some time he ran a company with Bob Ballard, the company Marquest. "I was supplying equipment, and Ballard needed someone to run his company so we made a perfect pair. I knew how to run operations, and he had the vision and charisma … he was the leader." Marquest was built to more than 40 people, but as Stewart succinctly summarized: "the Cold War ended," and so too did Marquest. Following Marquest Stewart opened MJ Stewart Associates, which he ran until MacArtney bought the organization. In reflecting on the breadth of his career, Stewart reckons that while technology has changed mightily in capability and price, one thing remains the same. "The technology has changed. We sold GPS systems for a million dollars that gave you 20m accuracy back in the early 80s; now I have a chart on my iPhone that's better than that," said Stewart. "But the people are the same. Bottom line, you have to have people that can go to sea, and make this stuff work at sea, and that's a whole different ballgame."

"The technology has changed … But the people are the same. Bottom line, you have to have people that can go to sea, and make this stuff work at sea."

Michael Stewart, reflecting on 40 years in the subsea sector

As Stewart sails toward retirement and ponders working his golf game (not that he needs it, with a handicap of 8) and future courses of cruise on his 33-ft. Grady White, he is proud of the legacy he has left and is particularly proud that his daughter Jennifer remains at the helm of MacArtney Northeast Operations.

"What I'm most proud of is building a business and seeing it grow from one customer in North America to a multi-million dollar business, and being respected by the industry for the product we sell," said Stewart. Not quite yet in retirement mode, he emphasized that "we try not to sell a product, we sell a solution."

PRODUCT & PROFESSIONAL SERVICES DIRECTORY

Advertiser Index

For Fast, Free Information from Advertisers visit www.maritimeequipment.com/mt

Page	Company	Website	Phone#
43	ASL Environmental Sciences Inc.	www.aslenv.com	Please visit us online
21	Birns, Inc.	www.birns.com	(805) 487-5393
33	Bluefin Robotics Corporation	www.bluefinrobotics	(617) 715-7000
15	C & C Technologies, Inc.	www.cctechnol.com	Please visit us online
11	DOE Incorporated	www.deepocean.com	(408) 436-1102
27	Evans Capacitor Co.	www.evanscap.com/deepwater_products.html	(401) 435-3555
C3	EvoLogics GmbH	www.evologics.de	49 30 4679 862 0
C4	Forum Energy Technologies	www.f-e-t.com/subsea	Please visit us online
25	Hydroid	www.hydroid.com	(508) 563-6565
41	Hydro-Lek Ltd	www.hydro-lek.com	+44 (0) 118 9736903
36	JW Fishers Mfg Inc.	www.jwfishers.com	(508) 822-7330
23	Kongsberg Maritime Subsea	www.kongsberg.com	011 47 32 28 500 00
49	Meridian Technologies Inc.	www.meridian-tech.com	(516) 366-8175
63	Ocean Business 15	www.oceanbusiness.com	Please visit us online
37	OceanServer Technology, Inc.	www.ocean-server.com	(508) 678-0550
9	Path the Arctic	www.thearcticpath.com	Please visit us online
47	RJE International	www.rjeint.com	(949) 727-9399
31	Rowe Technologies, Inc.	www.rowetechinc.com	(858) 842-3020
7	Saab Seaeye Ltd.	www.seaeye.com	Please visit us online
35	SBG Systems	www.sbg-systems.com	Please visit us online
17	Seacon Europe LTD	www.seaconworldwide.com	011 44 149 365 2733
45	Seatronics Ltd.	www.predator-rov.com	Please visit us online
51	Seco Seals, Inc.	www.secoseals.com	(714) 546-3478
29	Shark Marine Technologies Inc.	www.sharkmarine.com	(905) 687-6672
33	SNAME	www.sname.org	Please visit us online
19	SouthWest Electronic Energy Corp	www.swe.com	(281) 240-4000
45	Specialty Devices, Inc.	www.specialtydevices.com	(972) 429-4240
47	SubCtech GmbH	www.subctech.com	+49 (0) 431-22039 880
57	Subsalve USA Corporation	www.subsalve.com	(401) 884-8801
39	Teledyne Blueview	www.blueview.com	(425) 492-7400
13	Teledyne Marine Interconnect Solutions	www.teledynemis.com	Please visit us online
3	Teledyne RD Instruments	www.rdinstruments.com	Please visit us online
5	Teledyne SeaBotix Inc.	www.SeaBotix.com	(619) 450-4000
29	Valeport Limited	www.valeport.co.uk	44(0) 1803869292
C2	VideoRay LLC	www.videoray.com	(610) 458-300L
1	World's Cold Ocean Laboratory	www.btcrd.gov.nl.ca	Please visit us online

UNDERWATER COMMUNICATION AND POSITIONING SOLUTIONS

Evo Logics®

S2C technology: communication and tracking combined for a wide range of subsea applications

- time, space and cost-saving solutions
- low power consumption for autonomous operations
- advanced data delivery algorithms, addressing and networking, remotely configurable settings
- extendable platform with multiple configuration options: power-saving Wake Up module, acoustic releaser, additional sensors, custom solutions, OEM versions available

USBL POSITIONING SYSTEMS

simultaneous positioning and communication - no need to switch between positioning mode and modem mode

- multiple target tracking
- reliable data transmissions
- range: up to 8000 m
- accuracy: up to 0.04 degrees

LBL POSITIONING SYSTEMS

highly accurate, precise and stable performance

- multiple target tracking
- range: up to 8000 m
- accuracy: better than 0.01 m

UNDERWATER ACOUSTIC MODEMS

reliable data transmissions even in adverse conditions

- range: up to 8000 m
- depth: up to 6000 m
- data rate: up to 31.2 kbps
- bit error rate: better than 10^{-10}

EvoLogics GmbH
Ackerstrasse 76,
13355 Berlin, Germany
tel.: +49 30 4679 862-0
fax: +49 30 4679 862-01
sales@evologics.de
evologics.de

everything remotely possible™

FORUM™

SUBSEA TECHNOLOGIES

everything remotely possible™

To learn more about our products and services, visit us at f-e-t.com/subsea.