MARINE TECHNOLOGY REPORTER

May 2016

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Inside Boeing's Phantom Works & Building the 51-ft. UUV

Echo Voyager

Subsea Defense
Is Bigger Better?

Inside Norway's
Subsea Valley

New Technology
OI '16 Round-Up

Volume 59 Number 4

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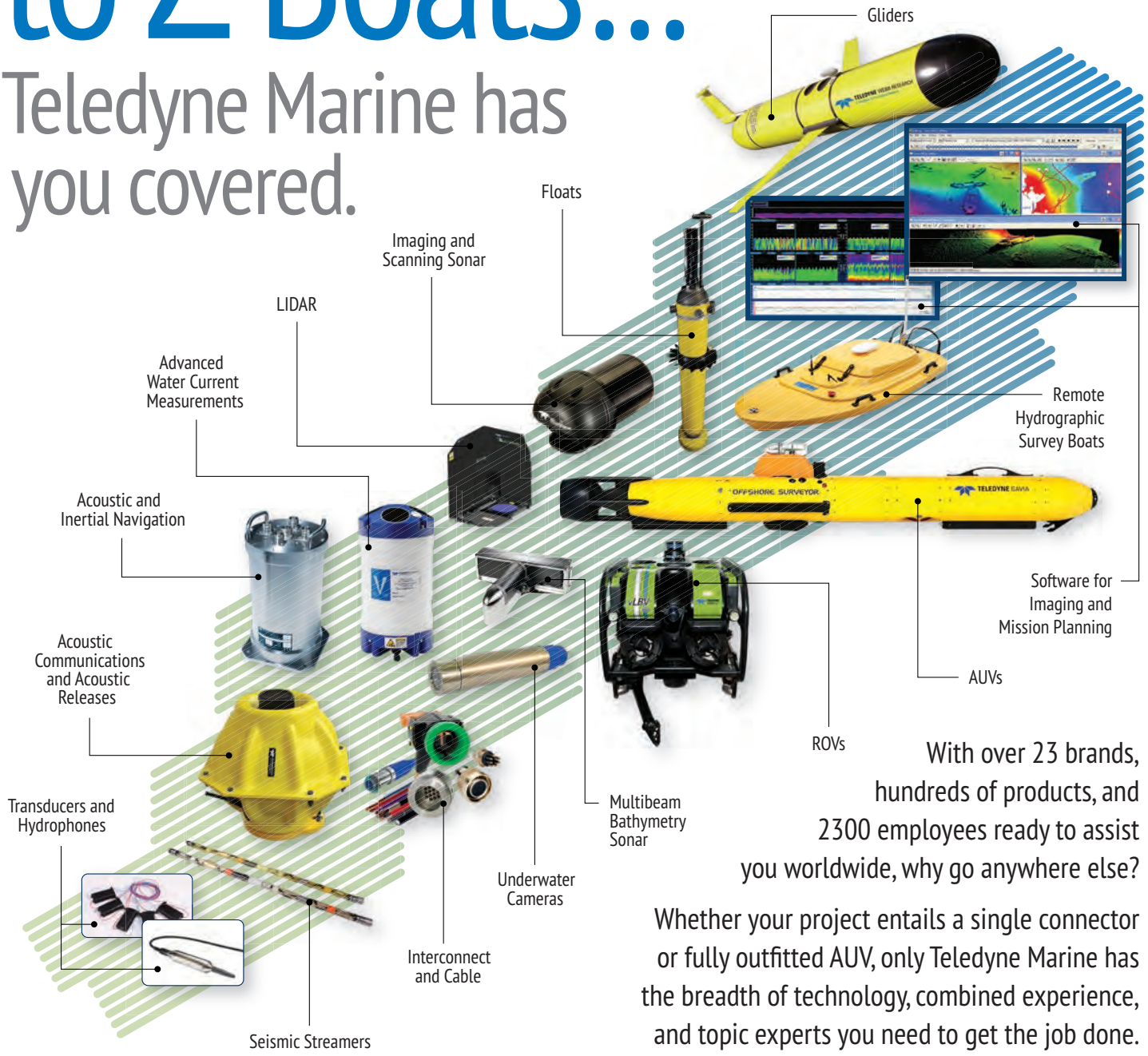

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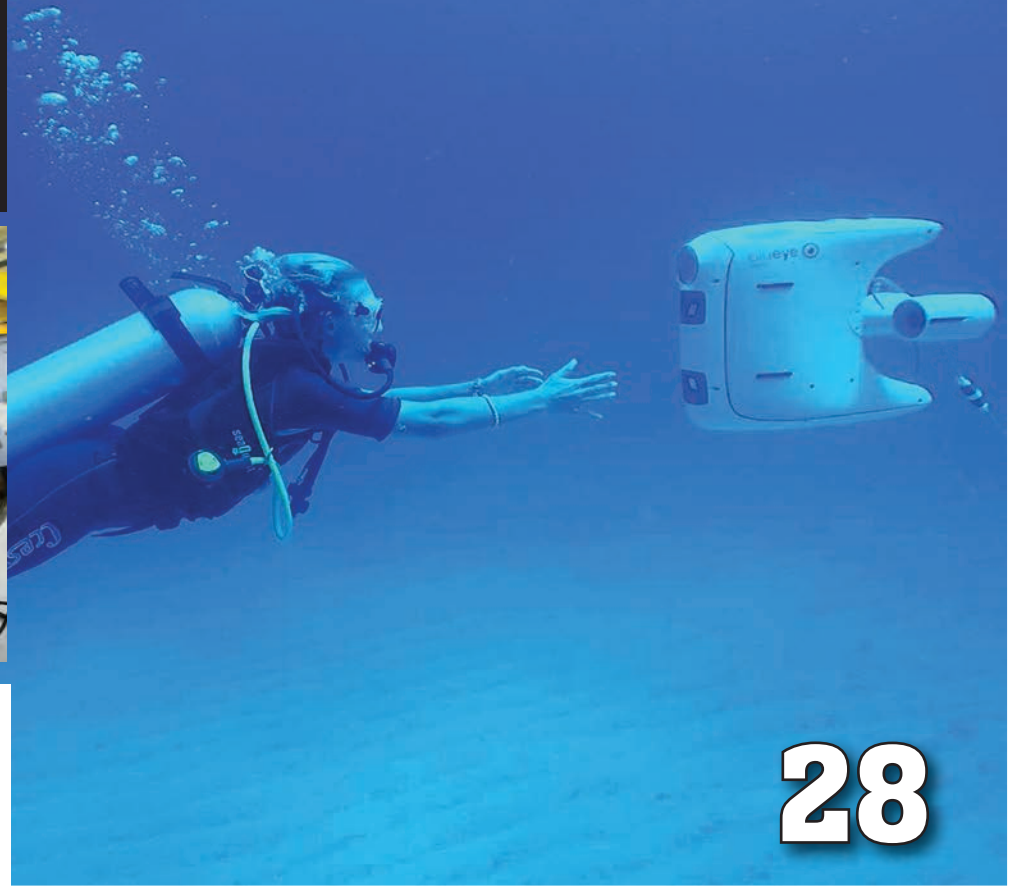

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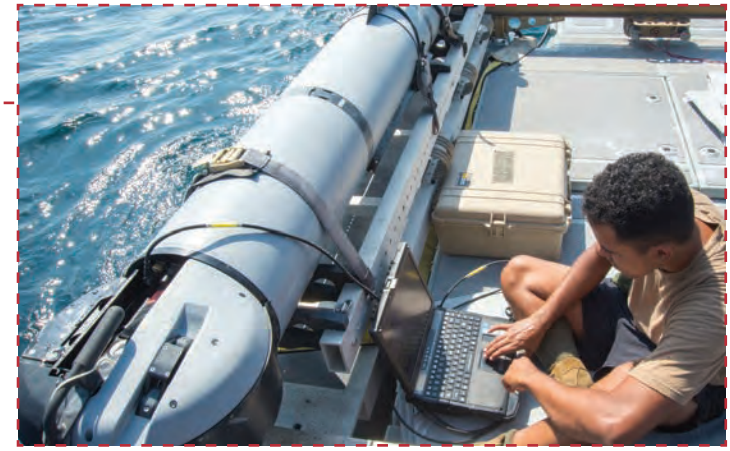

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Edward Lundquist

Edward Lundquist is a retired naval officer who writes on naval, maritime, defense and security issues. He is a regular contributor to Marine Technology Reporter.

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William Stoichevski

William Stoichevski lives and works in Oslo, and is a regular contributor to MTR.

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Insights on the blue tech & blue economy from the new executive director of The Maritime Alliance.

By Greg Trauthwein

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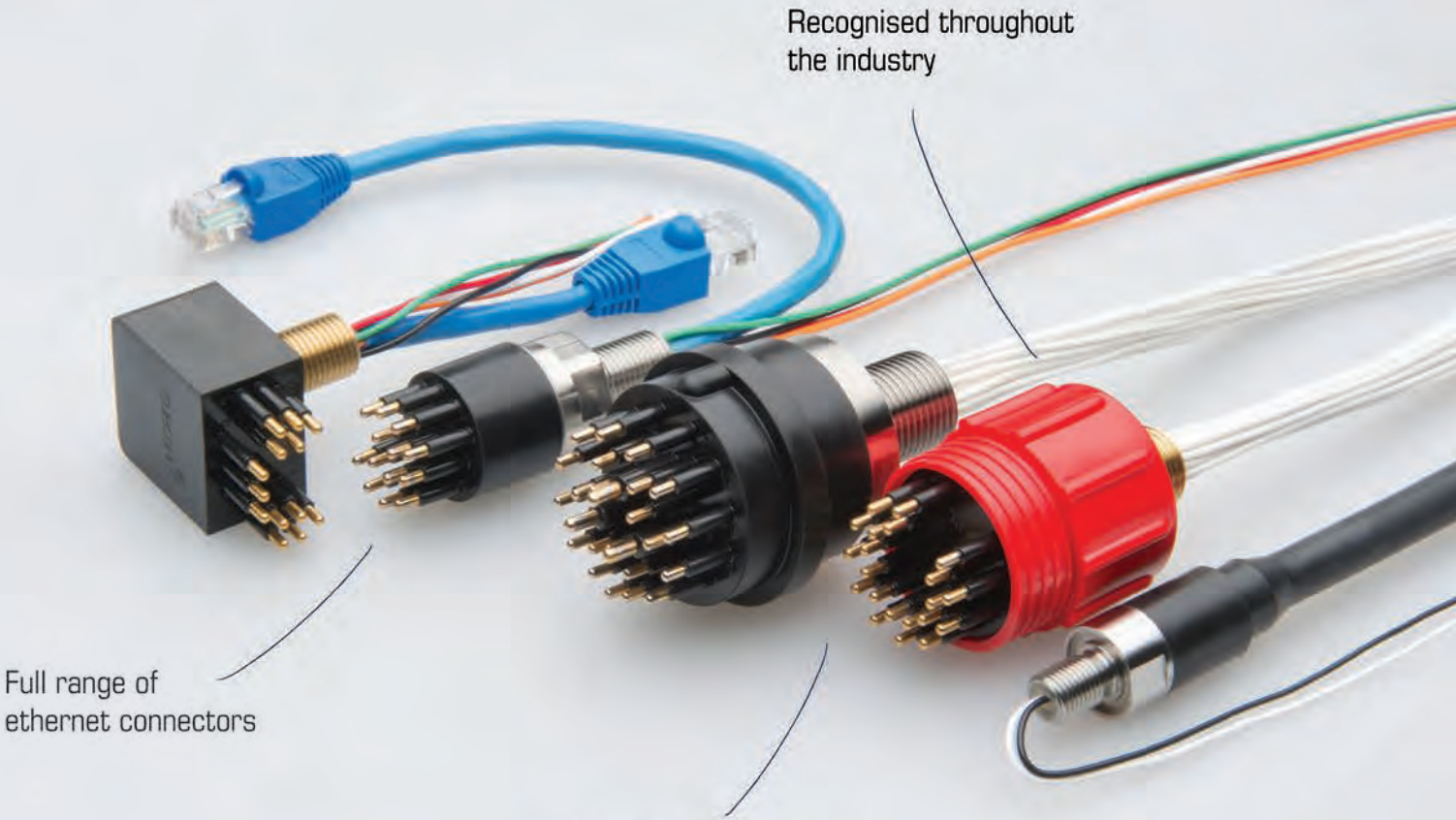

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NEW YORK
118 E. 25th St., New York, NY 10010
Tel: (212) 477-6700; Fax: (212) 254-6271

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

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

Big.

That little three-letter word accurately sums up my first thought when Kira Coley submitted her article detailing the development of Boeing's new 51-ft. Unmanned Underwater Vehicle, Echo Voyager, starting on page 22. Obviously UUVs come in every conceivable shape, size and capability, but Echo Voyager stands out for a number of reasons, and most of them come back to 'Big.' This 51-ft. frame packs in some major capability, with a massive 30 x 8.5 ft. payload bay. The UUV is game-changing in a number of ways, particularly as it carries a diesel generator capable of recharging the vehicle's lithium ion and silver zinc battery banks, giving the Echo Voyager a hard-to-match presence at sea.

As many readers of *MTR* slog through the slowdown in business due to the persistently low price for oil and gas, attention increasingly is turning to the global defense markets. To put it bluntly the world is becoming a more dangerous and volatile place. With that, the importance of Unmanned Underwater Vehicle systems is starting to grow exponentially, as Secretary of the U.S. Navy Ray Mabus said in our overview feature on subsea defense starting on page 16: "While nominal force structure requirements for FY25 have not been determined, the Navy is committed to growing both the size and composition of the AUV force. In the near-term, AUVs present an opportunity to increase undersea superiority and offset the efforts of our adversaries. LDUUV will be launched from a variety of platforms, including both surface ships and submarines. The craft's missions will include ISR, acoustic surveillance, ASW, mine countermeasures, and offensive operations."

Finally, we dispatched our Oslo-based contributor, William Stoichevski, into the creative nooks of the Norwegian Subsea Valley. The result is the first in a series of two reports, starting on page 28, which examines some of the grass roots innovation in the works in this country that possesses and unparalleled history of innovative thinking in the subsea space.

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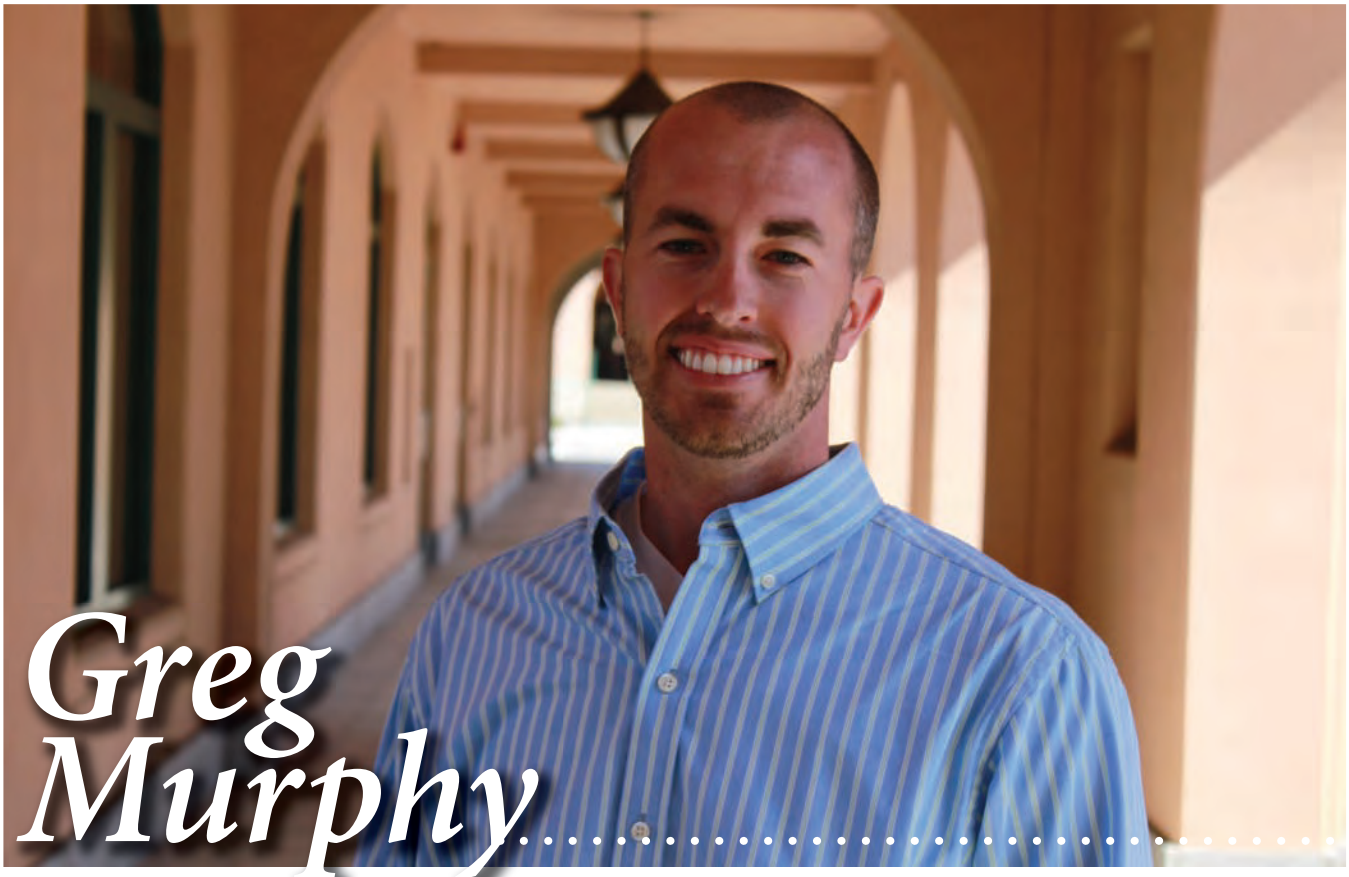


Greg Murphy

Executive Director, The Maritime Alliance & TMA Foundation

In a continuation of MTR's "View from the Top" interview spot, this month we speak with Greg Murphy, Executive Director, ***The Maritime Alliance & TMA Foundation****, which has been instrumental in forwarding the blue tech business in Southern California and beyond.*

By Greg Trauthwein

For readers not familiar with The Maritime Alliance, can you give a brief on the organization and its reach in the subsea sector.

The Maritime Alliance (TMA) is the non-profit industry association and organizer of the largest ocean and water technology cluster in the United States. Its tagline is Promoting BlueTech and Blue Jobs with a focus on economic development, ecosystem development and international outreach. TMA brings together 16 sectors of the Blue Economy that include, aquaculture, defense and security, desalination & clean water technology, marine recreation, maritime robotics, ocean energy and resources, and very large floating platforms under a common Blue Voice represented by academia, government and industry. While physically located in San Diego, TMA is active both nationally and internationally and is spearheading the creation of an international BlueTech Cluster Alliance to promote collaboration. Together with its sister non-profit organization, TMA Foundation, TMA advocates for sustainable, science-based ocean and water industry.

You recently became Executive Director of The Maritime Alliance. What attracted you to the position?

Our mission is critical and our mandate is clear. We promote sustainable, science-based ocean and water industry that balances conservation and economic development. I am inspired every day by the entrepreneurs, innovators and researchers who see a problem and find a solution that not only fills a market opportunity but benefits society. We grapple with global challenges related to biodiversity, clean water, climate change, disease, food security, global commerce, sea level rise and workforce development. It's clear to me that the ocean will increasingly become a bigger part of our daily lives, so it's my role to turn our collective attention to the ocean as a source of innovation, inspiration and jobs.

Stepping into the position, what were your immediate goals for The Maritime Alliance?

The Maritime Alliance is at an inflection point. We are a small non-profit and our membership is growing. Our Founder Michael Jones continues as President and we are fortunate to have a strong, dedicated Board of Directors and a growing, skilled staff. Our immediate goals are to grow capacity and institutionalize operations, with a focus of continuing to deliver value for our member companies and drive innovation. That includes the creation of a BlueTech Incubator this year, and expanding our efforts to educate elected officials, economic development officers, and the public about the value of the Blue Economy. A big focus this year will be workforce development because future growth requires motivated entrepreneurs and trained employees to create and fill the Blue Economy jobs of tomorrow.

We understand that your November event – Blue Tech & Blue Economy Summit – has evolved to become "San Diego Blue Tech Week." What specifically was the impetus for this expansion? What, specifically, is new this year?

Our 8th Annual BlueTech & Blue Economy Summit and Tech Expo will be part of a rebranded San Diego BlueTech Week, with 6 events in 5 days November 7-11, 2016. The ever popular 2-day Summit and Maritime Gala Dinner will highlight exciting new trends in BlueTech with speakers from around the world. Last year we launched a dedicated track on Workforce Development for educators, HR professionals and students to discuss career opportunities in the Blue Economy, and we are bringing it back again this year by popular demand. In addition, we are co-hosting a day-long event with Scripps Institution of Oceanography on Big Data, Data Security, and OceanGIS, and we're launching our first Investors, Philanthropy and Corporate Partner Day to give a platform for BlueTech inventors and entrepreneurs to look for partners for their innovative technologies and companies.

I was very interested to learn that TMA has invited other "Subsea & Maritime Clusters" to the San Diego event. I know the San Diego Cluster fairly well ... what specifically was the impetus to engage other clusters from around the world?

As TMA develops relationships around the world, we have found a handful of very active BlueTech clusters with the same goal of fostering innovation through collaboration. So we invited them to our Annual Summit in 2015, and were pleased that eight clusters participated from five countries (Canada, France, Ireland, UK and the US). We spent a very full, very productive day working through a series of topics of mutual interest and developed an initial roadmap for collaboration. This year we will host the second convening of international BlueTech clusters and anticipate having 10-12 clusters from countries like Canada, France, Ireland, Portugal, Norway, UK, and the US. We hope to formalize an international BlueTech Cluster Alliance in 2016 that promotes collaboration on projects, sharing of information and resources, and assisting each other's companies. Once the model is working, we hope that additional organized clusters will join.

Please discuss TMA's top three initiatives for the coming 12-24 months.

First, TMA has partnered with Reed Exhibitions to bring Oceanology International North America (OINA) to San Diego every two years beginning February 14-16, 2017. This will be the largest maritime technology trade show in the Western Hemisphere. We expect over 200 exhibitors and 3,000-5,000 attendees from 50 countries in 2017 and that it will grow from there. One area of particular focus for TMA is to engage organizations across Latin America. For example, TMA will be working with the Inter-American Committee on Ports (CIP) – part of the Organization of American States (OAS) – to develop topics that will be of interest to the 34 national port authorities from across the Caribbean and Latin America that are members of CIP. With San Diego's cluster of maritime technology companies, this is the right place and the right time to launch OINA. We welcome you to visit San Diego for the business development and networking, and stay for the beautiful weather! Second, we are expanding our international network with the BlueTech Cluster Alliance and the 8th annual BlueTech & Blue Economy Summit in November 2016 will focus on "Case Studies of Collaboration" between our global cluster partners. In March 2015, we led a trade mission to the south of France with seven of our member companies, two of which came home with agreements to do business with three French companies. There are more trade missions on the horizon, and we look forward to collaborating with BlueTech clusters around the world to support each other's companies.

Finally, we currently have more than 50 corporate members with a goal to reach 100 members by the end of 2016. Membership is the lifeblood of our organization and we work hard to assist our member companies. We have a benefit package for every level of membership and – as a big new benefit – TMA members will receive a 10% discount on exhibit space and to attend the concurrent conference at OINA. I hope that companies will contact TMA to discuss the benefits of becoming a member and helping us promote an international Blue Voice.

Every organization, every position has its challenges. What are your challenges, and how are you (personally and/or as an organization) investing to meet those challenges?

One of the challenges in the maritime technology industry is awareness. This BlueTech sector has largely gone unnoticed by

the general public, investors and politicians because so much of BlueTech is offshore, out of sight and out of mind. And yet Blue Tech companies are a critically important part of the economy.

In February 2016, NOAA published its first-ever economic study on the Ocean Enterprise, which TMA co-authored, that found more than 400 companies in 36 states doing over $7 Billion in sales annually. This important study, our San Diego Maritime Industry Study 2012, and other Blue Economy studies need to be shared with elected officials and say "Hey, look how many jobs this industry supports." We need to better understand and explain the size and growth of the U.S. and the global Blue Economy. We need more federal investment in the U.S. And we need to work together to create more innovative companies and good paying, Blue Jobs.

Greg Murphy, Executive Director, *The Maritime Alliance & TMA Foundation*

Greg Murphy started as Executive Director of The Maritime Alliance in November 2015 after serving six years as Policy Advisor for San Diego County Supervisor Greg Cox, advising him in his roles on the California Coastal Commission and the National Ocean Council Governance Coordinating Committee. While working for the Supervisor, Greg served on the board of The Maritime Alliance Foundation for two years. Prior to his work in public policy, Greg was a program manager in the UC San Diego Alumni Association where he started an award-winning alumni relations program with a team of 30 interns. Greg brings his experience in economic development, event coordination, fundraising, grant writing, non-profit management, public policy and workforce development to The Maritime Alliance where he helps organize the largest maritime technology cluster in the United States. He graduated in 2008 from the University of California, San Diego with a degree in political science.

Offshore Wind North America

First U.S.-flag Wind Farm Vessel Christened

by Eric Haun

Serving notice that U.S. yards can and do build workboats for the nascent North American offshore wind farm industry, Blount Boats has delivered the Atlantic Pioneer, America's first U.S.-flagged crew transfer vessel (CTV) for Atlantic Wind Transfers. Atlantic Wind Transfers is the commercial wind support services subsidiary of Rhode Island Fast Ferry, which secured a 20-year contract from Deepwater Wind Block Island, LLC to operate the vessel for the nation's first offshore wind farm, beginning in May 2016.

Christened on April 22 at a ceremony at Quonset Point in North Kingstown, R.I., Atlantic Pioneer is a 21-meter twin hulled, all-aluminum catamaran built to service the Block Island Wind Farm, which will be the first offshore wind farm to take shape in the U.S. with a five-turbine site that will provide 30MW power for Block Island.

Designed by South Boats IOW (Isle of Wight), which has designed and built approximately 81 crew transfer vessels for service to the European offshore wind sector, Atlantic Pioneer was built by Rhode Island's Blount Boats, which in 2011 signed an exclusive licensing agreement with South Boats covering the U.S. offshore wind industry.

"We take pride in every boat we build, but this boat is very special – the first U.S.-flagged vessel serving the first offshore wind farm in the United States," said Marcia Blount, president and chief financial officer at Blount Boats. "Built in Rhode Island for a Rhode Island operator servicing a Rhode Island wind farm; it doesn't get any better."

"This is the first vessel of its kind built in the United States. No one has built a boat like it. That's what makes it very, very unique," said Charles A. Donadio Jr., President of Rhode Island Fast Ferry.

Donadio said Atlantic Pioneer is also a "cross-platform vessel." It is dual certified to USCG subchapter L (offshore supply vessel) to carry up to 16 offshore workers and subchapter T (small passenger) to carry up to 47 passengers. "We can carry the technicians, but we also went one step further . . . certifying as a T passenger boat," Donadio said. "So we can actually take this boat out with 47 passengers and do a little tour around the bay or some small wind farm tours."

Atlantic Pioneer's propulsion system

Atlantic Pioneer features a special fendering system for connecting to wind turbines.

(Photo: Eric Haun)

consists of two MAN V12-1400 hp engines, ZF Marine 3050 Gears, and Hamilton Jet HM571 waterjets. The vessel exceeded the contractual performance during sea trials, reaching sprint speeds in excess of 30 knots, with the ability to cruise (80 percent power) at 26 knots when in a light condition.

A Cummins Onan 17kw generator provides AC power to the air conditioning system, a heating system and small galley.

A PTO driven hydraulic system powers a deck crane, fire pump, fuel transfer pump and a salt water pressure washing system. All other equipment is fed DC power through house batteries.

The vessel is engineered to carry up to 12 tons of cargo in the bow and 3 tons in the stern. The forward and after decks are outfitted with cargo lashing and container sockets. The bow has a boarding/loading platform to allow offshore workers to make the transition from the vessel to the wind turbine. The vessel, capable of making transfers in 1.5-meter significant wave heights, connects to the turbine base by use of a special bow fendering system. Atlantic Pioneer is coated with the anticorrosive ORCA HT Offshore vinyl film from Orca Maritime above sea level, including superstructure, hull and tunnel.

The interior of the deckhouse is outfitted with a head, a small galley area with settee seating, 12 suspension seats, storage lockers, entertainment system, Wi-Fi and sound absorbing decking. The entire deckhouse is isolated from the hull with vibration mounts for a quieter and smoother ride to and from the work site.

Atlantic Pioneer Main Particulars

Length, o.a.:	70.2 ft. (21.4m)
Max Beam	23.95 ft. (7.3m)
Trim Control	(2) Humphree Interceptors
Length, DWL	59.33' (18.08m)
Draft	4.06 ft. (1.24m)
Generator	Cummins Onan model 17 kW
Gearboxes	(2) ZF model 3050
Service Speed	26 knots
Windows	Sea Glaze Marine Windows Ltd
Waterjets	(2) Hamilton HM571
Paint	International Paint
Cargo DWT	12 Tons fwd & 3 Tons aft
Seats	Cabin / (12) Seat Design Co. b
Passengers	up to 47
Engines	(2) MAN V12-1200CR [V-Nue]
Interior Lighting	Imtra (24v LED)
Builder	Blount Boats, Inc.
Cargo DWT	12 Tons fwd & 3 Tons aft
Displacement (Lightship)	45 LT
Designer	South Boats IOW
Window Wipers	Exalto/Decca Straight line
Total Fuel Capacity	2100 U.S. gal.
Fire Detection	Seafire
Air Conditioning	(3) Dometic Cruise Air

Saab Seaeye:
Meeting the Challenges of Renewables

The renewable industry presents special challenges for underwater robotic vehicle operations with its shallow waters, high currents, intricate structures and, in some locations, unexploded ordnance. Saab Seaeye has found good success in the sector with a range of vehicles specially suited for the challenging tasks involved in building and maintaining the structures and interconnections.

With a range of robotic systems that are ideally suited for the sector. In particular, vehicles need to have exceptional power, along with fast acting intelligent control systems that together can handle strong currents while undertaking a wide range of tasks - including survey, disposal of unexploded ordnance, construction and IRM.

Saab Seaeye's low-profile Compact Cougar, for example, is designed to minimize the effect of current with its reduced frame size, buoyancy and weight – and a thinner 17mm tether cable that reduces the effect of drag.

It means that it can be used for tasks highly specific to the renewables industry, such as identifying the existence and location of buried cables. Innovatum, who design and manufacture such survey systems for tracking and detecting buried submarine cables and pipelines, use the Compact Cougar for this work, along with the even smaller Falcon, where not only do both vehicles have the power to handle the system array and the high currents, but they also have a low magnetic and acoustic noise signature that allows for optimum survey sensor data.

For Innovatum the Compact Cougar and the Falcon together offer a rapidly mobilized array package that can be deployed from a small vessel ready to survey all types of inshore and coastal submarine cables and pipelines. The result is a small and smart survey system that is designed to cut the cost of inshore survey work.

In Japan, where in a crowded and mountainous country the search for sites must go offshore, floating turbines in the deep waters off the rugged coastline is the main option. Here, sure-footed anchorage to the seabed is vital in such a vulnerable environment and a Saab Seaeye Falcon ROV is used to check the integrity of the mooring points 100 m down, in an operation where this easily manhandled but powerful vehicle is readily deployed from a small vessel.

For any operator facing more work related tasks in renewable sectors, there is the Panther XT Plus and the Leopard – the newest addition to the Saab Seaeye range.

The Panther is a powerful light work vehicle with 10 thrusters that will hold the vehicle steady in strong currents during work and observation tasks. Innovatum in particular use the Panther for cable laying support.

The Leopard, with its half ton of thrust, high tooling capability and advanced iCON intelligent control architecture, is the most powerful electric underwater robotic system of its size in the world and is seen as equivalent to an hydraulic vehicle, but at a fraction of the ownership and operating cost.

As the renewable industry grows and matures, Saab Seaeye sees an increasing role for robotic systems, particularly in IRM activities, with vehicles having an ever more intelligent and versatile infrastructure that allows evolving systems technology to be readily added and changed, while continuing to provide a powerful and steady platform to undertake the range of tasks needed, at a low operational cost.

Statoil Enters German Offshore Wind Market

Statoil entered the German offshore wind market via a 50 percent acquisition of the Arkona offshore wind farm. Statoil and E.ON also announce the final investment decision on the 385MW project. The estimated total investment for the project will be in excess of $1.2 billion.

The Arkona wind farm will provide renewable energy for up to 400,000 households in Germany, making it one of the largest ongoing offshore wind developments in Europe.

The addition of Arkona increases the total energy production capacity of the offshore wind projects in Statoil's portfolio by around 50 percent, and the company's own production capacity by 65 percent. The projects now have a combined capacity of more than 1,100 MW, supporting more than 1 million European homes with renewable energy.

"Statoil is an established player in offshore wind, leveraging our more than 40 years of experience from offshore oil and gas projects to create value," said Irene Rummelhoff, Statoil´s executive vice president for New Energy Solutions.

The Arkona wind farm will be located in the Baltic Sea, 35 km northeast of the Rügen island in Germany, southwest of the Danish island of Bornholm. It will consist of 60 six-MW turbines, to be mounted on monopile foundations installed at water depths of 23 to 37m.

(Credit: Statoil ASA)

E.ON will have responsibility for building and operating the wind farm. Up to 400 people will help build the wind farm during the two-year construction phase. Start of electricity production is expected in 2019.

(U.S. Navy photo by Mass Communication Specialist 3rd Class Jonah Stepanik/Released)

Undersea Superiority will rely on Large Underwater Vehicles, but the question begs ...

Is bigger better?

By Edward Lundquist

Mineman 3rd Class John Stephen-Torres, assigned to Commander, Task Group (CTG) 56.1, observes data from a MK 18 MOD 2 unmanned underwater vehicle (UUV) for a training evolution during a squadron exercise (SQUADEX). SQUADEX is a mine countermeasures training exercise aboard the Bay-class landing dock ship Cardigan Bay (L3009) of the Royal Fleet Auxiliary. CTG 56.1 conducts mine countermeasures, explosive ordnance disposal, salvage-diving, and force protection operations throughout the U.S. 5th Fleet area of operations.

The U.S. Navy has many mundane, messy and perilous underwater missions that are better performed unmanned vehicles. When considering the right vehicle for the mission, size does matter.

Unmanned Underwater Vehicles (UUVs) are classified into three basic size categories: man-portable, lightweight, and large displacement based on size (as measured by displacement) and endurance. The Navy considers vehicles that are larger in diameter than the standard submarine 21-inch torpedo tube as "large displacement" UUVs.

In his 2016 posture statement to Congress, Secretary of the Navy Ray Mabus said that Autonomous Undersea Vehicles (AUV) are a key component of the Navy's effort to expand undersea superiority AUVs are conducting sea sensing and mine countermeasure tasks today with human-in-the-loop supervision.

"By removing the need for environmental control systems – things like oxygen generation, G-force limitations, we can develop platforms that stretch the bounds of our imagination. Endurance is another important advantage unmanned technology brings to the fight. Our UUVs need to be able to stay out for months at a time, allowing them to observe large areas for prolonged periods, without interruption and without degradation," Mabus said. "While nominal force structure requirements for FY25 have not been determined, the Navy is committed to growing both the size and composition of the AUV force. In the near-term, AUVs present an opportunity to increase undersea superiority and offset the efforts of our adversaries," he said. "LDUUV will be launched from a variety of platforms, including both surface ships and submarines. The craft's missions will include ISR, acoustic surveillance, ASW, mine countermeasures, and offensive operations."

"While nominal force structure requirements for FY25 have not been determined, the Navy is committed to growing both the size and composition of the AUV force, said Secretary of the Navy (SECNAV) Ray Mabus. Mabus is pictured here in the Arctic Circle, greeting the captain and the chief of the boat as he boards the Los Angeles-class fast attack submarine USS Hampton (SSN 757) during Ice Exercise (ICEX) 2016.

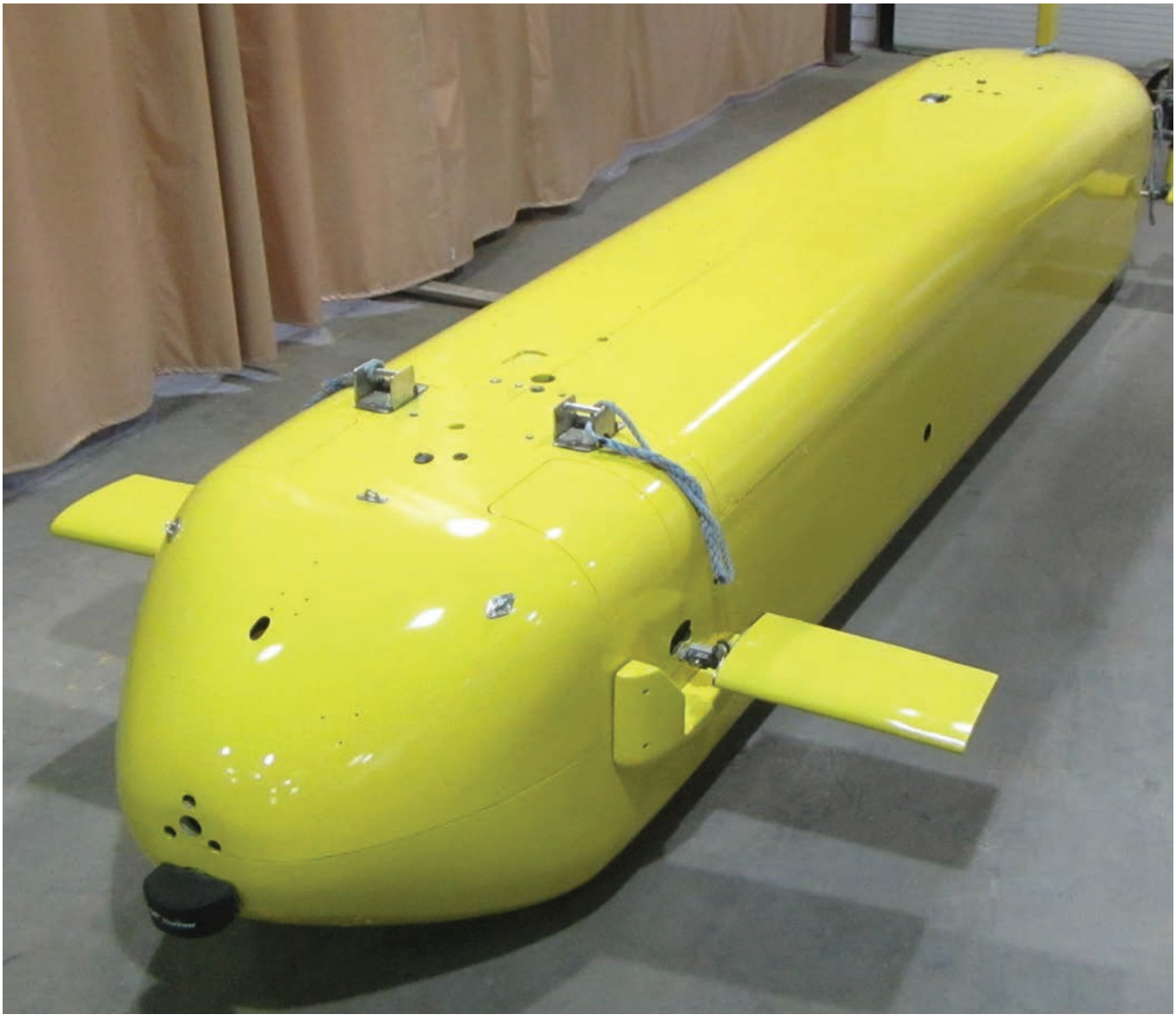
(U.S. Navy photo by Mass Communication Specialist 2nd Class Tyler Thompson/Released)

The LDUUV differs from other unmanned underwater vehicles built or evaluated by the Navy in that its large displacement allows for greater energy capacity to support increased persistence. "The greater energy capacity extends the reach of Navy UUVs," said Naval Sea Systems Command (NAVSEA) spokesman Dale Eng.

According to Eng, the LDUUV is planned as an unmanned undersea vehicle to conduct "dull, dirty, dangerous, and otherwise impossible" missions relative to manned platforms. The LDUUV will not only extend the mission capability of its host platform, but it will also allow the host to conduct concurrent operations due to its significant persistence—measured in weeks instead of hours. "As a result, the LDUUV effectively acts as a force multiplier. In addition, the LDUUV will support advances in technology and future payloads (such as advanced ISR capabilities, deployable payloads, and advanced, longer duration energy sources) via its modular open architecture."

The LDUUV program will design and build a modular, reconfigurable Unmanned Undersea Vehicle (UUV) with Open Architecture (OA) software (SW) focused on introducing a new class (large displacement) of UUVs to the Navy to provide increased endurance, payload hosting, and delivery capability. The LDUUV will be modular in design

The office of Naval Research Large Displacement Unmanned Underwater Vehicle - Innovative Naval Prototype (LDUUV-INP). The LDUUV-INP technologies will develop enhanced capabilities in endurance, energy, and autonomous capabilities.



(U.S. Navy photo)

and include hotel functionality (guidance and control, navigation, autonomy, situational awareness, core communications, and power distribution), energy and power, propulsion and maneuvering, mission sensors (payloads), and communications links.

"It is intended that modules will have well defined interfaces for the purposes of implementing cost-effective upgrades in future increments to leverage advances in technology," said Eng.

The Naval Undersea Warfare Center (NUWC) Newport Division will serve as lead system integrator. "We anticipate releasing additional opportunities in the future to industry to support LDUUV Prototype fabrication," said Eng. "Testing will be conducted by the government. Specific details such as testing location are still under review."

The effort is projected to include industry, academia and governmental field activities. NUWC Newport Division will release LDUUV-related opportunities for industry under FBO announcements, Eng says.

Innovative Naval Prototype

The Navy's "program of record" LDUUV is different than the Office of Naval Research Large Displacement Unmanned Underwater Vehicle Innovative Naval Prototype (LDUUV-INP) experimental UUV. "The LDUUV-INP advances the state of energy, autonomy, and endurance technologies in a large UUV format," said Eng. "Technologies developed under the ONR LDUUV-INP have informed, and will continue to inform the Navy LDUUV associated program of record. Further LDUUV-INP advances will enable future missions envisioned for this system."

ONR has long been involved in undersea technology and the development of underwater vehicles, including LDUUVs. According to Chief of Naval Research Rear Adm. Mat Winter, ONR's Innovative Naval Prototype LDUUV program will design and build five LDUUVs: two preliminary designs, two pier-to-pier vehicles, and one submarine compatible vehicle. "The program is developing energy, autonomy and core systems to operate in a complex ocean environment near harbors, shorelines, and other high traffic locations. Goals include doubling air-independent UUV energy density, using open architecture to lower cost, and enabling pier to pier autonomy in over-the-horizon operations. Achieving these goals will reduce platform vulnerability and extend the Navy's reach into denied areas. ONR is developing a long endurance, fuel cell-based power plant to be incorporated into LDUUV prototypes. A long endurance mission demonstration is sched-

uled in FY 2016."

Critical to the success of LDUUV is the energy source. "The Navy is reviewing multiple energy sources to include Silver-Zinc batteries, Lithium-Ion batteries, PEM (or Proton Exchange Membrane) fuel cells, solid oxide fuel cells, and various metal burner advanced energy systems such as aluminum combustors," Eng says. "Each energy source under review will be considered based on its energy density, safety, and procurement and life cycle cost."

Eng Chief of Naval Research the Navy plans to utilize multiple host platforms for LDUUV in support of worldwide operations. This includes surface ships such as LCS, and submarines (both SSGNs and Virginia class SSNs) via Large Ocean Interfaces (LOIs) such as the extended Dry Dock Shelter (DDS) and the Universal Launch and Recovery Module (ULRM). The Navy plans to utilize dedicated and specifically trained Sailors from an unmanned undersea vehicle detachment (Det. UUV) at Commander, Submarine Development Squadron 5 located at Bangor, Washington. Eng said the Sailors will be specifically trained to conduct mission planning, and will embark supporting host platforms in support of launch and recovery operations.

In fact, missions for some large unmanned vehicles, like the DARPA ACTAUV and Boeing's Echo Voyager XLDUUV (see story page 22) do begin and end at the pier, instead of being launched or recovered by a host ship.

A great example of a value-added role of a very big system is Theseus (see below), which laid 220 km of cable under Arctic ice a decade ago.

Easier Said Than Done

The promise of modularity and commonality are powerful. A UUV that can perform multiple missions makes sense, but the reality is more difficult. Many systems were rushed to the customer to meet an urgent need, without the benefit of common logistics, or the ability of systems to operate or communicate together. Many proprietary systems can mean that most of them will not truly mature.

"Successful system integration and true modularity don't come from just designing to requirements – they require a different mindset," said Ethan Butler, Director of Strategic Systems at Bluefin

International Submarine Engineering and the Canadian Department of National Defense developed Theseus to lay long lengths of fiber-optic cable under the Arctic ice pack. The vehicle completed successful deployments to the Arctic in 1995 and 1996. During the 1996 deployment, several 220 km cables were laid in 600 meter water depths under a 2.5 meter thick ice pack, establishing an AUV endurance record of 0ver 60 hours – all under ice.
Pictured is Theseus in the ISE Shop along side the Explorer AUV, and the prototype AUV ARCS.

International Submarine Engineering

Robotics in Quincy, Mass.

"It's vital to be thinking 'modular' from the very beginning, so that when the time comes to adapt to a different mission or payload you don't find yourself fighting against design decisions that only work for one."

Bluefin, which was an MIT spinoff in 1997 and was acquired by General Dynamics Mission Systems earlier this year, has integrated hundreds of different payloads into its vehicles, Butler said.

Butler points out that while the Knifefish mine countermeasures UUV is a highly specialized instantiation of the company's Bluefin 21 vehicle, it was the fundamentally modular design of the parent Bluefin 21 vehicle that made specialization possible. "Our architecture is modular down to the very lowest level so that we don't have to redesign the vehicle for every different mission."

The concept of modularity, and plug-and-play, is not as simple as it sounds, said consultant Mike Good. "We had a lot of people tell us that they had systems that were ready to use 'off the shelf.'

But many weren't at the technical maturity level they claimed," Good said. "These systems have to be tested in a rigorous environment – as a stand-alone system, and then as a system-of-systems (SoS). Integrating multiple systems into a new capability is much harder than most people realize."

Good said we've become used to the idea with our computers and USB connections. "But the simplicity of a USB thumb drive to the user can be misleading with respect to the enormous effort that is behind making it work. As an example, the current USB specification is several hundred pages long and the evolutionary product of over 22 years of work across many industry players," he says. "And that's just the paperwork for the agreed upon interface standard, not the final product itself."

Good, a retired Navy captain and former program manager for LCS mission modules, says that in conversations with OPNAV and Congressional staffs, he's found that the significant effort behind integration is not well understood – and almost always undervalued – which leads to it being under resourced.

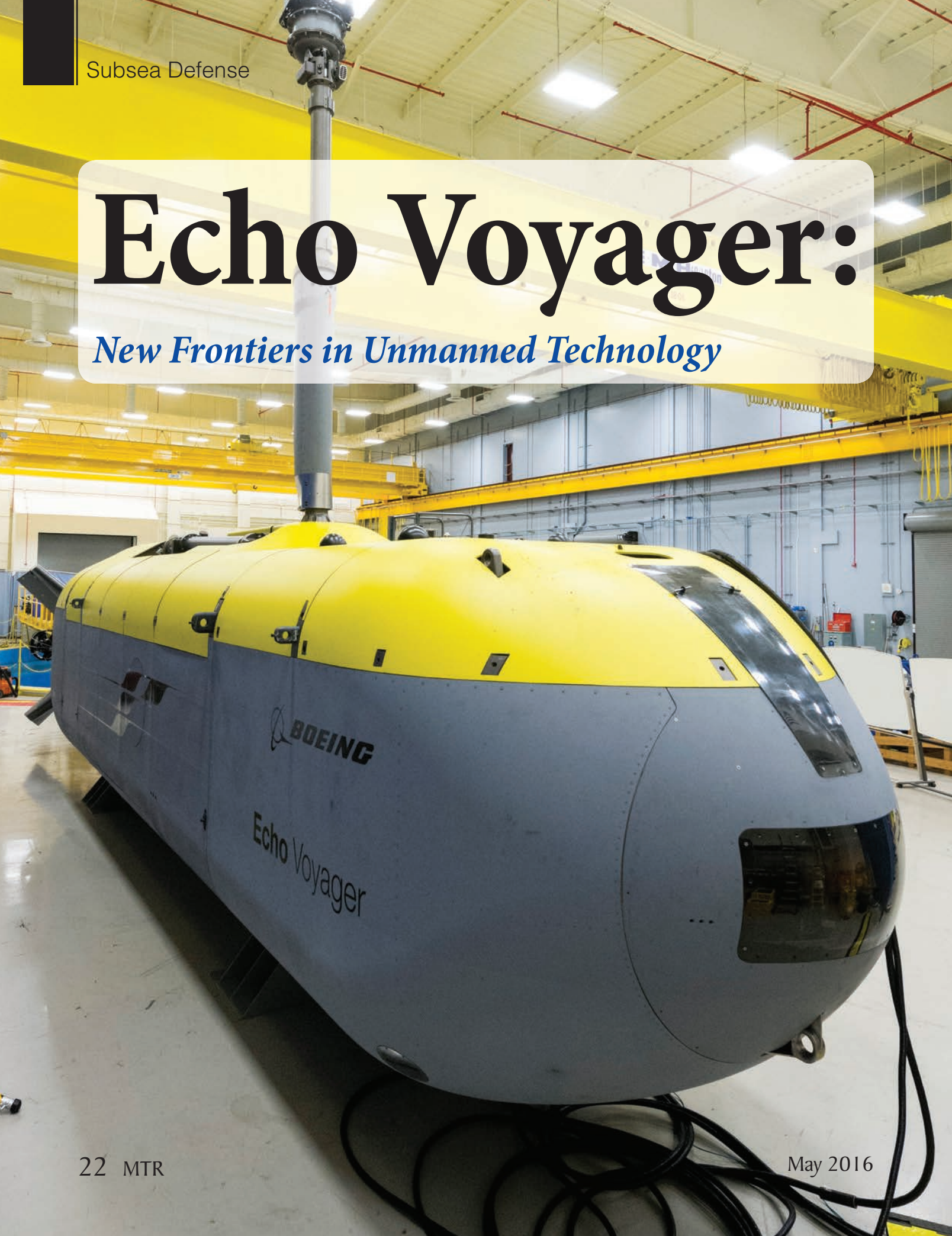
"That drives us to 'standalone' capabilities. We don't get the more powerful results we could with integrated ones."

U.S. Navy Lt. j.g. Jeff Morehead (left) and Electronics Technician 2nd Class William Stark, with Explosive Ordnance Disposal Mobile Unit (EODMU) 5, pull a MK18 Mod 2 unmanned underwater vehicle onto a tow sled at Jinhae-gu, Republic of Korea (ROK) March 31, 2016 during exercise Foal Eagle 2016.

(U.S. Navy combat camera photo by Mass Communication Specialist 1st Class Charles E. White/Released)

Echo Voyager:

New Frontiers in Unmanned Technology



All images: Boeing

By Kira Coley

Subsea technology has begun to change the way we explore, manage and defend the marine environment. Fleets of unmanned vehicles will create sensor networks above and below the ocean's surface and the ever-involving capabilities of these systems promise a future of robotic workforces completing dozens of complex tasks in challenging and dynamic marine environments. This will be especially vital in undersea defense as advancements in underwater technology brings about an age of stealth unmanned underwater vehicles (UUV) and intelligent submarines. The issue remains with reduced budgets and high associated costs of UUV operations from surface ships, hindering the speed to which an autonomous robotic future can be reached. Better known for their work in the Aerospace sector, Boeing aspires to deliver the defense and commercial sectors a game-changing UUV, in the revolutionary form of Echo Voyager.

Since the 1960s, Boeing has designed and operated manned and unmanned deep sea vehicles through the acquisition of Rockwell International legacy systems and U.S. Navy support programs. Currently Boeing offers three UUVs with varying capabilities: Echo Ranger, Echo Seeker and now, the Echo Voyager.

"We started off doing advanced underwater test shapes to support Navy Submarine hull design. Later in the 1990s,

Massive Payload

The 51-ft. UUV Echo Voyager can be launched from a pier, maintained, refueled & repaired in the water. In addition, it sports enough room for a massive payload: up to 30 x 8.5 ft.

we started developing advanced autonomous underwater vehicles (AUVs) that can go out on their own from several hours up to a couple of days at a time," said Lance Towers, Director of Sea & Land research division, Boeing Phantom Works.

In 2001, Boeing's Echo Ranger UUV was built and contracted for ocean surveys and payload experimentation. The Echo Ranger is 18-feet in length and can operate at 10,000-feet depth. It was used in the Gulf of Mexico in concert with Oil & Gas companies for hydrographic surveys. These initial surveys allowed Boeing to learn how to give the later UUV systems capabilities which allow them to operate for longer periods of time and avoid obstacles.

Developed to undertake a variety of underwater missions such as infrastructure protection and subsea reconnaissance, Boeing's Echo Seeker UUV was introduced in 2015. The newest system brought increased operational depth to 20,000-feet, improved endurance and advanced payload capabilities.

While each vehicle offered significant improvements, Boeing still saw the Seeker and Ranger as test beds for continued advancement of the technologies. These vehicles only operate out at sea for a maximum of few days at a time, and they also required the assistance of a surface ship, adding dramatic overheads to UUV projects.

"The Seeker and Ranger operations were hugely valuable for our understanding of what our customers need. For example, in bad weather the vehicle would need to be recovered, placed on the ship and pulled into port to ride out the storm: you're still paying for the crew and ship time, regardless of if you're out at sea or in port. With all the experience from the first two UUVs, what we learned is that the operational cost for running underwater systems can be very high, limiting our customers reach. We felt it was important to come up with a game-changing advanced UUV that does not require surface ship support," said Towers.

Developed for civil and military intelligence, surveillance and reconnaissance (ISR) roles, the genesis of Echo Voyager was in 2011. Boeing had found a way to come up with the capability to allow maritime sectors to conduct today's missions, whether it is defense or commercial, in a far more cost effective manner. Echo Voyager introduces capabilities to the UUV realm which are not currently available.

The ability to wet launch from a pier, independent of any surface ship, significantly reduces the operational cost of missions. Due to its innovative modular design, the 51-foot autonomous submarine can also be maintained, refueled

When it comes to the surface, it raises a mast and turns on **a diesel generator, charging the lithium ion and silver zinc batteries** *that power the system while submerged. On the surface, it can communicate via satellite to offload data and download a new operational plan. Even at 50 tons, one operator can control multiple vehicles from anywhere in the world.*

and repaired while in the water.

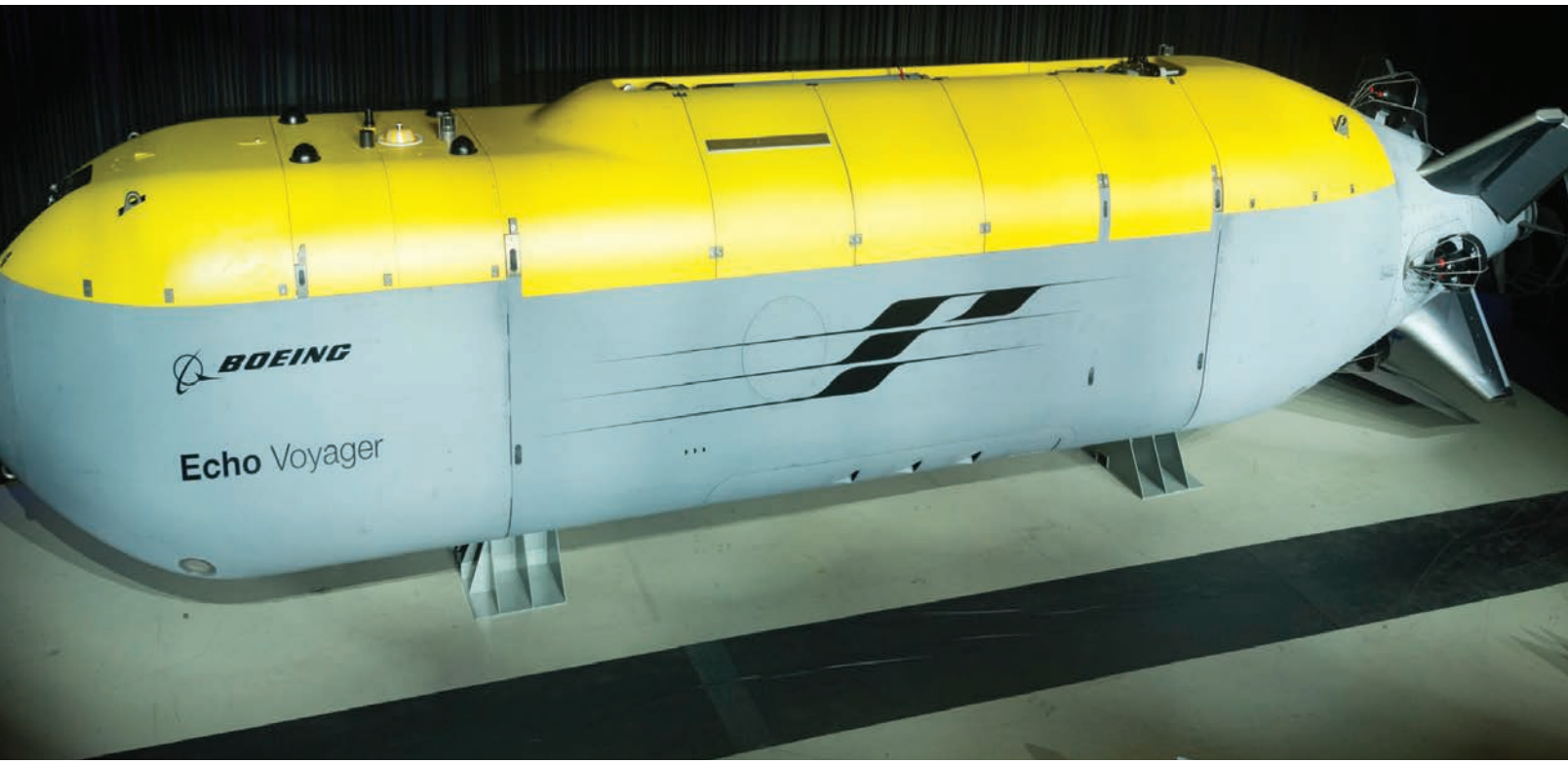
When it comes to the surface, it raises a mast and turns on a diesel generator, charging the lithium ion and silver zinc batteries that power the system while submerged. On the surface, it can communicate via satellite to offload data and download a new operational plan. Even at 50 tons, one operator can control multiple vehicles from anywhere in the world.

"The other game changing capability is that we developed a commercial interface for anybody's payload. Voyager can carry significant payload sizes from up to 30-foot long, 8.5-foot across in the payload bay: an equivalent to one and a half shipping containers," said Towers. "It has a tremendous amount of space and power that can be used for dozens of defence or commercial applications. In fact, it's about a factor of 100 greater payload space than other UUVs, as well as 18 kW of power."

Defense sectors all over the world are increasingly turning to unmanned systems to augment their manned capabilities. Until now, technological restrictions such as power and autonomous system integration have limited missions. The Echo Voyager negates some of these factors by offering a platform that can operate for up to 6 months at a time, powering vast payloads and travel up to 7,500 miles on one fuel tank.

"UUVs also need to operate in harsh environments. As you go deep, the pressure is significant – so at 10,000-feet below the surface you are seeing pressures of 5,000 pounds per square inch. Vehicles have to be able to withstand the pressure at depths, temperatures slightly below freezing and huge variations in these parameters," said Towers. "So, realistically we know things will fail. This is why we added several redundant systems which helps drive the vehicles size, but also so that you can lose a significant proportion of the systems and the vehicle will still come back. There are also six emergency backup systems: you can lose four primary computer systems and six emergency controllers and the last one will get the vehicle to the surface."

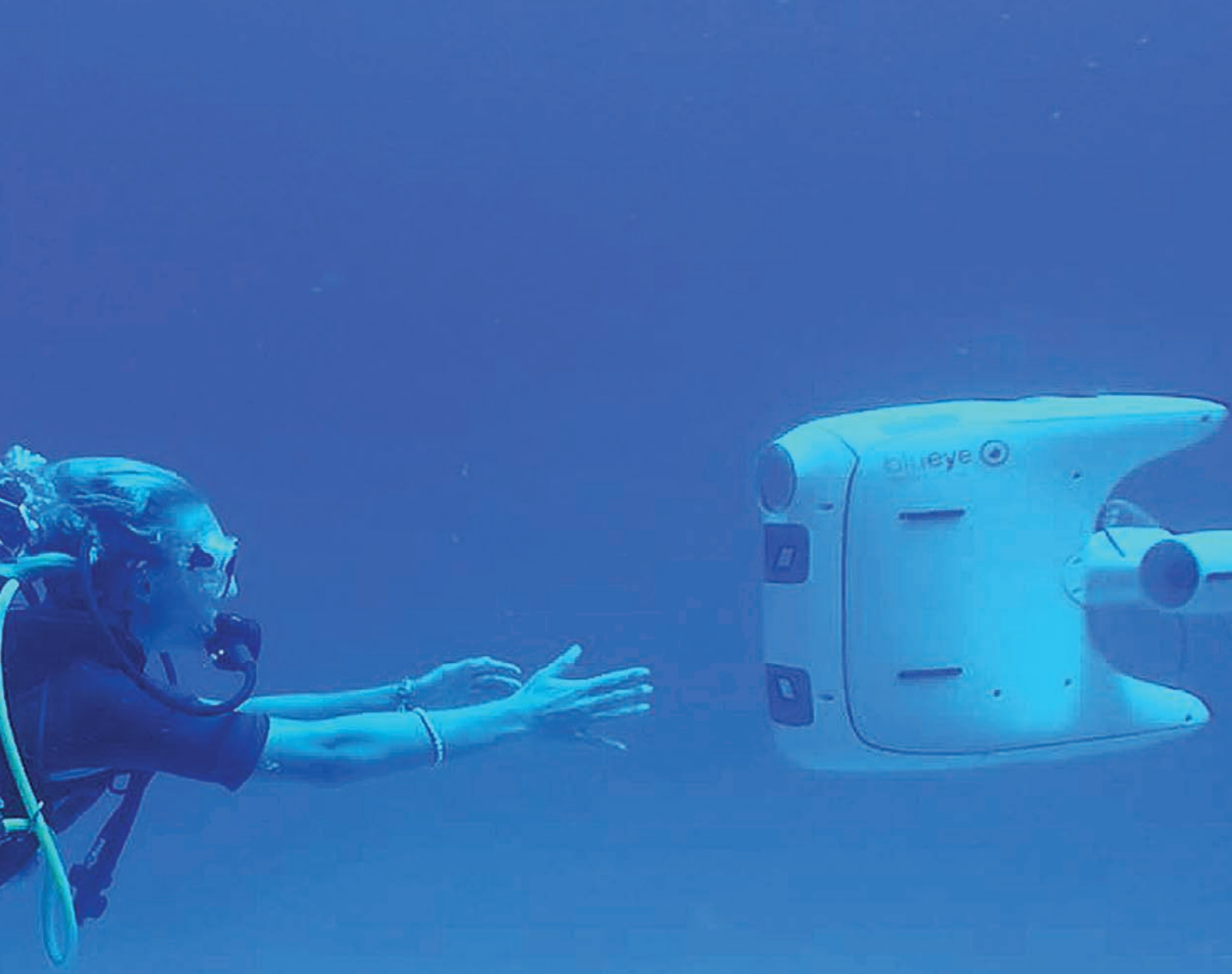
Over the summer, the Echo Voyager is scheduled for further testing and validation in Huntington Beach, California, when the vehicle will be placed in a large research pool. Once it is operating as desired, Boeing will then conduct open-ocean trials in Southern California, off the Islands of Catalina, and verify all the functionalities including depth of operation, avoidance and command control.



Towers said, "The intention for multiple customers is that we didn't want to develop the capability that only one customer would use, because that customer would pay for operational improvements. It's designed for defense, civil engineering, commercial and international, but there'll be multiple customers using this and sharing the cost of maintenance and upgrades over time. Right now we're focusing on working with different sectors to develop their payloads. Budgets are tight – Boeing funded these projects ourselves [no government backing or sponsorship]. We wanted to come up with the capability that allows a wide variety of customers to do today's missions at a far more cost effective manner."

In the short term, Boeing anticipates a wider use of these systems as the advancing capabilities of subsea technology allows us to extend out to different applications. Significant challenges must still be overcome, including vehicle maneuverability and cooperation between underwater systems for some more complex missions. However, as the technology advances, the way we use these systems will also reform how sectors operate. "Organizations such as NOAA currently complete fishing assessments with a surface ship using sonar systems, then deploy Remotely Operated Vehicles (ROVs). We have already demonstrated that by combining the sensors they use in our UUVs, we can gather the same data in less time using one platform. So, once the different sectors are comfortable with the technology, they will then start to re-evaluate today's processes and that is when we will really see defense, civil and commercial UUV operations at its best," said Towers.

Eyeing the Fu



ture of Things

Courtesy Blueye

"We're rolling in this downturn," beams Audun Martinsen, VP of analysis at Rystad Energy's harbor-front Oslo headquarters. Rystad has just opened in Rio and says demand for oilfield services stats from the Middle East is intensifying. Much of that interest is in Europe, where it'll be a while before the subsea segment fully recovers. Not sitting around, suppliers in Norway are designing smaller; targeting new markets and getting regulators to look at offshore rules changes that'll spur growth.

Courtesy Blueye

By William Stoichevski

Blueye

One company trying new things and targeting the ocean space is Trondheim-based ROV start-up, Blueye Robotics. Despite displaying a "mini-ROV" at the Subsea Valley oil and gas show, project manager Christine Spiten says they're really marketing their ROV as an "underwater drone" for the mass consumer market.

"It's for exploring and inspecting out-of-the-way, not easy-to-get-to locations," she says. With one camera, a main thruster, two vertical thrusters and two GoPro cameras for quality, the Blueye is envisioned filming marine life; inspecting subsea infrastructure for gas leaks or surveying a ship's hull or harbor for the unexpected. The potential for this throw-overboard technology as a diver's companion is plain to see, as are its possible military applications.

Offshore, the Blueye could cheaply "supervise" the lowering of expensive subsea kit to the shallow-water seabed without calling on ROV expertise. At the sea bottom, LED lights could shine on suction piles or pipeline pigs or just illuminate organisms for the oceanographer, pro or amateur. Other markets, she confirms, are fishermen, harbors and biologists.

"We tested a lot of mini-ROVs," Spiten says, belying an interest in converting them for the consumer market, "But it wasn't fun (enough). Often there was just one screen and a lot of equipment to carry. We wanted ours to be as fun as flying a drone." Shipboard control is by tablet, joystick or virtual reality goggles via fiber-optic cable to the "drone" 100 meters down (max. depth). Projected price: $2,000.

Two Blueye "drones" investigate.


Courtesy Blueye

EGGS Design housing

As if the Blueye wasn't small enough, a new version 30 percent smaller is understood to be under development for delivery next year, and the newest prototype was about to be shown when we went to print. It took 10 weeks to build a prototype, helped by local design consultancy EGGS Design — renderer of all from house-sized subsea manifolds and housings to handheld devices, rigs, and Rolls-Royce ship's bridges.

Kongsberg Maritime's Monitoring

Like the Blueye, Kongsberg Maritime's multiple-sensor enclosure, the K-Lander, could trim ROV costs for ocean monitoring that can reach $150,000 per day, according to VP, Subsea Monitoring, Soeren Themann. The K-Lander seabed observatory is the core of a Kongsberg Maritime subsea monitoring network, and starting this spring it will monitor the environmental impact of methane hydrate production. Methane hydrates are a "threat" to conventional oil and gas production for being so abundantly suspended in the world's northernmost oceans, including the coasts of Japan and Canada. This year's K-Lander "cage project" launches as we write and will transmit that environmental data from autonomous underwater vehicles, or AUVs.

Rambøll's "Wind" Platforms

Much of the effort nowadays by large subsea service providers and equipment vendors targets savings for oilfield operators. Getting in on projects early and standardizing designs

are now known cost-cutters. Building things smaller; scaling back scope; eliminating duplicate engineering and documents or eliminating the use of costly vessels are the newest wave. Yet in Norway, where offshore fleet-owners are anxious, trimming back vessel use is a treasonous proposition. An idea that generates offshore fleet use is welcome, and Denmark-based wind turbine and offshore platform jacket designer Rambøll appears to have just the ticket: introduce to Norway simple "unmanned, minimum-facility platforms" which are ubiquitous in neighboring shallow-water oil provinces along with normally unmanned platforms. The platforms are understood to be considerably less expensive to build and operate than many subsea developments, and some 60-odd European oilfield projects are scheduled to be subsea tie-ins. Other subsea projects are shelved but would be feasible should Rambøll's Type O to Type 4 platforms be used. The idea has found major traction in Norway, where the Norwegian Petroleum Directorate has just disseminated Rambøll's report on the subject. Just five percent of Norwegian platforms are unmanned compared to from 25 percent to 30 percent in the Dutch, Danish and U.K. sectors, where water depths are often similar. Operator Statoil was convinced enough to order in December 2015 an unmanned wellhead platform, jack-up drill rig and one dedicated support vessel for the Oseberg Vestflanken 2 field development. The operator says $122m has been saved by opting for the concept.

W2Ws

"We're not trying to end subsea," says Rambøll administrative director for offshore pipelines, subsea and jackets, Henrik Juhl. Remote controlled operations at Rambøll-built platforms suggests "minimum service visits" due to the minimum of equipment at these facilities. The designs are "standardized" and those installed in the '80's are still in use. The Rambøll Type 4 design is the simplest and is used in the Gulf of Mexico without a helideck, accommodations or cranes. It means offshore ship owners' new, employment-saving "walk-to-work" vessels are used to ferry in specialists and supplies. There are five simplified platform designs, including a Type 2 pig launcher for pipelines with cranes and a Type O for up to 30 wells. For Norway, it's the wind industry's relatively incident-free, helicopter-free mode of accessing offshore wind turbines that might matter most. Some 91 European discoveries, Juhl says, are less than 50 km from technology-laden infrastructure, where these simple surface wellhead platforms could provide 26 to 52 ship visits or up to 3,000 hours of walk-to-work vessel time per-year, per-platform of up to 12 wells. Some 850 of Rambøll's 13,500 global workforce is committed to offshore oil and gas projects. Many more work in its wind-energy business.

It's unknown how long the oceangoing supply chain will continue looking at new markets or old ideas to boost business. Rystad's Martinsen says deferred offshore oilfield developments is only adding to "the jackpot waiting to happen" when demand for subsea suppliers again strengthens. By that time, more offshore service vessels, or OSVs, might be servicing more Rambøl unmanned platforms, and Blueye might be satiated by the consumer market alone.

"Offshore services need to survive 2016 in order to have a bright future," says Martinsen, who adds that a slow 2017 will usher in the "jackpots" of 2018-2020. We'll see whose jackpot it'll be.

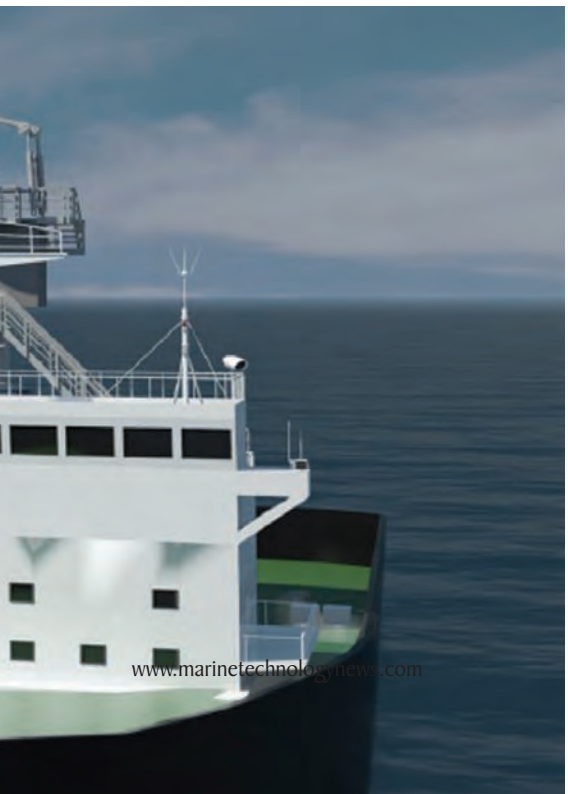
A Ramboll idea could mean more work for W2W-equipped vessels.

Illustration: NPD/Uptime International

Live oil prices at Rystad's Oslo head office.

Rystad's VP of anlalysis, Audun Martinsen

Images courtesy William Stoichevski



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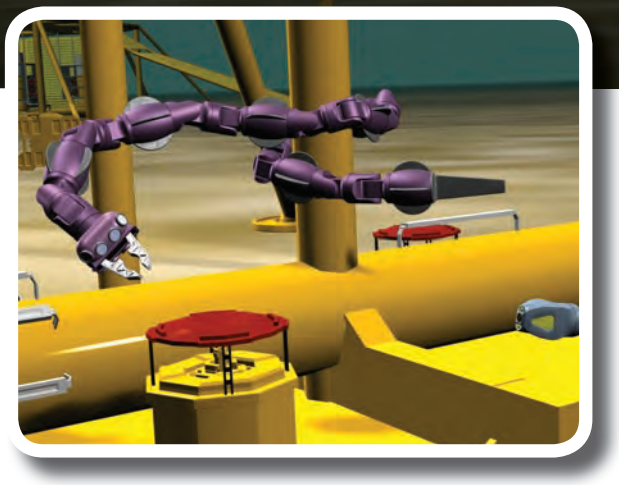
MTR 100

Swimming Robotic Snakes for Subsea Inspection



Kongsberg Maritime and Statoil have signed an agreement with Eelume, a NTNU spin-off company, to accelerate new technology that will significantly reduce costs related to subsea inspection, maintenance and repair operations. NTNU and Sintef have conducted research on snake robotics for more than 10 years. Eelume is now developing a disruptive solution for underwater inspection and maintenance in the form of a swimming robot. The idea is to let these robots do inspection and light intervention jobs on the seabed, reducing the use of larger, more expensive vessels. With its snake-like form, the slender and flexible body of the Eelume robot provides access to confined areas that are difficult to access with existing technology.

Eelume robots will be permanently installed on the seabed and will perform planned and on-demand inspections and interventions. The solution can be installed on both existing and new fields where typical jobs include; visual inspection, cleaning, and adjusting valves and chokes.

"With our unique expertise in the field of snake robotics Eelume is the first company in the world to bring these amazing robots into an industrial setting. Now we take the step from academia and into the commercial world to secure our place in the new and exciting subsea intervention landscape," says Pål Liljebäck, CTO Eelume

"This is a perfect example of how NTNU AMOS can contribute to bringing research based innovations into the market place through new spin-off companies and cooperation with leading industry players. Eelume is already the 5th spin-off company from researchers at NTNU AMOS and the third since 2013. SFF NTNU AMOS is strongly supported by the NTNU management, the Norwegian Research Council, Statoil, DNV GL and SINTEF Group," says Asgeir J. Sørensen, Director, NTNU AMOS, Center for Autonomous Marine Operations and Systems.

Watch he innovative new Eelume snake robot in action:

No thrusters:
https://www.youtube.com/watch?v=sIpIAbWo_2A

Thrusters:
https://www.youtube.com/watch?v=h-6FbxjNsQU

Statoil Launches Cap-X Subsea Concept

Statoil recently presented a new subsea concept called Cap-X, designed to reduce costs and increase efficiencies. The Cap-X subsea concept developed by Statoil was presented by Margareth Øvrum, executive vice president for technology, projects and drilling in Statoil.

"Once again we aim to drive subsea technology development on the Norwegian continental shelf together with our industry partners. The potential for increased efficiency and reduced costs can make this the next standard within subsea templates," Øvrum said. "With Cap-X, Statoil is one step closer to a 'plug and play' solution on the seabed."

Cap-X is a combination of existing and new technology. It is one-fourth the size of today's subsea templates and enables more operations from vessel instead of rig.

The technology increases the efficiency of horizontal drilling in shallow reservoirs. The main structure of the technology can be produced in shorter time by a larger number of suppliers, with potential for local production.

The development of Cap-X was initiated in 2013 to increase commerciality of potential resources in the Barents Sea.

Margareth Øvrum,
EVP, Technology, Projects & Drilling, Statoil

(Photo: Trond Isaksen - Statoil ASA)

A Vibrant Oceanology 2016 Closes in London

Oceanology International is widely regarded as the finest international exhibition for the subsea industry, and 2016 did not disappoint. Marine Technology Reporter was out in force at the show, scouting the aisles for the latest news and technologies. Here's a sampling of what we found.

Text & Photos by Eric Haun

Hydroid president Duane Fotheringham stands next to the new and improved REMUS.

Hydroid Debuts New Generation REMUS 100 AUV

Kongsberg Maritime subsidiary Hydroid, Inc. has been building the REMUS AUV since the company's inception in 2001, delivering more than 400 of these vehicles over that timeframe. Though the REMUS has received a number of incremental improvements over the years, it has never undergone an end-to-end technology revamp – until now. The overhauled New Generation REMUS 100 AUV combines the reliability of the original REMUS 100 AUV with several new features and capabilities, such as advanced core electronics, a flexible navigation suite with an exclusive conformal Doppler Velocity Log (DVL) and an open architecture platform for advanced autonomy, explained Hydroid president Duane Fotheringham.

"This is really a ground up refresh of the technology on the Remus 100 platform," Fotheringham said.

The new version of the vehicle was created over a period of two years, and is designed based on feedback from the AUV's user community.

The new generation AUV is also smaller and lighter, but with the same diameter as existing models in order to maintain compatibility with older generation modules, sensors and payloads.

New smaller and lighter core electronics (CE) replace the previous REMUS motherboard, as well as the CPU stack, emergency board and six serial cards. The new CE board uses an ARM +FPGA architecture that makes it both potent and versatile while consuming less than 5W of power—about 25 percent of the power required by the earlier version.

The New Generation REMUS 100 includes an exclusive conformal design, phased array transducer 300kHz DVL

A Lego model of survey vessel Bibby Athena at the Bibby stand.

in the rear of the vehicle, increasing bottom-tracking range to improve overall navigation performance. In addition, the REMUS 100 will now be available with a choice of inertial navigation system (INS).

Equipped with two or three (depending on the model) of Hydroid's 18650 Li-Ion based packs, the New Generation REMUS 100 AUVs will carry more energy than before. The packs use 3.2Ah Li-Ion cells and have the same electrical configuration as the REMUS 600 pack currently in use.

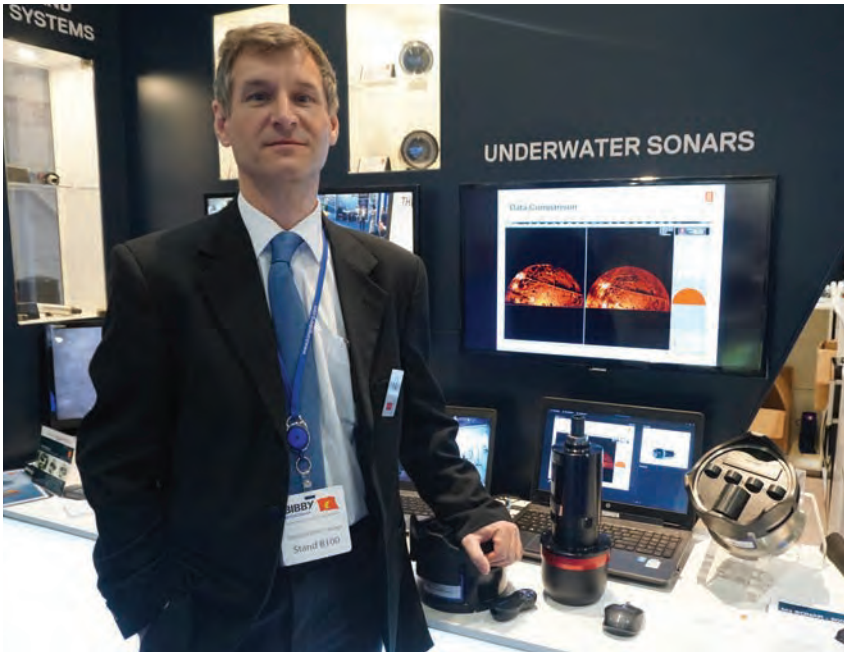
VideoRay Mission Specialist ROV

VideoRay brings to the market a new offering for specialized underwater operations with its Mission Specialist Series, which utilizes a system of interchangeable, modular components to create custom ROVs more quickly and cost effectively.

With its Mission Specialist ROVs, VideoRay said it has taken a "reformist approach" to the design and customization of its new vehicles, now engineering the ROVs to desired sensors or payloads for improved reliability effectiveness and cost for specific missions.

VideoRay marketing and training manager Brian Luzzi explained that the Mission Specialist Series feature various simple, modular components that can be configures into the vehicle depending on the mission specifics. Cameras, lighting, frames, flotation and propulsion are all customizable during the ROV's design.

VideoRay's Mission Specialist Series provides customization for specific missions through a range of modular components.



Daryl Morse at Kongsberg Mesotech, presented an acoustic lens that improves image quality by correcting acoustic defocusing of transducers in oil-filled domed sonar heads in deepwater applications.

The end result is a flexible and customizable platform that is easily adapted to target specific missions.

Initial depth rating is around 2 kilometers, though VideoRay hopes to reach full ocean depth in the future.

Falmat Goes 'Xtreme'

Cable manufacturer Falmat debuted its new Xtreme-Marine HD line of video cables engineered to provide HD and SD high quality video transmission down to depths of 7 kilometers. Designed for harsh environments, the rugged cables are available as single coax design with polyurethane jacket or in a composite construction with additional power conductors, strength layers or other features. A key feature of the cable is its impressive long range capabilities, said Falmat president Brian Falk.

Falmat president Brian Falk holds the new Xtreme-Marine HD cable.

Applications include ROV, diver umbilical, overboard drop camera, topside and subsea monitoring, ocean observatory, pipe and well inspection, robotics, fisheries, water theme entertainment and even marine movie production.

Teledyne Marine: 'Sea of Solutions'

Teledyne Marine brought with it a "Sea of Solutions" to Oceanology International 2016, presenting 16 new products for launch or preview over the company's five core technology segments: Imaging, Instruments, Interconnect, Seismic and Vehicles. Several of the key products are detailed below.

• ***UTS-9400 Universal Top Side Unit***
Built on the strength and dependability of the UDB-9400 Deck Unit, Benthos' new UTS-9400 offers new features and capabilities including a new user-friendly color touchscreen display, universal command capability.

• ***R2K Acoustic Release***

Teledyne RESON debuted the new SeaBat T50-P multibeam echosounder.

The newest member of the Teledyne Benthos acoustic release family, the R2K is a mid-water solution for acoustic release operation, featuring new advanced electronics architecture with battery voltage indication and tilt measurement in 1 percent increments.

• ***rapidCAST***
The Teledyne Oceanscience rapidCAST underway profiling system provides near real time SV data to surveyors, while eliminating survey downtime and minimizing bathymetry data uncertainty. The automated profiler deliver sound velocity casts to 500 m at 8 kts speed through water while underway, without the requirement of an operator on deck.

• ***Z-Boat / Z-boat 1800 RP***
Oceanscience's two-man portable Z-Boats aims to deliver value and convenience for hydrographic surveyors conducting shallow water inshore bathymetric surveys by removing the expense of mobilizing manned boats and the danger of placing technicians in hazardous locations. The Z-Boats echosounder, GPS and radio modem allow the operator to track the boat in real time from a shore laptop. The new Z-Boat 1800 RP offers an interchangeable sensor well, which allows for the easy integration of an array of surveying sensors.

• ***SeaBat T50-P***
The new SeaBat T50-P multibeam echosounder from Teledyne RESON offers clean and ultra-high resolution data, portability and wider swath coverage. The SeaBat T50-P Full Rate Dual Head configuration was shown for the first time at OI 2016.

• ***Saturn-DVL***
Showcasing the capabilities of Teledyne Marine, Saturn-DVL is TSS' new fiber optic gyro device providing an integrated navigation solution for subsea vehicles. It can provide a wealth of navigation and inertial measurement from its durable yet compact housing. Soon to be available in 0.1°, 0.3° and 0.5° heading accuracies and with a 600kHz or 300kHz DVL, the unit will be depth rated to 4,000 meters as standard.

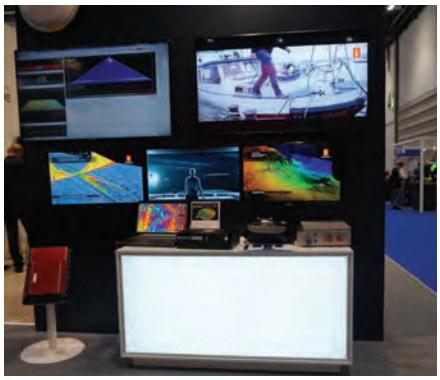
Teledyne had a number of new and existing products on display at Oceanology International 2016.

Kongsberg Demos New EM 2040P

Kongsberg Maritime demonstrated its latest development of its EM 2040 multibeam echo sounder technology platform at Oceanology International 2016. Test surveys were run on demo boat Northern Wind.

The new highly portable EM 2040P is first and foremost lighter and more compact, according to Ståle Myklebust, Senior Engineer Service Field Service Hyd, Kongsberg Maritime. The shallow water multibeam echo sounder is designed for easy transport and quick deployment, while offering survey performance up to and exceeding the IHO-S44 special order and the more stringent LINZ specification.

"We see this as a good replacement for



The basic EM 2040P has three units: a Sonar Head with receiver and transmitter integrated, the EM Portable PU and a workstation.

Kongsberg Maritime demoed EM 2040P at OI aboard the Northern Wind.

Exhibition attendees compete in an underwater vehicle racing game at the Forum Energy Technologies stand

the 2040C," Myklebust said.

A key aspect of the system is that it features three sector transmitters (TX), which allows for active stabilization for the vessels roll, pitch and yaw. The transmit fan is divided into three sectors pinging simultaneously at separate frequencies, which ensures effective dampening of 'multi-bounce interference'. This enables the user to conduct surveys in rough seas and weather conditions, and still maintain full seabed ensonification.

Both the TX and the RX transducers are combined into one sonar head for ease of installation and integration. The operating frequency range is 200 to 400 kHz, enabling the operator to select the best operating frequency at any time: 300 kHz for near bottom, 200 kHz for deeper waters, and 400 kHz for very high resolution inspection.

New features available on the EM 2040P include Extra Detection, which enables the user to identify, classify and map objects above the seafloor and in the water column. The pipe-tracker is another new feature enabling the system to increase the number of beams and focus on the pipe, which delivers a higher resolution image of the pipe.

The EM 2040P is made possible through the development of a new Kongsberg EM Portable PU (Processing Unit), a ruggedized splash proof processing unit created to work with all KONGSBERG shallow water EM-series multibeams. Designed for operation in harsh conditions, the EM Portable PU allows the full feature set of Kongsberg multibeam technology to be utilized.

The basic EM 2040P has three units: A Sonar Head with both the receiver and transmitter integrated, the EM Portable PU and a workstation. Data input from a motion sensor and a positioning system, such as the new Kongsberg Seapath 130, which offers the same portability as the EM 2040P, is required. The sonar head may be delivered mounted on a frame together with the motion sensor and a sound speed sensor, factory aligned for ease of mounting.

MacArtney Takes Pan-and-tilt 360°

The new LUXUS Dual 360° P/T (pan and tilt) unit combines operational and service flexibility, performance and reliability to offer 360-dgree pan and tilt for cameras, lights, sonar equipment or other instruments on work class ROVs.

MacArtney said this LUXUS product is the first pan-and-tilt unit to feature unlimited movements of both pan

LUXUS Dual 360° P/T is the first to allow continuous rotation at both axes.

and tilt rotating continuously which is made possible by means of the slip rings mounted. This facilitates operation at all angles and full-scale activation.

The unit's sturdy design is based on a sandblasted titanium housing which permits a working depth of 4,000 meters, and its housing is strong, corrosion-resistant and non-oxidizing, meaning the LUXUS Dual 360º P/T is suitable for heavy-duty operations.

The LUXUS Dual 360º P/T also features high torque of 100 Nm and a max payload of 100 kg.

MEL director Brian Evans shows off the new Dolphin 2d sonar.

New Dolphin 2D Sonar from Marine Electronics

The new Dolphin 2D has joined the lineup of sonar products from Guernsey-based Marine Electronics Ltd. (MEL). Based on MEL's existing longer-range Dolphin 3001 model which operates at 250 kHz, the Dolphin 2D is a compact and lightweight 720 kHz model suited for use on small ROVs and AUVs, as well as for other applications on surface craft. Its versatility and ease of use is also improved by an Ethernet connection to the underwater unit.

A Dolphin 2D prototype was first presented a year ago, but a final product is now ready for operational use following further testing and fine-tuning, explained MEL director Brian Evans.

The Dolphin 2D features a one-piece composite ceramic unit with 96 elements producing 192 acoustic beams to create a 120 degree horizontal display. The unit can provide clear images at 30 frames per second for close range work at less than 1 meter, as well as 7.5 frames per second for longer ranges up to 100 meters.

"Despite its compact size, the new Dolphin also contains a nine-axis MEMS motion sensor and its output requires no surface image processing," Evans said. "This means that whatever leaves the unit via its Ethernet connection is what the user sees on the surface."

EIVA Launches NaviPac 4

EIVA launched its NaviPac 4, representing an overhaul of its survey navigation and positioning software as part of the NaviSuite software suite for offshore and shallow water operations.

Key features of the new software generation include a new configuration tool, LiDAR navigation capability and new Helmsman's Display. NaviPac 4 brings visualization and processing features from EIVA NaviModel, the NaviSuite solution for 4D modeling and visualization. This also means that the software now offers a native, real-time 3D engine.

According to EIVA, NaviPac 4 allows users to eliminate the number of solutions required to carry out survey and construction operations, standardize setup by using the same software for different types of operations, and simplify and automate operation workflow to reduce operator time.

Jérôme Cuny, business development manager and co-founder of French company Open Ocean, exhibited Metocean Analytics, an innovative SaaS platform for metocean conditions analysis.

EIVA's new NaviPac4 was on display at the company's stand.

Atlantas Marine Ventures into ROV Instrumentation

From Left: Paul Falloon and Sam Rolfe of Atlantas Marine.

Atlantas Marine Ltd, a company that has been selling small ROVs and providing survey services for more than 15 years, has ventured into ROV instrumentation with the design and manufacture of a video overlay device intended to make cathodic protection surveys easier and faster.

The new tool, shown for the first time at OI 2016, has been designed to display the readings obtained by a cathodic protection probe as an overlay on the ROV's video display, creating a permanent record and eliminating the need for the ROV operator to make handwritten notes of individual probe readings while surveying the condition of a vessel's anodes.

The CP video overlay unit consists of a small black box that can be quickly and easily interfaced with the ROV's cathodic measurement probe and the pilot's video display. It is the answer to a practical problem that Atlantas Marine ROV operators had been grappling with for many years and it now enables them to give their undivided attention to the task of operating the ROV and its probe. When the ROV is driven forward against the hull or anode of a vessel the current reading obtained by its probe is traditionally displayed on a separate unit. From there it must be transcribed by the ROV pilot or an assistant in a way that enables the reading to be related to a specific anode. This can be a challenge if sea conditions are difficult or visibility is limited but with the CP data overlay it is no longer necessary. The reading obtained by the probe is shown as part of the ROV's video display which is creating a permanent record of the dive. By reviewing the recording later it becomes possible to relate the data to the exact location in a way that efficiently avoids any mistakes or ambiguity.

Jack Herbert of Phoenix International Holdings (right) talks with a guest at his company's stand

iXBlue Debuts ROVINS NANO

Designed specifically for ROV navigation, iXBlue's new inertial navigation system ROVINS NANO provides accurate positioning at all depths, including for Middle Water Station Keeping.

Based on the manufacturer's fiber optic gyroscope technology, iXBlue has developed ROVINS NANO to offer ROV pilots stability and accuracy of the inertial position, outputting true north, roll, pitch and rotation rates.

Paul Wysocki, iXBlue ROVINS NANO Product Manager said ROVINS NANO can directly and accurately transmit position due to an integrated INS algorithm capable of collecting acoustic data, regardless of depth.

Where the Doppler Velocity Log (DVL) has limitations, especially when operating in middle water, ROVINS NANO is now there to guarantee optimal navigation safety. "In the future, it will no longer be necessary to use a DVL: even in 'sparse array' LBL fields, with the presence of only one or two beacons, the combination between ROVINS NANO and our RAMSES acoustic sys-

The new ROVINS NANO on display on iXBlue's stand at Oceanology.

tem enables to reach extremely accurate positioning data," Wysocki said.

Additionally, iXBlue said the ROVINS NANO is easy to integrate thanks to its compactness, lightness and open architecture with all third-party sensors.

New from Nautilus Marine Service

Nautilus Marine Service, provider of VITROVEX glass housings capable of operating in the Earth's most extreme regions, has launched a new 13-in. diameter glass sphere that can withstand full ocean pressure, as well as a 20-in. diameter glass sphere with more than 40 kg uplift. Various high optical grade spheres up to 7.5-om/ diameter complement the deep water product range of VITROVEX enclosures for applications featuring camera, video and lights. VITROVEX glass enclosures offer the dual advantage of buoyancy and pressure proof housings – a perfect combination for small and autonomous underwater instrumentation packages.

Nautilus Marine Service displays its new glass sphere.

Aquatec: New Acoustic Profiler, Optical Modem

The newly launched AQUAscat 1000LT acoustic profiler joins Aquatec's AQUAscat range to enable even easier measurement of suspended sediment concentration in water depths up to 200 meters. The AQUAscat 1000LT observes profiles of suspended sediment concentration of up to 2.5 meters using multi-frequency acoustics. Profiling allows sediment dynamics such as re-suspension and entrainment to be explored, which is not possible with single point measurements. AQUAscat 1000LT contains two fixed transducers of 1 and 4 MHz for increased flexibility. The new instrument is supplied with the latest post-processing software that allows the mean particle size and concentration to be calculated from the acoustic backscatter output.

One of the several boats used to demonstrate exhibitors' equipment in action on the Thames waterside.

AQUAscat 1000LT (left) and AQUAmodem Op1L (right).

Also new from the Aquatec Group is the AQUAmodem Op1L, a lightweight version of its standard optical modem designed for use by divers and on small ROVs. The optical modem allows short range interrogation, commanding and data download from underwater equipment. The AQUAmodem Op1L is compatible with any instrument with an RS232 serial interface, including Aquatec's AQUAlogger and HYDROlog ranges, and can replace costly ROV mateable connectors or cables. The latest version is also interchangeable with Aquatec's original optical modem.

New from Valeport

New from Valeport is the fastCTD Profiler, an evolution of the miniCTD designed to deliver high quality CTD casts at rapid drop rates. A conductivity cell designed for optimum flow-through, a fast response thermistor temperature sensor and a 0.01 percent pressure sensor synchronously sampling at 32Hz deliver the high quality profiles in a lightweight and robust package. Add in an

(Image: Valeport)

fastCTD Profiler.

integral fluorometer based on Valeport's new Hyperion range, an optional Bluetooth communications module and the miniCTD Fast Profiler offers a unique and versatile package.

Also new is the SWiFT SVP, designed from the outset with the intention of a seamless workflow, the SWiFT SVP has integral GPS to geo-locate every profile. With a rechargeable battery endurance of up to a week and easy charging via USB, the SWiFT SVP is intended for coastal, harbor and inland hydrographic survey, aimed in particular at the shallow water market (0-100 meters). This new compact unit features high accuracy SV, pressure and temperature, plus integral GPS, rechargeable battery, LED status indications for GPS, battery and communications. Data can be easily and quickly downloaded, reviewed and translated to common SVP formats wirelessly via Bluetooth Smart using the SWiFT APP on iOS devices where data can be instantly shared via FTP, email and cloud services. Valeport's standard DataLog X2 software for PC use will also support SWiFT.

SBG Systems Launches New Inertial Sensors

SBG Systems has added two new inertial sensors to its MEMS technology based Apogee product line: a Motion Reference Unit (MRU) Apogee-M and an Inertial Navigation System Apogee-U – both made of titanium with a depth rating of 200 meters.

According to its developer, Apogee integrates the latest generation of MEMS sensors to reach a high degree of precision - 0.008° in roll and pitch in real-time – while delivering a robust and accurate heading thanks to the continuous fusion of GNSS and IMU data. Made of titanium, Apogee-M and Apogee-U are suited to mount close to the sonar head for hydrographic tasks from shallow to deep water.

The Apogee provides a real-time heave accurate to 5 centimeters, which automatically detects the wave frequency and constantly adjusts to it, SBG Systems said. When wave frequency is erratic or in case of long period swell, the delayed heave feature can save the day by allowing survey in rough conditions. This algorithm allows a more extensive calculation, resulting in a heave accurate to 2 centimeters displayed in real-time with a little delay.

Saab Seaeye displayed a number of vehicles at its stand

SBG Systems launched a new inertial sensor system.

Apogee sensors can be paired with any type of survey-grade GNSS receiver or by the one offered by SBG Systems. The SplitBox GNSS integrates the latest tri-frequency GNSS receiver to offer several positioning features such as RTK, Marinestar, OmniSTAR, Veripos and TerraStar corrections.

Configuration is made easy throughout the intuitive embedded web interface where all parameters can be quickly displayed and adjusted. The new 3D View helps users check the mechanical installation, especially sensor and antennas position, alignments and lever arms. Users can then connect the Apogee to the main hydrographic software thanks to available drivers.

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