MARINE TECHNOLOGY REPORTER

July/August 2016

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11th Annual

MTR100

Volume 59 Number 6

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October 24-26, 2016
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MARITIME & ARCTIC
SECURITY & SAFETY CONFERENCE

October 27-28, 2016
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ArcticTechnologyConference.org | MaritimeArcticSecurity.ca | TheArcticPath.com

Newfoundland Labrador
CANADA

July/August 2016

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Volume 59 • Number 6

Announcing the New Generation, Man-Portable REMUS 100 AUV

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Associate Publisher & Editor
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If I had the time to flip back through the previous 10 MTR100 editions, I would venture a guess that in this spot each and every time I called it my "favorite and least favorite edition" of the year: favorite because it affords me the opportunity to catch up on the works of the people and companies serving this market; least favorite because of the amount of work it takes. Unequivocally I can say that the 11th installment of the MTR100 is my favorite. Why? Because **Eric Haun**, web editor of **MarineTechnologyNews.com** is steadily increasing his work load in the industry and in our pages, and this year Eric took the point and the machete in hacking through the jungle of MTR100 applicants.

Again, 2016 was a record year of applicants for the MTR100. While I try to maintain good editorial judgment always, I would be lying if I didn't admit an affinity for the young 'up and comers,' those innovative spirits that are new and unknown. Will they still serve this market a decade from now? Will they be scooped up by some corporate conglomerate? Will they be working down the block from me on Wall Street? I have no clue. But I do know that companies like Blue Robotics (page 10); and individual and companies participating in the "X-Prize" contests (page 38); and the next generation of industry leaders currently growing in some of the world's finest institutions and institutes (page 46) add daily to the excitement and innovation that we present in our pages.

Perhaps the toughest job I had this edition was final selection of the cover, and again, that was easy. First and foremost thanks to The Alfred Wegener Institute (page 48) and photographer Stefan Hendricks for the stunning image. When I write about working in the ocean, I often refer to the ocean environment as "the harshest environment to work in on the planet." The cover of this edition takes "harshest" to the next level – and without a doubt this picture is worth more than a thousand words – as the Bremerhaven, Germany based AWI is renowned for its active presence in both polar regions. To me, the image that graces our front page is the best testament and 'hat's off' I could give to the people and technologies working in this industry every day.

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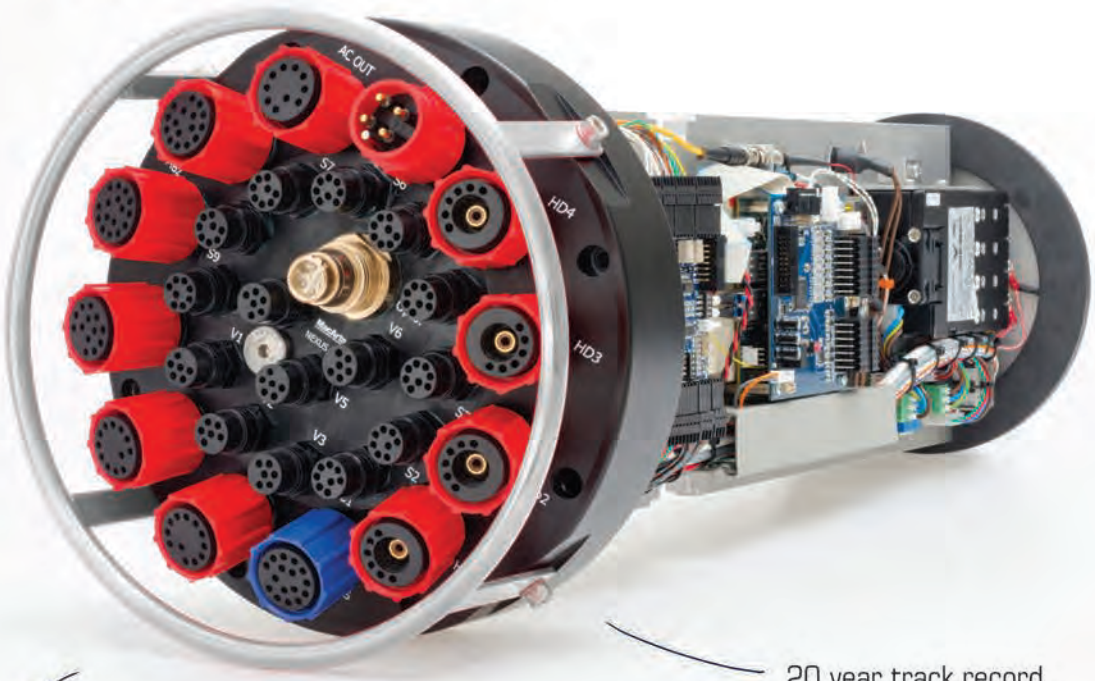

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Allspeeds Ltd

Allspeeds have a reputation for manufacturing a wide range of quality products for the oil and gas, maritime and military industries. Allspeeds' Webtool brand offers a broad range of hydraulic cutters for ROVs and maritime and subsea emergency disconnection systems. In addition to a range of standard cutters, Webtool is able to provide custom cutting equipment for use at any water depth. Suitable for cutting wire rope, guide wire, cables, hoses, umbilicals and fiber rope, Allspeeds' cutting tool design allows for easy positioning of the cutter and is ideal for operation in confined spaces. In addition to blade-on-anvil cutting, recently Webtool has developed a new blade-on-blade cutting design that maintains the roundness of the steel wire rope cross-section makes it much easier to re-use cut ropes during drilling operations.

Email: info@allspeeds.co.uk
www.allspeeds.co.uk

Aquatec Group

Aquatec Group creates instruments, services and solutions for measurement, monitoring and communication underwater, providing solutions for all water environments, including offshore structures and pipelines; oceans, estuaries, rivers and lakes; and marine mammals and fisheries.

Founded by the current managing director in 1990 as a specialist consultancy in oceanographic instrumentation design, Aquatec has since established a diverse portfolio of products for the measurement of oceanographic and process parameters, including temperature, depth, turbidity, suspended sediment, motion, orientation, cathodic protection, subsea leaks and marine mammal activity, as well as through and above water data communication systems. Other areas of expertise include consultancy, systems integration and real time monitoring systems.

Email: inquiry@aquatecgroup.com
www.aquatecgroup.com/

Aquatic

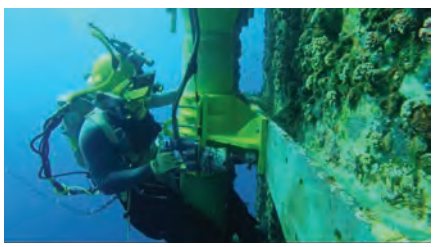
Aquatic Engineering & Construction Ltd., an Acteon company, is an independent operator of modular equipment for the global oil and gas, telecommunications and energy industries. The engineering and construction business provides equipment and services to support flexible product installation, recovery, replacement and decommissioning operations. Aquatic's range of modular, flexible equipment is available to be transported anywhere in the world and can be dismantled to fit into standard 40 ft. shipping containers, enabling Aquatic kits to be installed on relatively small vessels from more economical quayside locations, if required. Aquatic has tried and tested products and solutions for the installation, recovery and replacement of flexible products, onshore transpooling operations, the handling of flexibles, umbilicals and steel pipes, fleeting control, rapid cutting, straightening steel pipe and coiled tubing, multiple reel lay and ancillary products to assist in the spooling, deployment and recovery operations.

Aquatic can install, replace and recover semi-rigid products such as coiled tubing; mooring lines; power cables; production flowlines; production, gas lift and injection risers; reelable steel pipe; telecommunication cables; umbilicals; water pipes and wire rope products. The Aquatic carousel and integrated tensioner solution has been designed to maximize product capacity, minimize vessel days and maintain operational efficiency in demanding marine installation projects. The system provides the strength and stability that can withstand the installation of the heaviest equipment in deepwater. Its capability and flexibility in all waters is being proven on projects that demand increasingly long subsea tiebacks to processing platforms.

Email: info@aquaticsubsea.com
www.aquaticsubsea.com

Aqueos Corporation

Subsea service provider Aqueos Corporation offers a full range of services that includes marine construction, commercial diving, remotely operated vehicle (ROV), and vessel contracting services. The Aqueos-designed and -built



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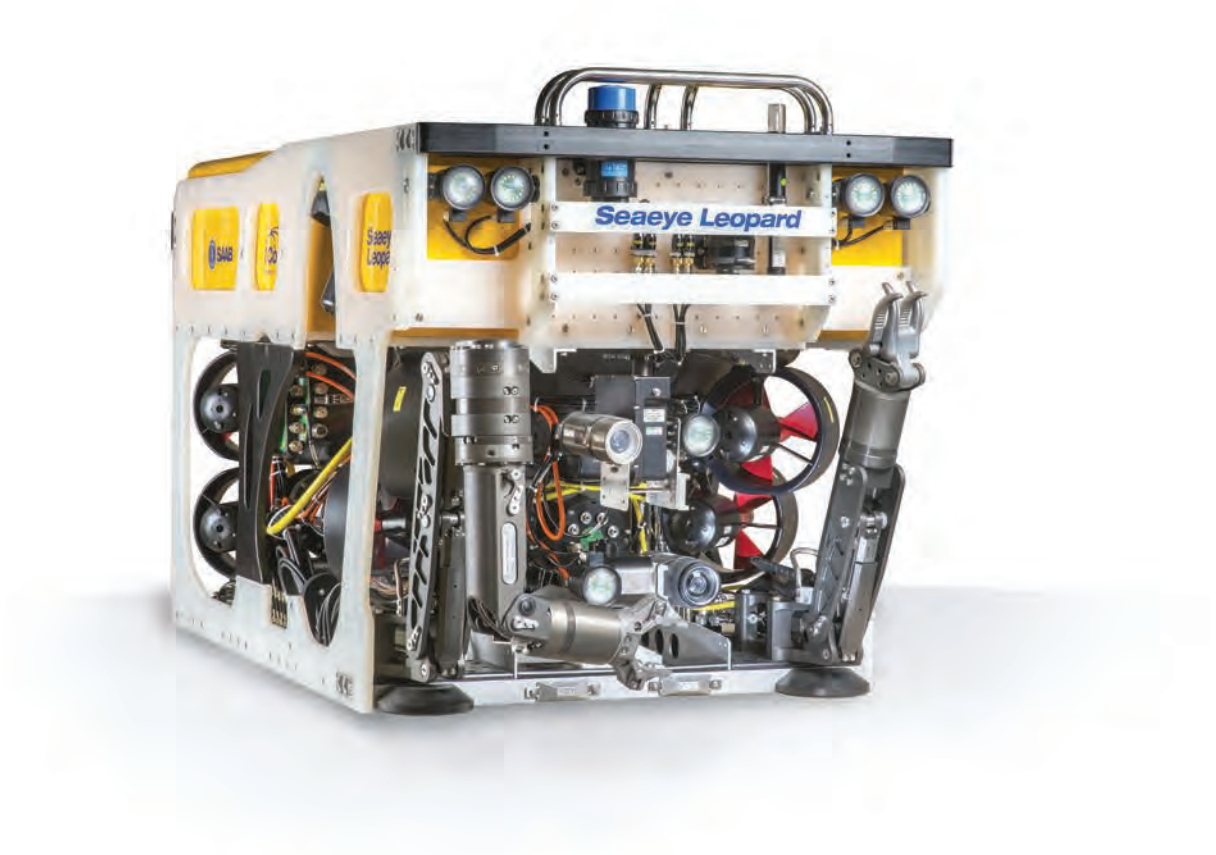

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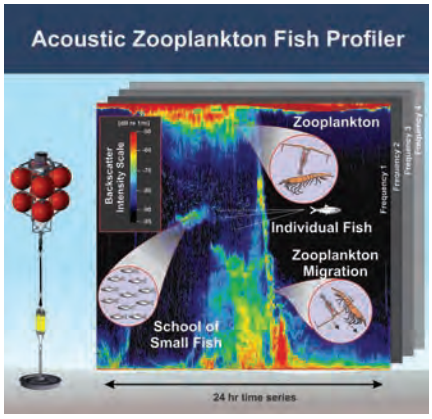
Email: mlebouef@aqueossubsea.com
www.aqueossubsea.com

ASL Environmental

ASL Environmental Sciences taps more than 38 years of experience in oceanographic, acoustic, remote sensing and ice research products and scientific consulting services, to provide innovative solutions and services in the areas of ice studies, metocean measurements, bio-acoustic backscatter, sediment transport and numerical modeling.

Making measurements in the harsh ocean environment demands skill and experience. ASL Environmental Sciences specializes in the physical measurement of the world's oceans, lakes and rivers. The company has conducted more than 950 government and commercially-funded scientific and technical projects, some valued at over $1.7 million, in environments ranging from the Arctic to the sub-tropics. This unique storehouse of experience is available for the toughest measurement problems, on its own or as part of long-standing interdisciplinary teaming arrangements.



ASL's instrumentation group has developed leading-edge acoustic instruments for oceanographic and hydroelectric flow measurements, and for ice, wave, and water column profiling. To date, ASL has designed and built about 350 individual autonomous echosounders for the recording of bio-acoustic backscatter and for the measurement of ice draft (proxy for ice thickness) for 6-month to 24-month deployments in some of the planet's most isolated areas.

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www.aslenv.com

ASV

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Website: http://www.asvglobal.com
CEO/President:Dan Hook
Number of Employees: 70
Engeneering Director: Richard Daltry
Chairman: Thomas S. Chance

A leader in the growing market for Autonomous Surface Vehicle technology, ASV's combines platform manufacturing and control system development to bring the latest in maritime autonomous technology to market. Its platforms are in operation across the globe.

Having delivered more than 75 autonomous systems to some 40-plus customers in 10 countries, ASV has established itself in the evolving Autonomous Surface Vehicle industry. The ASV team holds specialist expertise and experience in ASV concept design, build and commissioning, operation and maintenance. ASV vehicles and control systems are designed, built, fitted and tested from the company HQ near Portsmouth, U.K. The company also has a vehicle service center in Louisiana, U.S. to enable quick mobilization to the Gulf of Mexico. The company undertakes a wide variety of projects which see Autonomous Surface Vehicle technology utilized in a multitude of industry applications. These include hydrographic survey, offshore construction, oceanographic survey, mine countermeasures, security and naval gunnery training. ASV maintains an active role in industry working closely alongside relevant authorities and maritime institutions to develop and promote responsible autonomous operations at sea. The company played a pivotal role in the publication of the U.K. Marine Industries Alliance (MIA) Maritime Autonomous Systems Code of Conduct published in March 2016. ASV's technology is ever evolving with the company's product line having expanded to meet growing demand for new applications. ASV's purpose built platforms range from 2m catamarans to 13m monohull speed boats. In March 2016 ASV launched a fleet of newly produced C-Worker 5 vehicles **(pictured above).** These 5m ASVs are specifically designed to carry out hydrographic survey work.

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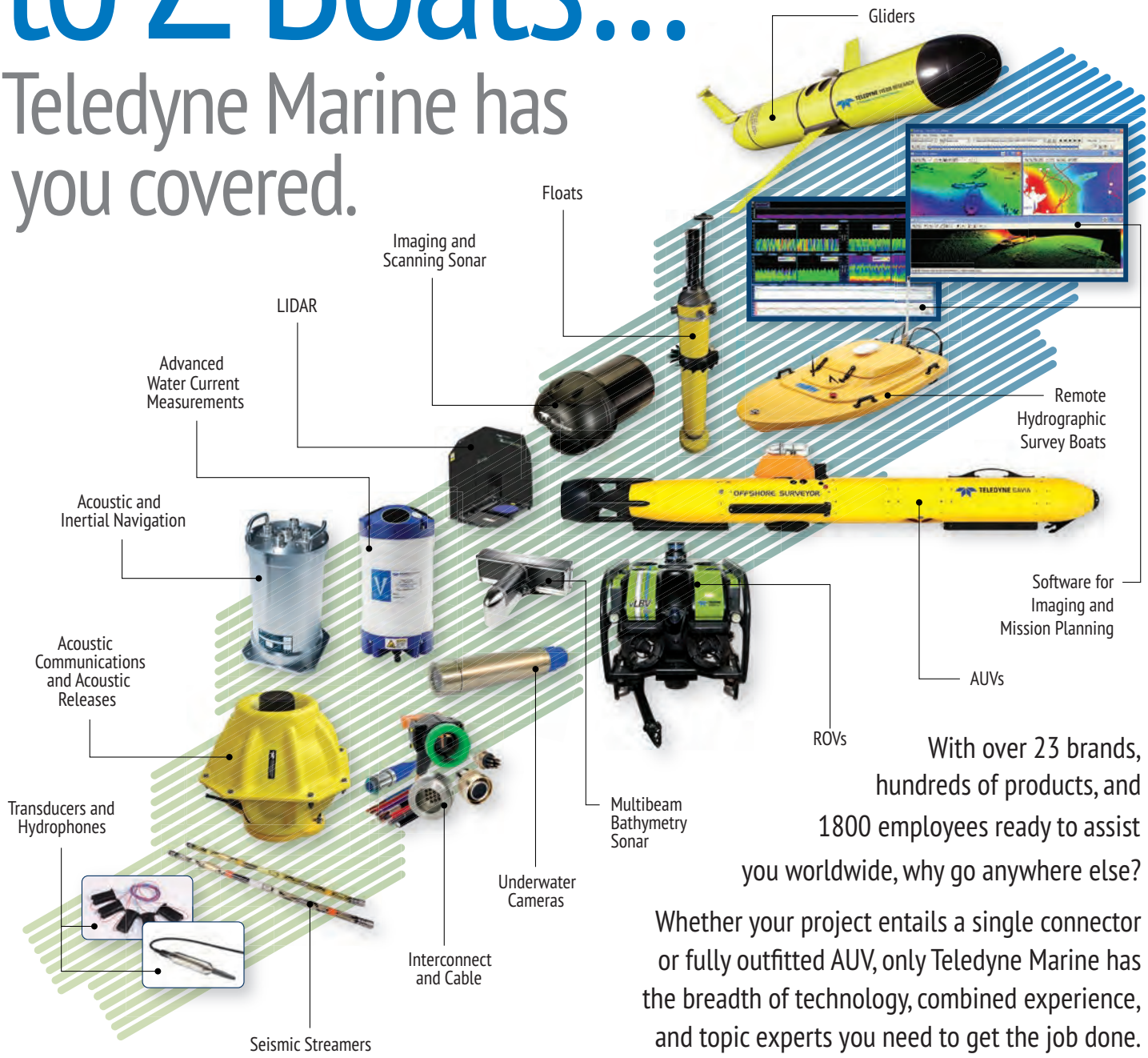

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Blue Robotics Inc

Blue Robotics is a young and innovative company in the marine robotics industry. Since launching its T100 Thruster through a Kickstarter campaign in 2014, the company has expanded to offer nearly 100 products designed to make marine robotics more accessible, including its recently released BlueROV2, one of the most affordable and capable ROVs available. The BlueROV2 combines many other Blue Robotics products into a single ROV that is touted as cost efficient given its capabilities and flexibility. The BlueROV2 has already seen extensive interest and sold more than 50 units in the first week since release.

The Blue Robotics technology portfolio is focused on innovative thruster designs and other components as well as open-source software and hardware. These technologies provide high quality at a revolutionarily low cost. The company's patent-pending thruster design uses a unique brushless motor design that is highly compact and inherently pressure tolerant.

In 2016 Blue Robotics released a number of sensors and electronics solutions including a pressure sensor rated to 300m depth, a high-accuracy temp sensor, and several tether interface boards. These products are all open-source hardware, following the open-source revolution within the aerial drone market that has spurred innovation and rapid growth. Similarly, the new ArduSub subsea vehicle control software is designed around the open-source DroneCode autopilot hardware and the ArduPilot codebase, bringing in hundreds of contributors, years of development, and providing features similar to the most advanced ROVs.

Email: info@bluerobotics.com
www.bluerobotics.com/

Caley Ocean Systems

In 2016, Caley has raised the bar for dive bell handling systems, with development of 18-man and 24-man DNV classed, twin bell, saturation dive systems; and a 3m wide portable saturation dive bell handling system - one of the most ultra-compact, fully road transportable, bell handling systems ever made.

Based in Scotland and established in 1968, Caley Ocean Systems – a business within the Seanamic Group – produces offshore handling systems for the oil and

AXSUB

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www.axsub.com
CEO/President: Eric GAUDREAU
Number of Employees: 5

After six years of operation, Canadian based AXSUB Inc. has become a key supplier for the commercial diving industries, hyperbaric industries and military in Canada, with distributors around the world.

The AXSUB team has designed several types of monitoring systems for the underwater and hyperbaric industry. AXSUB manufactures diving equipment such as digital video recorders, low voltage LED lamps, underwater cameras and electronic depth meters, and its systems are used by the key players for video recording and continuous real time depth monitoring of divers.

The AXSUB flagship product is the AxVIEW 2V-RM. Designed for commercial diving operations, when used with a computer, it enables video recording and numeric depth meter connectivity which will transform the AxVIEW into a diver control platform. This is the company's second generation of diving data management system, AxDDM, that is design for a typical rack-mount installation available as a 1-, 2-, 3- or 4-diver system. AXSUB will launch in 2016 its high definition

portable system, AxVIEWHD V-P, available as a 1- or a 2-diver system, which can be delivered with a Panasonic Toughpad and monitors installed in the lid of the Pelican case. When using the AxVIEW systems with other AXSUB products such as the AxLIGHT 35 LED lamp with the integrated overheating protection circuit and the AxSEE 57i SMART camera equipped with a built-in depth sensor, it becomes an integrated solution that allows managers and supervisors to effectively increase safety and efficiency of diving operations.

gas industry; oceanographic, marine science and naval emergency vessels; and offshore power and telecom cabling. The company's services include marine and offshore handling systems development, design consultancy, professional project management and engineering services. Caley Ocean Systems provides full installation and commissioning of offshore handling systems, crew training programs and worldwide after sales support. Caley Ocean Systems is a technology leader in offshore handling systems including: A-frame and winch systems, rigid inflatable rescue boats and workboat davit systems, bespoke oil and gas deployment systems; ROV, AUV and dive bell handling systems, and cable laying carousels and spoolers. A-frame and winch systems range from submersible and submarine rescue vessels LARS including several systems in continuous service for over 30 years, through to oceanographic tool deployment to 10,000m, and deepwater lowering systems for subsea processing systems. In addition to systems design facilities including 3D modeling (Autodesk Inventor & Solidworks) and Finite Element Analysis (ANSYS Professional), Caley has a large manufacturing facility. Covering more than 2,323 sq. m., the high bay, multifunction workshops include two 2 x 40 metric ton overhead cranes. Caley offers a range of dive handling solutions, and also supplies bespoke handling systems for ROV and AUV for water depths over 4,000m. The Caley Davit is recommended around the world as the premier solution for safe deployment of rescue and workboats.

info@caley.co.uk
www.caley.co.uk

CEE HydroSystems

CEE HydroSystems is committed to continuing to developing new modern SBES options for cost-effective shallow water hydrographic surveying.

Bruttour International launched CEE HydroSystems in 2011 as a new division established to focus on the development and manufacture of field proven shallow water CEE hydrographic survey products first designed by Bruttour. Since the company's inception, CEE HydroSystems have grown and increased design and engineering capabilities to enhance its product range and now offer a suite of highly specified single beam echo sounders. In 2015, Australia based CEE HydroSystems opened the first overseas office in San Diego, U.S.

CEE HydroSystems continues to innovate and bring modern processing power to single beam echo sounder equipment. This approach results in equipment substantially smaller, lighter, and more robust than products that may be based on technology that has changed little over several years. As a result of electronic component development, there no longer has to be a compromise between size, convenience and performance of shallow water hydrographic echo sounders. With CEE HydroSystems equipment, it is possible to have capability and convenience at the same time.

Email: info@ceehydrosystems.com
www.ceehydrosystems.com

BioSonics Inc.

4027 Leary Way NW, BioSonics, Seattle, WA 98107
Phone: 202 782 2211
Email: emunday@biosonicsinc.com
www.biosonicsinc.com
CEO/President: Timothy Acker
Number of Employees: 15
Vice President:Beverly Acker

BioSonics is a pioneer in unique deployment methods for surveying in the most challenging environments and a developer of unique software for habitat mapping and real-time, automated fisheries data processing

BioSonics first introduced fixed-location hydroacoustic fish monitoring in 1980. BioSonics introduced the mobile scientific echosounder in the mid '80s and since evolved the technology to the current DT-X Digital and MX Habitat series. Systems can be configured for mobile, automated fixed-position, and submersible autonomous deployments. BioSonics echosounders are used in all aquatic environments where accurate assessment of marine life abundance, distribution or behavior is required. Versatile, rugged designs allow for use in every environment imaginable. Technical staff includes a team of experts in software and electrical engineering, fisheries science, oceanography, and hydroacoustics.

BioSonics technology centers on focused, split beam and single beam hydroacoustics. Core products are the DT-X and MX series mobile echosounders for fisheries and aquatic habitat assessment. Digital transducers with superior signal to noise ratio, extremely low side-lobes, and multi-frequency, multi-channel systems are some of the unique technology advantages offered.

A recent BioSonics innovation is its fixed-station monitoring system technology for debris monitoring at

cooling water intakes, with several systems now in use at nuclear power facilities used for early warning and reducing risk of clogged intake screens.

BioSonics developed an automated software that processes split beam data in real-time to create track lists containing information that includes the size, location, direction and speed of travel for each target detected.

The company's ROV mounted echosounders for aquatic habitat and fisheries surveys conducted by remote control using wireless Ethernet communication allows for data collection in environmentally sensitive and/or hazardous areas inaccessible by manned vessels.

Chelsea Technologies

Chelsea Technologies Group (CTG) specializes in the design and manufacture of a range of sensors and systems for the oceanographic, maritime, environmental and defense markets. Innovation within the Chelsea Technologies Group crosses throughout the company's core market sectors with key state-of-the-art technologies commonly adopted through the market groups. Chelsea Instruments Ltd. was established in 1965 as a spin off from Imperial Collage, London. It merged in 2001 with Marine Acoustics Ltd. to form Chelsea Technologies Group Ltd. A team of scientists and engineers are engaged in design, development, production engineering and marketing of a wide range of oceanographic sensors, sonar systems, acoustic transducers and towed vehicle systems. Applications include environmental monitoring, acoustics sonar, biotechnology, advanced optics and technical and consultancy. CTG's comprehensive research and development facility provides a center of excellence for novel sensor design, prototyping and manufacture.

CTG provide sensors and systems for measurement of key environmental parameters within the oceanographic, coastal and inland water zones. The range of sensors include Lux fluorometers, for detection of chl-a, cyanobacterias, as well as dyes for tracer studies. The family also include UV fluorometers for detection of Hydrocarbons, CDOM and Effluent / Bacteria. CTG's UviLux sensor provides highly sensitive data on a wide variety of UV fluorescence parameters. Active fluorescence fluorometers are also provided with the Fast Ocean range, a family of multi-wavelength Fast Repetition Rate Fluorometer systems for in situ and laboratory studies of phytoplankton photosynthesis and gross primary productivity.

Email: lhiller@chelsea.co.uk
www.chelsea.co.uk/

CLIO Offshore/Odyssey Marine Exploration

CLIO Offshore, a division of deep-ocean exploration company Odyssey Marine Exploration (OMEX), is focused on providing survey, ROV and recovery solutions for depths up to 6,000 meters. Commercial companies can now contract the team, tools and technologies utilized by OMEX via containerized packages designed for fast and efficient mobilization, driving operations from conceptual stages to completion.

Leveraging resources built and tested over the last 20 years by Odyssey, CLIO Offshore offers clients bespoke subsea services that deliver cost-effective solutions to meet individual requirements. From its suite of individual tools and services to supplement existing operations, through to a complete project delivery and management CLIO deliveries range from desktop studies to marine asset procurement, mobilizations, offshore executions and reporting.

Email: lshows@odysseymarine.com

www.cliooffshore.com/

Coda Octopus Products

Established in 1994, Coda Octopus Products Limited has become a global leader and specialist in underwater technologies as the patent holder for the world's first and only real-time 3D sonar, the Echoscope, which enables subsea operators to constantly monitor operations when poor water visibility prevents the use of traditional cameras. The company's unique sonar and proprietary software, Underwater Survey Explorer (USE), provides real-time 3D imaging without the need to post-process data and is the only system in the world with this capability, enabling both real-time 3D visualization of the subsea scene in poor to zero visibility and high grade survey of the surrounding area including production of detailed bathymetry of the seabed to IHO S-44 Stan-

Chet Morrison Contractors

9 Bayou Dularge Road, Houma, LA 70363
Phone: 9858681950
Email: kreeves@chetm.com
www.chetmorrison.com
CEO/President: Chet Morrison
Number of Employees: 500
Vice President: John DeBlieux

Founded in 1983, Chet Morrison Contractors is a privately held company that has steadily grown from an inland marine operation to a multidisciplinary diverse service company. The company provides integrated oil and gas industry services throughout the lifecycle of the well, ranging from marine construction and maintenance to P&A and decommissioning.

Chet Morrison Contractors operates four locations with convenient access to Gulf of Mexico: Houma, New Orleans, Mexico and Trinidad. Its Deepwater Riser Services Division has an API Spec Q1 Registered Quality Management System and is certified to provide the highest standard of inspection and repair services in the industry according to APIQR and OEM specifications. It is also certified as a Licensed Inspection & Repair Service Provider for GE Oil & Gas – one of only two such facilities in Louisiana. The company is also an approved inspection and repair vendor for Cameron as well as an authorized repair facility for Trelleborg. The breadth of Chet Morrison Contractors' resources – from its dynamic team of experts, to its company-owned equipment and diverse fleet of vessels – forms a network of innovation that continues to drive its success. Chet Morrison Contractors' newest tool, MUDBUG, is an air-actuated, self-propelled device that uses oscillating brushes to clean debris build-up inside drilling and production risers without relying on high-pressure water to remove rust, scale and drilling mud buildup. As it moves through the length of the riser and back out again, MUDBUG uses only 120-psi air to operate, eliminating the problem of water disposal and risk associated with high-pressure washing. MUDBUG requires a two- or three-man crew and is transported via plane or helicopter to any remote location. The tool's small job box, measuring two feet by four feet, takes up very little space, making it suitable for rigs or other offshore operations.

dard. In addition to providing real-time 3D visibility, the sonar can be used in the same way as a traditional multibeam sonar to complete as laid surveys of the installed equipment once the installation operation is complete.

The Echoscope and sister products, the C500 and Dimension, can be deployed on a subsea remotely operated vehicle (ROV) or from a surface survey vessel. Echoscope has been used for a wide range of oil and gas operations, including pipeline survey, pipeline installation, touchdown monitoring, connection of assets and general ROV navigation and survey. The use of the Echoscope has the potential to reduce operating costs and time caused by poor visibility and weather outages affecting projects. Coda Octopus' product portfolio also includes a range of GNSS aided inertial navigation systems, MOTION F180 series. With expertise in supplying this leading-edge software and hardware solutions within its 3D, MOTION and GEO range of products, Coda Octopus has built a reputation of delivering high quality solutions.

Email: theresa.esser@codaoctopus.com

www.codaoctopus.com

DeepWater Buoyancy

DeepWater Buoyancy creates subsea buoyancy products for oceanographic, offshore oil and gas, and technology companies around the world, offering a product line, formerly manufactured by Flotation Technologies. DeepWater Buoyancy's subsea buoyancy products, which use proprietary syntactic foam technology, are suited for use from the ocean surface to depths exceeding 6,000

meters. The company offers full design services to customize stock products, as well as create equipment that is entirely custom, with in-house capability to design and manufacture in foam, plastic, urethane and metal. As such, the entire product can be designed and produced under one roof, including ADCP buoys and inline frames, bottom mounts, mooring buoys, instrument collars, cable and marker floats, ROV/AUV buoyancy, and custom syntactic foam solutions.

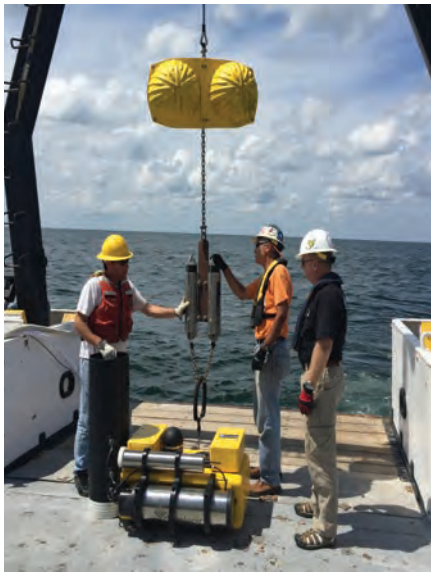
Email: davidcap@deepwb.com
www.DeepWaterBuoyancy.com

develogic

German-based develogic develops and manufactures turnkey customized data-acquisition and telemetry solutions for marine monitoring applications. The company has developed a building block system containing all necessary elements for collecting data anywhere in the ocean and transporting it to the customers' office.

Develogic's end-to-end design and manufacturing process integrates electronic and 3D mechanical design, multiphysics and structural simulation, 3D CAM and computer-aided inspection. In addition to the custom solutions business, develogic also specializes in marine acoustic solutions: acoustic telemetry systems with proven ranges up to 30,000m, passive recording capabilities up to three years and RAFOS sound sources for underwater navigation are part of the standard product portfolio. develogics' standard product range includes hydroacoustic modems, satellite/RF communication modules, acoustic and seismic recording systems, underwater cameras, modular seafloor lander platforms and advanced pressure housings with depth ratings of 6,000m and deeper.

Email: sales@develogic.de
www.develogic.de



EdgeTech

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Phone: +1-508-291-0057
Email: info@edgetech.com
www.edgetech.com
CEO/President: R.Jablonski
Number of Employees: 100
Facility: West Wareham, MA and Boca Raton, FL

EdgeTech designs, manufactures, sells and supports a variety of standard and engineered-to-order underwater sonar systems including side scan sonars, sub-bottom profilers, bathymetric, combined and modular systems. The systems are available in a range of configurations for towed, deep towed, AUV, USV, ROV, ROTV and custom platforms providing underwater imaging. Additionally, EdgeTech provides USBL acoustic tracking and positioning systems, transponder beacons, deep sea acoustic releases, shallow water and long life acoustic releases, underwater acoustic command and control systems and custom-engineered acoustic products.

Celebrating 50 years in the field of underwater technology, EdgeTech continues to innovate, with a number of new technologies and products in development. Recently EdgeTech introduced the new 2300 Combined Tri-Frequency Side Sonar, Sub-bottom Profiling & Bathymetry System. The system comes standard with a tri-frequency side scan combination. Sub-bottom profiler

capabilities have been expanded on the new 2300 and includes the ability to incorporate up to four low frequency transducers as part of EdgeTech's DW-106 (1-10kHz) deep penetration system. Coupled with that is the ability to utilize a large PVDF hydrophone array providing better sub-bottom receive sensitivity and directivity. The Multi Phase Echo Sounder (MPES) produces real-time, high resolution, 3D maps of the seafloor while providing co-registered simultaneous dual frequency side scan imagery. Additional features include a remote head USBL beacon, optional Nexus Multiplexer, a rear magnetometer shackle mount, and adjustable trim panels.

Engineered Syntactic Systems

Engineered Syntactic Systems (ESS) is exclusively focused on the formulation, engineering and manufacturing of superior quality syntactic foam, a class of material created using pre-formed hollow spheres (commonly made of glass, ceramic, polymer or even metal) bound together with a polymer. Thanks to its unique properties of high strength at low density, syntactic foam is widely used in subsea buoyancy applications.

ESS offers a range of products in a variety of densities, depths and other critical-to-performance measurements used for structural core applications, thermal conductivity, ballistic/energy absorption and acoustic management structures. Its materials, which support applications operating just below the surface down to 10,000 meters, are designed to withstand long-term cyclic exposure and hydrostatic pressure, especially in the deep ocean.

ESS' advanced composite syntactic for demanding core applications, MacroCore, features a toughened macrosphere matrix that provides greater stiffness, strength, impact and shock properties than standard core materials. It is suited for composite-to-metal joints, a well-documented area of concern in all composite structures. As a closed cell structure, the core easily processes in all composite applications including vacuum bag, RTM, and pultrusion without increasing overall density.

The company has worked on critical projects for the U.S. Navy as well as leading organizations in the oceanographic and subsea industries.

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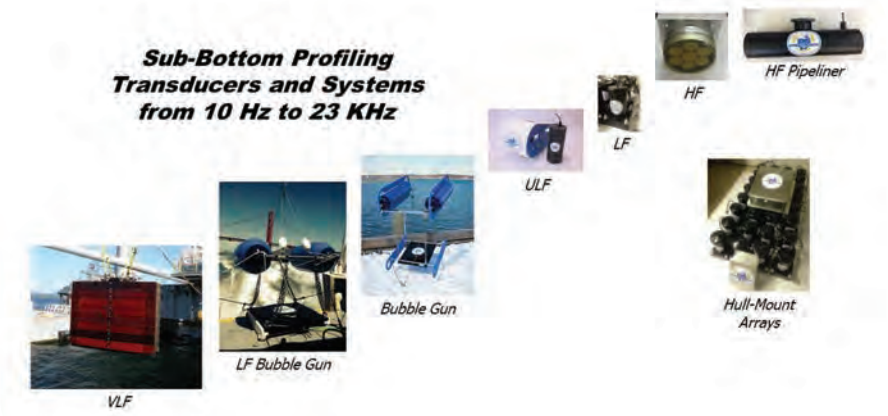
www.esyntactic.com

Falmouth Scientific, Inc

Falmouth Scientific, Inc. has a long history of supplying precision instruments and services into the marine science community and oceanographic markets. Throughout the years FSI has been recognized for high quality instrumentation to measure physical ocean and fresh water parameters. The company is no longer only known for these measurement systems as it has made a place for itself in the marine survey industry with advanced seismic, sub-bottom, and side scan sonar systems. These systems are a result of its strong engineering design knowledge, extensive field experience, and its rich history in marine technology solutions.

Falmouth Scientific offers sub-bottom and seismic profling systems and transducers in frequency bands from 10 Hz up to 23 KHz. The introduction of the CHIRPceiver in 2015 has given FSI the capability to provide end-to-end solutions for survey vessels of any size and application. The product portfolio also includes remote software controlled preamplifiers, junction boxes, cabling, and specialized deployment systems. Design and installation services are available as well. The Bubble Gun has been utilized for harbor expansion surveys, shallow hazard surveys, pre-construction surveys and many other applications around the world where larger, more cumbersome systems cannot be deployed.



Physical ocean sensors include the PLUS Family of reliable and rugged current, wave and tide instruments. On-site resources include the acoustic, environmental, and electronic equipment required for the design, development, production and testing of oceanographic sensors and underwater acoustic systems.

Email: fsi@falmouth.com
www.falmouth.com

Klein Marine Systems, Inc.

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Email: Klein.Mail@KleinMarineSystems.com
www.KleinMarineSystems.com
CEO/President: Guy Malden
Number of Employees: 45
Vice President: Frank Cobis

Founded by Marty Klein in 1968, in a small factory in Salem, N.H., Klein Associates became the world's first commercial manufacturer of side scan sonar, and since then has gone on to become a leading supplier of side scan sonar equipment, as well as waterside security and surveillance systems to navies, shipbuilders, secure installations, researchers, oil and gas explorers and hydrographers. Klein designs and manufactures high-resolution side scan and multi-beam sonar equipment, and radar-based security and surveillance systems at its 56,000 sq. ft. facility 30 miles from Boston. The System 5900 Multi-Beam Side Scan Sonar represents Klein's advanced multifunction sonar platform and includes high resolution multi-beam side scan sonar, swath bathymetry sonar, gap filler sonar, and integrated tow body sensor and subsystems. The sonar employs advanced signal processing techniques and superior acoustic design to improve overall along track target resolution. The UUV 3500 was developed as a side scan sonar with the benefit of an advanced bathymetry payload for the AUV, ROV and UUV markets. The Klein Marine Systems HydroChart 3500 is a lightweight, low-cost, wide-swath, professional shallow-water underwater survey mapping instrument that supports IHO SP-44 Special Order quality bathymetric survey data collection, co-registered with high-resolution side scan imagery for navigational charting, dredging and engineering support, habitat characterization and other shallow-water mapping applications. The 4900 is a versatile SSS with high-fidelity, high-definition imaging abilities and portability, making it a tool suitable for SAR missions, while its rugged construction, selectable frequencies and 300 m operational depth rating provide superb capabilities for the coastal survey and security communities.

Flydog Solutions LLC

Flydog Solutions LLC was founded in 2007 as hardware design and product development company in Tallinn, Estonia. During the years, Flydog has carried out and delivered many interdisciplinary projects involving mechanics, industrial design, electronics, HMI, engineering and prototyping, all of which has played a part in shaping the company's understanding of and growth within the manufacturing and operational phase of the marine industry. Flydog's main hardware product line includes data buoys, vertical profiler buoys, submersed profilers and custom data-loggers. The company has a resourceful network of collaborators from engineering, design, and academic areas for fast, flexible and result-oriented project setup and delivery. Its Data Buoy is fully customizable in design and size for any project. The company's Profiler Buoy is equipped with an onboard winch that moves the CTD up and down to collect data from the full range of the vertical water column. For tougher environment conditions choose our Submersed Profiler that is sank to the bottom of the sea safe from the waves and storms on the surface. Flydog Marine compliments its hardware solutions with a custom data-logger and software which simplifies the process of controlling, configuring and retrieving data.

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www.flydogmarine.com

Focal Technologies Corporation

Focal Technologies, a Moog Inc. company, has 32 years experience in the marine industry, specializing in providing electrical slip rings, fiber optic rotary joints, hydraulic utility swivels and fiber optic multiplexer solutions for the worldwide marine industry including ROV, seismic, FPSO turret and oceanographic applications. From design to deployment, Focal's team specializes in providing solutions for the worldwide marine industry, with innovation and performance incorporated along the way.

Product features include hybrid packages that combine

fiber, electrical, and fluid rotary joints for harsh environments, explosion-proof / flameproof for hazardous locations and adaptation to customers' size and mounting constraints. Focal Technologies designs, manufactures and delivers unique FPSO swivels. Typically comprised of electrical slip rings, hydraulic utility swivels and fiber optic rotary joints, swivels are used in a variety of Floating Production Systems (FPS) including buoys, turret moorings and offshore loading towers. The Focal multiplexer product line offers a range of time division multiplexers (TDM) and wave division multiplexers (WDM). These multiplexing techniques can be used to

simplify optical transmission systems and reduce cost, improve reliability, reduce weight and enhance performance.

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Global Marine Systems

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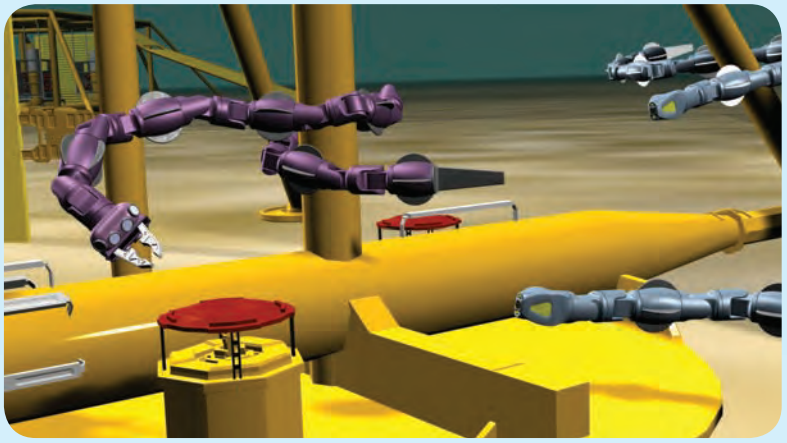
Website: http://www.globalmarinesystems.com/
CEO/President: Ian Douglas
Number of Employees: 147

Global Marine Systems Limited: a leading provider of engineering and underwater services to oil & gas, renewable energy & power and telecommunications markets. We provide subsea cable installation, maintenance and burial with a fleet of vessels and subsea trenching and burial equipment and have a legacy of 165 years.

Global Marine Systems Limited provides engineering and underwater services, responding to the subsea cable installation, maintenance and burial requirements of customers around the world. The company has a legacy of 165 years in deep and shallow water operations and operates worldwide with main offices in Chelmsford, U.K. and Singapore. Global Marine offers a comprehensive, end-to-end solution for multiple offshore industries including oil and gas, telecoms, offshore renewables, power and deep sea research. In September 2014, Global Marine was acquired by HC2, marking the beginning of a new chapter for the business, bringing with it the opportunity to develop existing services and take the company's capabilities to new markets around the world. In February 2016, Global Marine acquired a majority stake in offshore renewables specialist CWind, adding a diverse range of construction and O&M services to its current capabilities. Global Marine obtained recognition for its innovation and best practice in the field of engineering, receiving the Engineering Award at the International Business Awards held in Singapore, 2014. And previously, Global Marine was ranked in the Top Track 250 by the UK Sunday Times. The award compliments Britain's leading mid-market private companies with the biggest sales.

Testing Capabilities: The Head Office in Chelmsford houses Global Marine's industry leading test facility for cable manufacturers and other industry organizations. Cable products must be suitable for the harsh marine environment it has to operate in. Therefore, cables, joints, rope, hawser or repeaters can be tested rigorously here before deployment. A complete range of mechanical, electrical, environmental and optical test facilities are included to simulate marine deployment and oceanographic conditions. These include tensile testing (up to 100kN), torsion, high voltage and pressure testing – to internationally agreed standards and with full monitoring and data logging, both electrical and optical. Pressure testing can simulate the conditions at the deepest point of the ocean; high voltage testing can simulate electrical surges, and the round the sheave tests simulate all types of deployment from vessels. Following testing, concise reports are issued together with test certificates. Global Marine holds the RoSPA Order of Distinction in recognition of 16 consecutive years of outstanding occupational health and safety results.

Kongsberg Maritime



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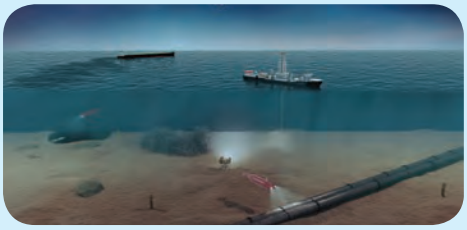
Email: subsea@kongsberg.com
Website: http://km.kongsberg.com
CEO/President: Egil Haugsdal
Number of Employees: 4,726 (2015)
Annual Sales: Operating revenues: $1.2B



(Image: KONGSBERG)

Kongsberg Maritime is a marine technology company with a portfolio of innovative solutions designed to overcome challenges in all marine industry sectors, including merchant, offshore, subsea, naval and fisheries. Kongsberg says it offers the largest portfolio of technology available from any single supplier, thus maximizing performance by providing "The Full Picture." The company delivers a wide range of systems for subsea survey and construction, maritime security, environmental monitoring, dynamic positioning and navigation systems, marine automation, safety management, cargo handling, maritime simulation and training, satellite positioning, naval sonar systems, fishery research and catching systems, underwater mapping systems and marine robotics.

The Norway based company has a global presence, with 55 offices in 18 countries, including manufacturing locations in Canada, China, Germany and several in the U.S., U.K. and Norway.

Kongsberg Maritime's sonar, multibeam echo sounders, cameras, positioning and underwater communication systems, and AUVs are used in survey and inspection operations worldwide. Working closely with customers to develop technology that pushes the limits in subsea applications, Kongsberg Maritime is also dedicated to developing innovative environmental monitoring solutions.

Kongsberg develops subsea solutions with teams dedicated to underwater mapping (UMAP), underwater navigation (UNAV), subsea monitoring (SuMo), marine robotics (MARO), underwater cameras and a dedicated Simrad product line for commercial fishery and marine science. The company is focused on delivery of integrated systems for research vessels and in 2016 announced a move into aquaculture, with focus on emerging offshore facilities. Kongsberg also provides underwater and positioning technology and systems for survey vessel operation and a portfolio of hydroacoustic systems and underwater vehicles for scientific and commercial use. Commercial fishing vessels also rely on Kongsberg Maritime's Simrad equipment to maximize catch performance.

It develops cutting-edge hydroacoustic survey systems including multibeam and single beam echo sounders, and sonars, positioning and subsea communication equipment, heading and motion sensing instruments, and sound velocity sensors and processing software.

Kongsberg is also a leader in the field of underwater cameras and is the company behind the well-known Seaglider, REMUS, HUGIN and MUNIN AUVs. It is also involved with Eelume, a unique new 'snake-like' robot for underwater inspection/maintenance.

Recent developments include environmental monitoring using a diverse array of sensors and a unique integrated technology to enable new, groundbreaking 'exposed' fish farming facilities.

Kongsberg Mesotech Ltd., a Canadian KONGSBERG subsidiary, is also leader in the underwater acoustic industry. Clariscan is the latest development in its domed sonar technology for underwater vehicles and provides a significant improvement in resolution and usable operating range. The MS1000 High-Resolution Sonar System is used by search and recovery organizations worldwide, while PulSAR is a sophisticated high resolution side scan sonar also for search and recovery operations, in addition to underwater inspection, engineering and scientific surveys.

Deep Sea Mooring, Moorland & Vryhof

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Email: dan.pedersen@globalmaritime.com
www.globalmaritime.com
CEO/President: Wolfgang Wandl
Number of Employees: 70
Annual Sales: $100M

With the complexity and remoteness of offshore developments and the need to manage costs yet adhere to safety and asset integrity, Global Maritime is meeting customer challenges through a total mooring solution. Global Maritime Vryhof is a developer and provider of offshore anchoring technology. Global Maritime Vryhof's expertise is complimented by that of its sister companies, Global Maritime Mooring Group s.a. Deep Sea Mooring and Moorlink. This allows the company to offer customers a full engineering, procurement, construction and installation (EPCI) package from design and installation through to hook-up of the complete mooring system. Global Maritime recently put this total mooring proposition to the test on the semisubmersible drilling unit Ocean Monarch with the operator Woodside. The total solution consisted of eight 1,750-meter mooring lines and four storm mooring lines to ensure stability during the cyclone season; high-strength Moorlink swivels used to relieve the twist and torque that builds up in the mooring line; and mK5 Stevshark anchors. Deep Sea Mooring's Advanced Distance and Positioning System ADAPS and Device Tracking and Control Systems DTAC were also used. This is just one example of how Global Maritime is adding value to mooring operations worldwide with other recent contracts taking place with Det Norske, Quadrant, Transocean, Statoil and more.

Global Maritime Deep Sea Mooring offers a comprehensive portfolio of offshore mooring services, including the rental of cutting-edge mooring equipment, complete pre-lay and rig move mooring solutions, marine engineering, and a broad range of ancillary services. Equipment is marked with the company's patented RFID technology that allows for fully traceable logistics, usage and service history. Everything is also linked to Global Maritime's unique E-Yard and Rig Manager software. Global Maritime Vryhof is the world's leading developer and supplier of offshore anchoring technology. It provides mobile mooring, permanent mooring, and installation mooring solutions to the offshore oil and gas, dredging, and marine renewable energy industries. Global Maritime Vryhof recently introduced its virtual reality moorings experience where - through virtual reality glasses – people are able to walk on the seabed and inspect the moorings of different kinds of floaters. Global Maritime Moorlink designs, produces, and installs certified swivel links, connections, and wire clamps for use on any chain, wire, or rope. The company's expertise enables us to provide safe and flexible mooring solutions adapted to specific requirements.

INNOMAR Technologie

INNOMAR Technologie GmbH has been in the business of developing and manufacturing efficient underwater acoustic systems for about 20 years. Having sold some 300 sold systems, INNOMAR claims a place as a market leader in parametric sub-bottom profilers.

INNOMAR mainly develops and manufactures high-resolution parametric sub-bottom profilers. This technology provides sub-bottom data at excellent vertical and horizontal resolution for various applications like geological surveys, burial-of-depth surveys for buried pipelines or cables or UXO surveys at offshore construction sites.

The company's main product line is the INNOMAR SES-2000 series of parametric sub-bottom profilers with echo-sounder functionality for water depths from less than one meter up to full ocean depth. All data are recorded digitally, but analogue outputs are available, too. Transmit pulse properties can be adjusted by a user-friendly data acquisition and control software to fit specific survey requirements. Optimized user-friendly post-processing software is available as well. Transducers are available for hull-mounting or over-the-side mounting to fit specific user requirements. The narrow-beam INNOMAR sub-bottom profilers are suited for exploring the sub-seafloor at high resolution with a sediment penetration of up to 150m. Applications include mapping of fluid mud layers and sediment structures for dredging and geological surveys as well as searching and mapping buried pipelines/cables or archaeological artifacts. There are two models incorporating a narrow-beam parametric SBP (4-15kHz; 100kHz) and a dual-channel side scan sonar (250, 410,

600kHz) for simultaneous operation.

New developments include a multi-transducer SBP providing high data density suitable for 3D visualization, a towed SBP and a survey catamaran (USV) for remote operation in protected or extremely shallow areas. INNOMAR's quality management has been certified by DIN EN ISO 9001 since January 2000.

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www.innomar.com

InterOcean Systems Inc.

Established in 1945, InterOcean Systems provides oceanographic sensors such as wave/tide and current meters, integrated data acquisition systems, acoustic releases for mooring deployment and recovery, cable handling winches for coastal or deep ocean survey, and pollution detection and control devices for reducing oil spills in the environment. In addition, InterOcean Systems also offers specialized design, engineering, and production for unique applications. The products developed and fabricated by InterOcean use proven and up-to-date technologies to meet customer requirements with durable, easy-to-use solutions that offer long-term reliability for many applications in demanding marine environments.

The company was recently acquired by the ownership of Delmar Systems, Inc in June 2016. Delmar, headquartered in Broussard, La., with technical services based in Houston, has a 48-year history of providing mooring and subsea services to the offshore industry in some of the world's most challenging offshore environments.

Together, InterOcean Systems and Delmar Systems intend to use their combined synergies to continue their respective strengths and maintain the innovative high technology development for solutions that have resulted in success for the industry and provided key long-term benefits for their customers.

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JW Fishers Mfg Inc

For more than 45 years JW Fishers Mfg has specialized in the design and manufacture of high-tech, reasonably priced underwater search equipment. Its side scan sonars, underwater metal detectors, ROVs, and magnetometers are in use by commercial diving companies, public safety dive teams, government agencies, police and military units worldwide. JW Fishers began manufacturing underwater metal detectors for recreational scuba divers, and as demand for its products grew as commercial diving companies and police departments began asking for other types of underwater search equipment, JW Fishers expanded its product line to include boat-towed detectors, video systems and ROVs. In the '90s R&D expanded into the sonar sector with computers becoming smaller and more capable of data transfer. Today Fishers offers three high-tech, low cost side scan systems employing the most commonly requested frequencies: 100 kHz, 600 kHz and 1200 kHz. Low frequency provides long range, but lower resolution and high frequency gives the highest resolution, but shortest range; the middle frequency provides an optimal combination of both. Fishers scanning sonar systems are also popular with many public safety dive teams due to its lower cost compared to side scan. It is lowered from the boat and produces detailed images of objects on the bottom. The newest addition to Fishers sonar product line is a Sub Bottom Profiler. The SBP-1 produces low frequency sound waves capable of penetrating through the ocean floor and producing images of objects buried under the strata layers. JW Fishers designs/manufactures all of its underwater search systems at its factory in East Taunton, Mass. The extensive line of equipment includes hand-held & boat-towed metal detectors and magnetometers, underwater video systems, ROVs, side scan sonars, scanning sonars, acoustic pingers and receivers, pipe and cable trackers and a recently added sub bottom profiler system. The company is continuously updating and improving the software used with its sonar systems and boat-towed detectors, adding new features and capabilities while making the equipment easier to use and more powerful. In 2016 all video and light systems underwent an overhaul eliminating the quartz-halogen light bulbs and introduced high intensity LED lighting as a system standard. Sonar and boat towed system owners also now have the ability to mount a Microsoft Surface tablet in the lid of the control box, making it a sleeker package for the end user.

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Kraken

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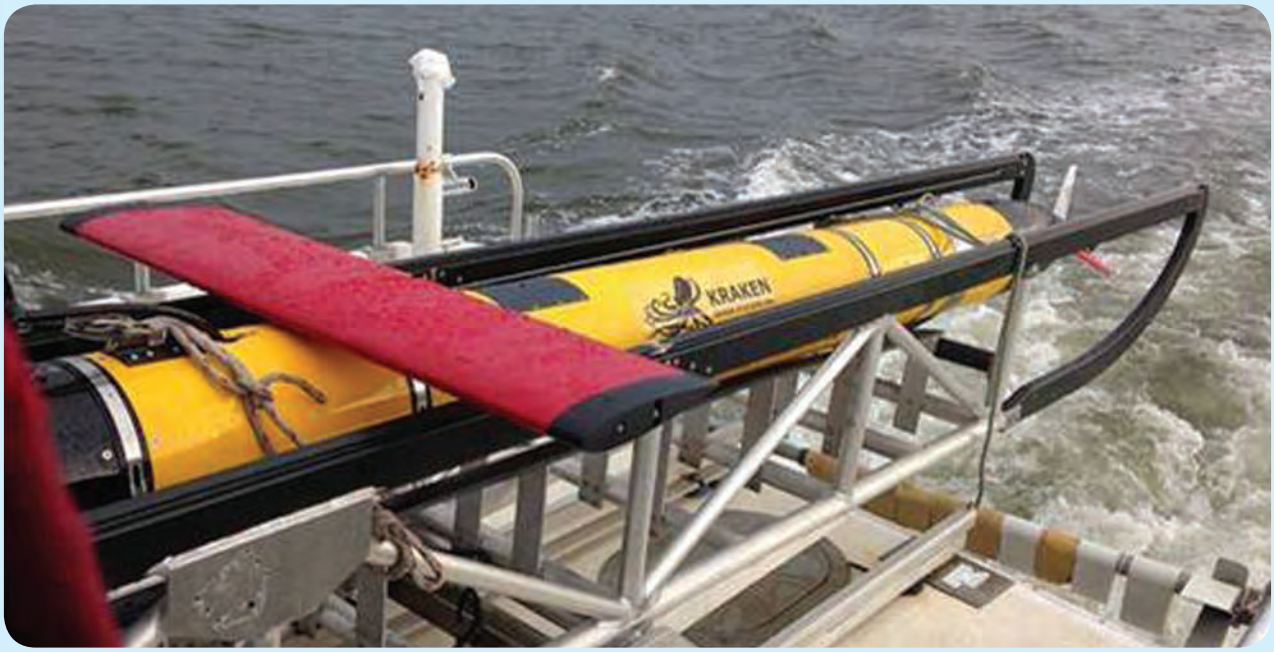
Email: info@krakensonar.com
Website: http://www.krakensonar.com
CEO/President: Karl Kenny
Vice President: David Shea
Number of Employees: 25



Kraken Sonar Systems Inc. is a world leader in advanced sonar and sensor technology. Kraken's AquaPix has set a new standard for high-speed, high-resolution underwater imaging. The system provides both high resolution seabed imagery and 3D bathymetry with a spatial resolution of 3 cm and swath widths of 600 meters.

Kraken Sonar Inc. is a marine technology company engaged in the design, development and marketing of advanced sonar and acoustic velocity sensors for Unmanned Underwater Vehicles used in military and commercial applications. Over the last two years, the company has earned a reputation as world leaders in Synthetic Aperture Sonar, a revolutionary underwater imaging technology that dramatically improves seabed surveys by providing ultra-high resolution imagery at superior coverage rates. Kraken's systems offer comparable performance to existing high end military systems at less than 20 percent of the cost.

Expanding on the successful Synthetic Aperture Sonar (SAS) product line, Kraken is introducing a new underwater system. The Kraken Active Towfish (or KATFISH) is a complete system solution for collecting and viewing SAS seafloor data in real-time. SAS uses sophisticated signal processing techniques to compare multiple observations of the same area of seafloor. The resulting image resolution is significantly increased, often by an order of magnitude, when compared with conventional sidescan sonar. The KATFISH combines the Kraken Miniature Interferometric Synthetic Aperture Sonar (MINSAS) with an actively controlled towed platform. As a towed system, SAS images can be viewed as they are processed in real-time making it ideal for search and survey operations where the earliest possible prosecution of seabed targets is required.

The active control system onboard ensures not only that the system is able to meet the stability requirements of the SAS, but also adds a higher level of autonomy to the system with features such as terrain following and obstacle avoidance. The KATFISH is a portable, complete system package and can easily be deployed on any surface vessel, including USVs. The higher level of autonomy simplifies operations while the remote operation capability allows the system to be controlled through a radio link to a remote station.

Lankhorst Ropes

Lankhorst Ropes is a leading supplier of synthetic fiber and steel wire mooring and towing ropes, and specialist ropes for the maritime and offshore industries, particularly deepwater moorings and handling systems. As a Royal Lankhorst Euronete Group company, Lankhorst Ropes, Founded in 1803, is also part of the world's largest steel wire manufacturer, WireCo WorldGroup, leveraging over 200 years' experience in the manufacture and supply of high performance ropes for mooring and towing applications. It has won awards for maritime rope safety and handling, and recently an OTC Spotlight on New Technology Award for a new rope extending the reach of subsea lowering systems.

The company's core business is the development and production of high performance, synthetic and steel wire ropes for mooring and anchor systems, as well as towing and crane hoisting and luffing applications. Its rope brands include TIPTO 'Strong & Durable' family, EURO 'Strong & Stretch' family and LANKO 'Strong & Light' family, which provide an optimal combination of breaking strength, life-time safety and ease of handling .

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Sea-Bird Scientific

For over 40 years, Sea-Bird Scientific has developed award-winning technologies and CTDs that are the centerpiece of most oceanographic moorings, AUVs and profiling systems. The global Argo Array, with unprecedented accuracy and stability in temperature and salinity, has enabled scientists to detect ocean climate trends not previously possible. Sea-Bird also provides sensors to the NSF funded SOCCOM program to produce climate-quality data record for carbon cycling. Sea-Bird Scientific combines the capabilities of Sea-Bird Electronics, WET Labs and Satlantic to provide sensors and systems for oceanographic research and environmental water quality monitoring of physical and biogeochemical properties.

Sea-Bird products are used across industries, all over the world in numerous critical environmental research and monitoring efforts, ranging from determining the ocean's role in, and the as-

LinkQuest Inc.

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Email: sales@link-quest.com
www.link-quest.com
CEO/President: Ning Xiao, Ph.D.
Testing Capabilities: 12000 psi pressure testing facility.

San Diego based LinkQuest Inc. manufactures precision acoustic instruments for offshore oil exploration, construction, drilling, survey, environmental study and other oceanographic applications. The company's acoustic communication and positioning products are based on the innovative Broadband Acoustic Spread Spectrum (BASS) Technology and are widely used worldwide. LinkQuest's high speed underwater acoustic modems transport more than 95 percent of the world's acoustic communication data, having set a series of technical performance records in field deployments all over the world. LinkQuest's line of TrackLink Acoustic Tracking Systems provide robust, accurate and cost-effective Ultra Short Baseline (USBL) solutions. The FlowQuest Acoustic Current Profilers, FlowScout Acoustic Flow Meters and NavQuest Doppler Velocity Logs (DVL) were designed to provide solutions for current profiling, wave measurement, flow measurement or precision underwater navigation applications, and aim to offer longer

range with high accuracy. LinkQuest's EchoSweep 300 Multibeam Echosounder is a high-resolution, robust and cost-effective swath bathymetric system for mapping of sea floor, inland waterways and reservoirs. LinkQuest also manufactures PinPoint LBL acoustic positioning systems and Precision Marine Geodetic Systems used for tsunami and earthquake monitoring and prediction.

sociated impact from, climate changes to the monitoring of environmental impacts of major episodic events such as oil spills and tsunamis. Every Sea-Bird instrument is delivered fully calibrated. Its 28 CTD and DO calibration baths at our U.S. factory and at our European calibration lab ensure Sea-Bird instruments are the gold standard in research and operations. These automated calibration systems perform a combined total of more than 40,000 complete sensor calibrations per year. Sea-Bird Scientific has an extensive internal science team, with a number of Ph.D. oceanographers spanning several focus areas to determine scientific requirements for its instruments, test and evaluate prototypes, oversee production calibration processes and answer questions from scientists using its instruments around the world. Key oceanographic parameters measured by Sea-Bird instruments include temperature, salinity, pressure, oxygen, pH, fluorescence, turbidity, nitrate, phosphate and irradiance. The company's instruments are used on shipboard profiling systems, moored platforms, autonomous floats and moored profilers. Sea-Bird Scientific also manufactures several platforms for integration with sensors, including autonomous profiling floats and moored profilers. Advances in autonomous profiling float technology now provide reliable, stable temperature, conductivity and pressure measurements for five years and beyond. This, in large part, has been enabled by the Sea-Bird Scientific SBE 41 CTD sensor, which is the standard for temperature and conductivity measurements for the Argo program. The Sea-Bird Scientific Navis Autonomous Profiling Float is used in the Argo and

other ocean monitoring programs such as SOCCOM, with sufficient power for over 300 profiles with the SBE 41 CTD. The SOCCOM project is augmenting conventional Argo floats with biogeochemical sensors to measure carbon (pH), nutrients (nitrate) and oxygen.

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Seafloor Systems, Inc.

Formed in 1999 by veteran U.S. Navy Hydrographer John Tamplin, Seafloor Systems provides a full spectrum of hydrographic survey equipment, software, personnel, training and support, specializing in the geophysical sector for survey companies worldwide. The firm designs and manufactures the HydroLite portable hydrographic survey system, the HyDrone-ASVand EchoBoat-ASV autonomously and remotely controlled survey platforms for unmanned hydrographic survey applications, and maintains the largest rental pool of multibeam echosounder equipment in the U.S.

Seafloor Systems provides custom hydrographic survey solutions, integrating multibeam echosounder systems and state-of-the art positioning and orientation systems into a complete, turnkey product. Its EchoBoat-ASV is an extremely capable unmanned surface vehicle designed for larger payload applications such as dual-frequency and multibeam echosounders as well as ADCP and side scan sonar systems. It features a large, dry internal compartment, dual, water-cooled DC motors, and a multi-purpose, multiple antenna mast. The HyDrone-ASV is a multi-payload, autonomously controlled survey catamaran platform featuring portability, improved thrust, and large payload capacity. The vehicle can be monitored while under way, in both Auto and Manual modes, while within line-of-sight range.

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www.seafloorsystems.com

SEAMOR Marine Ltd

SEAMOR Marine Ltd., a self-described up-and-coming ROV company, is on the cutting edge of observation class vehicles. Now celebrating its 10th year in business, SEAMOR designs, manufactures and distributes subsea observation and inspection-class ROVs and a range of modular accessories and related devices.

SEAMOR ROVs are designed to maximize the adaptability, portability, reliability and ease of use. The modular, open-frame layout allows for ease of access into the "guts" of the vehicle, which also aids in the integration of equipment such as the SEAMOR 7 function manipulator system (7 H-Arm), tooling, navigational aids and inspection sensors.

The Canada based company continues to deliver vehicles to clients around the world, with vehicles in use in every major body of water globally. SEAMOR has recently undergone expansion in the European market, and has further its ties with China, particularly in the hydro dam and energy sectors. SEAMOR ROVs have been used for some major archaeological discoveries in the past year, including a landmark research trip to Malta to investigate a sunken ship with historical cargo on board. Also, an older model vehicle was used to uncover a sunken Japanese World War II submarine off the coast of Nagasaki.

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SeeByte

SeeByte provides clients in the maritime, military, and oil and gas sectors with smart software solutions to enhance the capabilities of underwater sensors, vehicles and systems. SeeByte came to be in 2002 in the Oceans Lab at Heriot-Watt University, and has since grown to become a leader in advanced software solutions with a global market presence. In October 2013 SeeByte was acquired by Battelle Memorial Institute, enabling rapid development and deployment of solutions for government and commercial clients around the world.

SeeByte's SeeTrack software, which enables fast and efficient mission-planning, monitoring and post-mission analysis, has been chosen by more than 20 of the world's navies to optimize unmanned underwater vehicle operations. SeeByte's software aims to provide UMS operators with high quality data by generating a single integrated picture of events from multiple sensors and platforms. Run through SeeTrack, Neptune forms SeeByte's autonomy engine. Neptune is an adaptive planning tool for optimizing the execution of AUV operations. It supports high-level goal-based mission descriptions and allows the matching of mission requirements against vehicle capabilities. Neptune also includes behaviors capable of adapting the mission based on changes in the environment, assets and mission objectives.

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Saab Seaeye

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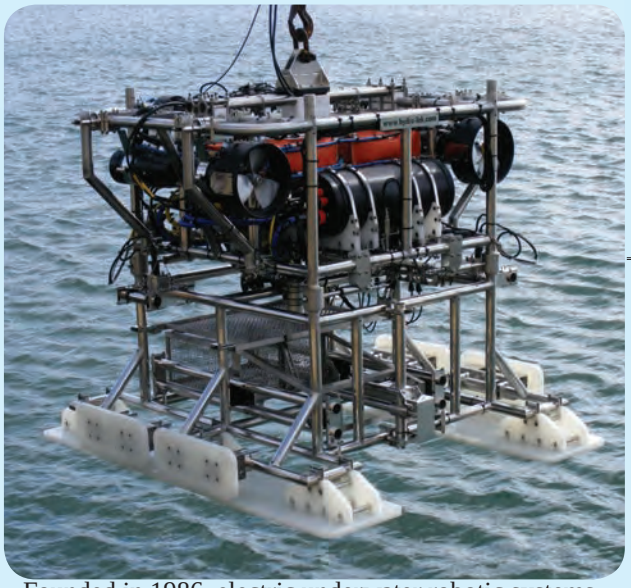
Managing Director: Jon Robertson
Sales Director: Matt Bates

Founded in 1986, electric underwater robotic systems manufacturer Saab Seaeye produces a diverse range of pioneering ROVs and system packages for virtually all subsea tasks across a range of industries, including oil and gas, renewable energy, hydro and civil engineering, marine science, aquaculture, nuclear engineering, telecoms, security and emergency, salvage, seabed mining, leisure and defense. It has a turnover of around $70 million.



HyBIS – a deepsea suspended observation and deployment/recovery system (Photo: Saab Seaeye)

Founded in 1986, electric underwater robotic systems manufacturer Saab Seaeye produces a diverse range of pioneering ROVs and system packages for virtually all subsea tasks across a range of industries, including oil and gas, renewable energy, hydro and civil engineering, marine science, aquaculture, nuclear engineering, telecoms, security and emergency, salvage, seabed mining, leisure and defense. It has a turnover of around $70 million. Technologically, the Saab Seaeye vehicle range comes in various sizes, power and tasking options that extend from compact systems to work systems. They extend from tethered and autonomous to remote resident systems. Seaeye has sold more than 850 ROVs, fitted with an array of standard and custom designed tooling and sensors that includes cameras, manipulators, survey sensors, cutters, tracking systems, sonars, torque tools and water jetting tools. The company also designs and manufactures a range of ROV handling devices including Tether Management Systems. Seaeye has pioneered many innovations within the ROV industry, such as brushless DC thrusters, polypropylene chassis, carbon fiber pressure vessels, distributed intelligence control system, fault-tolerant systems with self-diagnostics and high frequency power distribution. The breadth of capability in the range offers a system suitable for a wide range of tasks. These include observation and inspection, diver support, search and rescue, survey and remote monitoring, salvage support, light construction, drill support, deep tunnel penetration and dam inspection and defense/paramilitary operations.

Two overarching and interlocking breakthrough Saab concepts drive Saab Seaeye operations, development and innovation across the company: Technology Toolbox and iCON intelligent control.

The Seaeye Technology Toolbox creates a common architecture that gives the lowest number of parts at the least possible cost for the highest possible performance and quality. Commonalty of software and hardware across all vehicles offers customers simpler repair and maintenance, easier upgrades, quicker delivery, more assured quality and a lower real through life cost. It also results in simplified and common training for operators in using and maintaining the systems.

Commercial Range:

- Falcon – Portable system for easy deployment. Distributed control system. Five thrusters. Rated 300 and 1,000m.
- Tiger - Industry standard inspection and observation system. Five thrusters. Rated 1,000m.
- Lynx - Larger than the Tiger with additional outlets for survey sensors. Six thrusters. Rated 1500m.
- Cougar XT - Powerful observation and light work system. Six thrusters. Rated 2,000m.
- Cougar XT Compact – Low profile version for strong currents. Six thrusters. Rated 300m.
- Cougar XTi – iCON control system. Six thrusters. Rated 3000m.
- Panther XT – Light Work and Survey system. Six thrusters. Rated 1500m.
- Panther XT Plus – Powerful fast swimming version. Ten thrusters. Rated 1000m
- Leopard – Compact, powerful, work class system. iCON control. Eleven thrusters. Rated 3000m plus.
- Jaguar - Largest work ROV. iCON control system. Eight thrusters. Rated 3,000m plus.
- Sabertooth – Autonomous, hovering, long range AUV/ROV hybrid for inspection and light work tasks.
- HyBIS – Deepsea suspended observation and deployment/recovery system suitable for deepwater sampling. Rated 6,000m.

Sensor Technology Ltd.

Sensor Technology Ltd. manufactures custom hydrophones, ultrasonic and acoustic transducers, as well as the piezoelectric ceramics at the heart of these devices, offering existing designs as well as fully custom components. With machining, assembly and testing facilities all in-house, Sensor Technology Ltd. is capable of taking customers from concept, to prototyping, to full-scale production.

The custom transducers and hydrophones produced by SensorTech often serve as a critical component in next generation systems for applications including mine hunting, sub-bottom imaging, trawl monitoring, fish tagging and geophysical exploration. Based in Canada, the ISO 9001:2008 registered company exports the majority of its production to customers in countries around the globe. To date, SensorTech has made more than a million hydrophones.

Sensor Technology Ltd. is constantly expanding its capabilities and improving its production processes. In the last year the company purchased two new CNC machines and made huge improvements to its methods for producing piezoelectric ceramic hemispheres and spheres. The results are improved product consistency, faster turn-around and increasingly smaller sizes. The company is now capable of producing piezoelectric hemispheres with frequencies as high as 440 kHz.

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CEO/President: Niru Somayajula

Liquid Robotics

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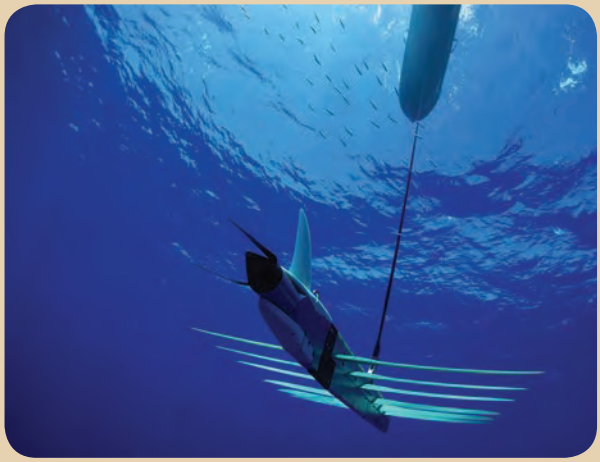
www.liquid-robotics.com
CEO/President: Gary Gysin
Number Of Employees: 106
Engeneering Director: Roger Hine, CTO
Acres: 5
Square Footage: 20,000

Liquid Robotics is a leader in long duration, unmanned ocean robots, with its Wave Gliders deployed across the globe, from the Arctic to the Antarctic, travelling more than 1.1 million nautical miles to collecting some 131 million ocean measurements, operated through 17 hurricanes – having done all of this using only wave and solar energies; no fuel, no emissions.

A private, venture backed company located in Silicon Valley, Liquid Robotics was founded in 2007 by Joe Rizzi and Roger Hine, who invented the company's signature product: the Wave Glider. Initially created to capture the singing of Humpback Whales and communicate the whale songs to shore, Wave Glider's span of applications has grown to into the defense, maritime security, science, and oil and gas markets.

Designed and manufactured by Liquid Robotics, the Wave Glider is the world's first wave and solar powered ocean robot, harvesting 100% of its operational power from renewable energies – without fuel, emissions or personnel. The Wave Glider is composed of the float and a sub with wings. Connected by 8-m tether, the float



is on the surface of the ocean where conditions are the harshest with the sub below where it is calm. It converts the up and down motion of the waves into forward thrust, while solar energy powers the onboard computing, communications, navigation and sensor payloads. By removing the dependency on fossil fuels, the Wave Glider is able to stay at sea for months and up to a year at a time enabling long duration missions over time spans and distances never before possible.

Liquid Robotics works with global partners to create industry specific solutions, including notable partnerships with industry giants Boeing and Leidos for defense as well as Schlumberger for oil and gas.

Silicon Sensing Systems

Silicon Sensing Systems is a provider of silicon MEMS-based gyroscopes, accelerometers and inertial measurement units. The latest solutions offer robust non-magnetic North Finding technology – a cost-effective alternative to FOG-based products – as well as systems suitable for a wide range of navigation and stabilization requirements.

With a heritage dating back more than 100 years, Silicon Sensing Systems Ltd and its predecessor companies have a unique record in delivering gyroscope systems to the marine industry. Based in Plymouth in the southwest of the U.K., Silicon Sensing Systems produces low-cost highly reliable gyros. Having gained entry into the consumer car market, the company now produces up to 4 million devices per year, and more than 30 million to date. The company is now jointly owned by UTC Aerospace Systems, co-located in Plymouth, and Sumitomo Precision Products Amagasaki, Japan, bringing inertial expertise from the U.K./U.S. side, and silicon MEMS fabrication from Japan.

The patented construction of its silicon MEMS gyros – based on a vibrating ring – makes the Silicon Sensing Systems gyros highly resistant to shock and vibration, increasing the reliability and quality of its inertial portfolio. An in-house MEMS foundry has manufactured all of the core gyro technology since the birth of the joint venture. Among its unique fabrication equipment is a deep reactive-ion etching capability, developed in-house in Japan. Most recently, Silicon Sensing Systems has leveraged the inherent capability of its MEMS devices to create a new range of high performance gyros and inertial

systems. Sensitive enough to detect earth rotation rate, these devices enable a North-seeking capability to be offered to the market – offering performance equivalent to fiber-optic systems but at a greatly reduced price. Specific new products now on offer include, CRS39 and CRH02 gyros (with performance better than 0.1deg/hr bias instability), plus DMU10, DMU11 and DMU30 inertial measurement units.

Email: sales@siliconsensing.com
Website: http://www.siliconsensing.com

SubC Imaging

SubC Imaging develops advanced underwater optical imaging systems for a worldwide clientele. The private ocean technology company was founded in 2010 by a former ROV pilot and offshore project manager and creates technologically advanced and capable video equipment for the offshore and subsea markets. Its product portfolio includes cameras, lasers, multiplexers, batteries, and topside media management systems. SubC has made changes in the way subsea imaging is conducted with Remote Operated Vehicles (ROVs). Its first technology was the 1Cam; a camera that enabled ROV pilots to upload standard definition (SD) footage through existing cables while high definition (HD) footage was recorded to the camera itself, to be uploaded once the ROV returned to the surface. This was a game changer for those operating ROVs without the ability to transmit live HD video to the surface. SubC's products are typically used on ROVs, AUVs, towed platforms, ocean observatories and drop camera systems. In addition to a 11,000m rated

system recently delivered to Shanghai Ocean University, its latest product releases include the VisioSphere Situational Awareness system and the 4K Ultra High Definition (UHD)suite. SubC has been involved in several recent high profile international projects, including the search for Amelia Earhart's plane wreckage and a survey of the Australian World War II light cruiser, the HMAS Sydney wreck. SubC has also had extensive involvement in Ocean Networks Canada Neptune and University of Washington's RSN ocean observatories. The company has been leading the R&D efforts in the area of underwater imaging, exploring new technological depths for harsh, subzero, ice-infused environments, with an eye on future demand for Arctic applications.

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CEO/President: Chad Collett

Greensea

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Website: https://greenseainc.com
CEO/President: Ben Kinnaman
Number of Employees: 20
Vice President: Marybeth Gilliam

U.S. based Greensea started in 2006 based on the belief that a reliable, operator-friendly, integrated navigation and control system could dramatically improve work with marine vehicles. Today, the company provides practical commercial solutions to make the work of the marine industry easier, cheaper and ultimately more effective. Using its core technology patent-pending OPENSEA software platform, Greensea has transformed vehicles into fully integrated systems across the marine industry – manned, unmanned, surface, subsea. Using the OPENSEA operating platform, Greensea has developed commercially available navigation and control products that are flexible and scalable, allowing the same reliable products to run on ROVs, submarines, waterjet boats, DPDs, etc. OPENSEA provides a common architecture in an industry full of single-use solutions; it works with any vehicle and any sensor set, and has been integrated into more than 600 vehicles, giving stability to even the most disruptive technology.

How it works: the OPENSEA library ensures proven performance and functionality by providing native support for thousands of devices. The OPENSEA suite, a

set of applications built on the OPENSEA library, powers capabilities like inertial navigation, device management, vehicle control, and mission management. And it's all anchored by the library's comprehensive health and status management framework. Technology Products Using the OPENSEA operating platform, Greensea provides inertial navigation products (INSpect GS) and vehicle control systems (Balefire) for a full range of autopilots and autonomy. All Greensea products provide a fully integrated platform for vehicles to work as a unified system.

Greensea is a small business serving the marine industry, including manned, unmanned, surface and subsea segments. Greensea works with military, scientific, academic and commercial organizations.

Teledyne Maintains Course

In what has become something of an MTR100 tradition, MTR visits with a trio of executives from Teledyne, a diverse company with links in each sector of the market, for insights on current developments and future trends. This year we speak with ***Mike Read****, President of Teledyne Marine;* ***William Egan*** *- Vice President Sales & Marketing – Imaging & Instruments for Teledyne Marine; and* ***Ken Nagengast****, SVP, Global Technology & Group CTO.*

TELEDYNE HAS GROWN STEADILY, SERVING AS A MARKET CONSOLIDATOR OVER THE PAST DECADE. PLEASE DISCUSS THE OVERALL CORPORATE STRATEGY DEVISED TO ALIGN THIS GROUP OF COMPANIES AND CAPABILITIES INTO A COHESIVE CORPORATE ENTITY.

Egan The goal has been to align with our customers in their markets, ensuring that we maximize the return on investment for our customers through leveraging skills and knowledge across the whole Teledyne Marine group and Teledyne as a whole. This has necessitated a change on how we go to market in sales, so rather than multiple independent approaches, we are able to bring a coherent and cohesive approach to our customers, with the ability to demonstrate the complete solution from Teledyne Marine supported by domain experts.

Additionally, across the group we are developing capabilities and solutions with the consolidation and relocation of key business operations to enable centers of excellences. This is something incredibly unique within the marine industry to ensure we can deliver better products and services to our customers.

By bringing these business operations together under common management structures and locations, we are creating businesses of more significant scale to better serve our customers with more powerful scientific capabilities and stronger applications development, to continue our success built on innovation, investment and customer service.

FOR THOSE READERS NOT FAMILIAR WITH THE CUMULATIVE TELEDYNE BRAND, CAN YOU SHARE SOME FACTS AND FIGURES THAT GIVE SIZE, SHAPE AND SCOPE TO YOUR OFFERING TODAY.

Read Teledyne Technologies Inc. (NYSE – TDY) is a $2.3B company, founded in the early 1960s that provides enabling technologies for industrial growth markets. We have evolved from a company that was primarily focused on aerospace and defense to one that serves multiple markets that require advanced technology and high reliability. In addition to defense and aerospace, these markets include deep-water oil and gas exploration and production, oceanographic research, air and water quality environmental monitoring, factory automation and medical imaging.

Teledyne Marine was created in 2015 and is a market-focused collection of 23 Teledyne companies operating as a single consolidated business organization. With over 1700 employees operating out of 25 global manufacturing plants and service centers strategically located in major marine and energy centers around the world. We offer the most significant range of technology in the marine industry built around five synergistic technology platforms: Imaging (Acoustic & Optical), Instruments, Interconnect, Seismic and Vehicles. We are focused primarily on six significant markets: Energy, Oceanographic Science, Hydrography/Navigation, Defense/Security, Water Resources/Civil engineering and Aquaculture/Fisheries. This enables us to offer integrated technologies to solve our customers' most challenging problems.

PLEASE DISCUSS KEY ACQUISITIONS IN THE PREVIOUS 12 MONTHS, WITH INSIGHTS ON WHAT EACH COMPANY OR BRAND 'BRINGS TO THE TABLE.'

Read Over the last year we have integrated the 23 brands of Teledyne Marine into a single cohesive operating team. We've structured our team into the five technology segments, to cover our six primary markets and in addition, in response to our customers' requests to aid them in controlling cost, we have consolidated manufacturing operations by establishing centers of excellence around the world and expanding sales offices into the heart of our busiest regions. Most recently we expanded our Shanghai office and service center to better service and support the Asia-pacific region. Our latest acquisitions include; Bowtech, a leader in subsea cameras and lighting and Bolt Technologies, a leader in seismic explora-

Read

Egan

Nagengast

-tion sound sources and control systems. Bowtech has provided our team with additive technology in optical imaging to augment our strong acoustic imaging presence. Through the Bolt Acquisition, we gained an expanded piece of the seismic technology to support our Teledyne Geophysical streamer line. Bolt is a leader in Seismic Source, and coupled with Real Time Systems controls and AGG interconnect, Teledyne Marine now boasts a significant share of the total seismic solution set. The Bolt acquisition delivered an additive capability to supplement our strong vehicles segment with the SeaBotix family of inspection class ROVs. SeaBotix has earned an enviable reputation for reliability and performance across multiple markets from ocean science to defense and security. Most recently, Teledyne has acquired CARIS, a leader in processing and visualizing sonar data, as well as producing, managing and distributing marine geospatial information. (See related story on page 36).

THOUGH IT HAS STARTED TO RECOVER, MUCH DISCUSSION OVER THE PAST 18 MONTHS HAS CENTERED ON THE PRECIPITOUS DROP IN ENERGY PRICING GLOBALLY. PLEASE PUT IN PERSPECTIVE HOW THIS PROTRACTED MARKET LULL HAS IMPACTED YOUR COMPANY.

Read Like the rest of the industry, the price of oil has impacted our business. We have taken the opportunity to increase the focus on cost controls, and on reducing many of the non-value-added activities throughout the design, operations and deployment stages. We are embracing the opportunities to work with our customers even earlier and more closely to design in the best technical solutions, using the best material and system designs to meet the specific performance requirements for the particular project. We are encouraged that in this cycle the operators are participating and are in fact working together to embrace the ideas that the supply chain can offer. We are confident that with all the creative solutions that Teledyne Marine can provide, we will in fact come out of this cycle in an even stronger position.

WHAT ARE THE SIGNS/STATISTICS YOU MONITOR TO GAUGE THE CURRENT HEALTH AND FUTURE PROSPECTS OF YOUR BUSINESS?

Egan There are many economic factors we take into consideration due to the diversity of our business. Examples that we monitor are the development of ports and harbors, the investment of governments into civil infrastructure and environmental programs, the new and emerging technologies in defense and security, defense programs, as well as the investment status of offshore oil and gas projects. We also closely monitor global oceanographic research and monitoring budgets.

WHAT DO THOSE SIGNS TELL YOU NOW?

Egan While the offshore market, specifically oil and gas, is down, we do see that this is now (hopefully) at the bottom. However, the advances in technology and cost leadership to ensure cost effective and efficient working has allowed to us continue to develop successful collaborations. Our success in winning new projects and programmes for defense worldwide has strengthened our position in this market with new technologies and underpinning our strategic vision. Despite some of our challenging markets, our new alignment of resources and approaches has already resulted in significant new business.

EVERY BUSINESS HAS ITS CHALLENGES. WHAT DO YOU CONSIDER TO BE YOUR ORGANIZATION'S BIGGEST CHALLENGE(S), AND HOW ARE YOU INVESTING TO ADDRESS THOSE CHALLENGES?

Egan With rapid and volatile markets, agility and adaptation is paramount, along with a robust and solid foundation. We have and will continue to monitor our routes to market and ensuring our business is streamlined to meet the future market conditions. Specifically, it is our people who will affect the greatest change, so our investment in our people is a constant theme to ensure continued success.

Nagengast Our people are our greatest asset and can also be our greatest challenge. We continue to seek out the most highly skilled people to support our mis-

sion. Our technology group has developed an excellent partnership with local universities that ensures we are always looking at the best talent entering the workforce. We have set up a successful internship program that allows us to test a nice cross-section of students prior to them graduating. We provide challenging problems for the interns to solve, and in turn, we not only get results that directly benefit our organization, but we also get to evaluate their strengths and potential. We have hired many interns and this has helped to strengthen our company, maintain the most up to date skills and meet the demands of the business. The key to succeeding as Teledyne Marine is to execute as if we are one team rather than individual groups. We continually drive this message home, that we are one global team, which addresses the challenges that each smaller individual group may have by providing a large base of staff to assist in execution.

AS THE TELEDYNE BRAND GROWS IN BREADTH AND DEPTH, WHAT DO YOU CONSIDER THE PRIMARY STRENGTH OF THE ORGANIZATION AS A WHOLE?

Egan With over 1,700 employees in locations over the globe, literally "everywhere you look", Teledyne Marine is able to support our customers quickly, ensuring the utilization of their investment. We are fortunate that within Teledyne Technologies we have a customer and company sponsored applied research center that strengthens our product development expertise, and combined with our ability to offer complete solutions from Teledyne Marine, these attributes enable our customers to have leading edge technologies to drive and support their growth. Within Teledyne, we have a technically experienced workforce to operate alongside our customers, assisting them to deliver the results they need.

WHAT CAN THE COMPANY DO TO BETTER LEVERAGE THOSE STRENGTHS?

Egan We will continue to invest in our people, work closely with our customers and drive the new technologies to solve the challenges for our customers today and for the future. Working closely within the Teledyne group of companies we will continue to offer new solutions from our portfolio to enhance our customer's offerings and operational excellence to ensure customer satisfaction and engagement.

We will continue to explore synergies and opportunities across group, and maintain the trust our customers have in us.

LOOKING AT THE SUBSEA MARKET AS A WHOLE, WHAT DO YOU SEE AS THE DEFINING TRENDS OR TECHNOLOGIES THAT WILL DRIVE YOUR BUSINESS FOR THE COMING GENERATION?

Egan We see more and more of the market moving to drive the efficiency of working, safety of personnel, and creating better value through cost controls, earned through earlier partnering on projects, through establishing standards in design, and setting realistic performance requirements matched to the application. Customers are looking for cost effective solutions for existing and new operations, the ability to gain more insight through better technologies and ensuring safety of personnel by utilizing unmanned or autonomous platforms with longer mission duration.

Teledyne Marine is well positioned to create new efficient solutions, be that for new or existing operators, with the breath of systems and complete solutions we have to offer today and the future. Our expanded Technical Sales organization is applications-aware and is prepared to usher in Teledyne subject matter experts to assist our customers in resolving challenges across our solutions range, whether within Teledyne Marine or out to the expanded expertise of Teledyne, as with our access to Materials Scientists at Teledyne Scientific.

Nagengast The lower oil price has im-

Teledyne CARIS

For more than 35 years, Teledyne CARIS has been making software designed for the marine GIS community. Teledyne CARIS also offers a comprehensive level of support through training sessions and consulting, online technical support, email and multilingual telephone support. Employing more than 170 engineering, IT and business professionals, Teledyne CARIS headquarters is located in Fredericton, Canada, and holds additional offices in the Netherlands, the U.S., Australia and the U.K. CARIS software is selected by national mapping and charting agencies, survey companies, port and waterway authorities, oil and gas companies and academic institutions worldwide. The Ping-to-Chart solution is designed to deliver an integrated and seamless solution for the entire workflow of hydrographic information, from processing the echosounder ping to the production and distribution of the chart. This integrated software line provides clients with resource optimization and a true operational advantage. The Ping-to-Chart toolset includes products that address the need to manage bathymetric data sets containing billions of soundings, to support the development of multiple chart types from a single source, and to be able to distribute and interrogate high density bathymetry over the internet. **CARIS Onboard is the newest package in the CARIS suite of products**. This is a near real-time and autonomous data processing package that has been developed with AUVs and Unmanned Surface Vehicles in mind, but is also a force multiplier when used on survey motor launches.

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pacted not only the oil and gas industry ,but also many adjacent industries that rely on oil and gas to fund oceanographic research. This new found interest in providing more cost effective solutions is at the top of our focus in all of our current technology development projects. We have been early to adopt a philosophy of partnering with our customers to provide better value solutions. We feel that we are leading the way in focusing on lowering overall lifecycle costs to our customers. This trend is here to stay and we are happy that we have already positioned our teams to this end. Our ability to share resources across Teledyne Marine provides us with great opportunities to provide integrated and innovative solutions in many aspects of worldwide subsea needs.

R&D: CAN YOU SHARE WITH OUR READERS SOME INSIGHTS ON HOW THE R&D EFFORT IS SET UP WITHIN TELEDYNE, WITH SPECIFICS ON THE CUMULATIVE ANNUAL INVESTMENT AND NUMBERS TO GIVE THE EFFORT SIZE AND SCOPE?

Egan We have many things we can work on across the group, but the challenge is ensuring we balance technology gaps, new and emerging technologies as well as being agile to respond to demands. We continually assess the return on investment both for our customers and ourselves, as well as ensuring we are aligning with market requirements both today and tomorrow.

Nagengast Teledyne Marine invests a significant fraction of our sales annually on internal R&D. Additionally, we receive healthy amounts of external funding from our customers which greatly increases our total annual R&D investment. In 2016, we will receive over $20M in funded R&D to develop innovative products to solve our customer's important challenges. We have a strong global technical team of approximately 250 staff, a comprehensive world class test an& evaluation facility in our Technology Development Center in Daytona, easy access to our scientists at Teledyne's Scientific Center and a strong IP portfolio. We approach every development project with a "show me the data" approach. Our development process and reliability program, we believe, is world leading. We believe this differentiates us from most if not all of our competitors and is why our customers continue to invest in us.

R&D: WHAT ARE YOU WORKING ON TODAY THAT YOUR CUSTOMERS CAN EXPECT TO SEE IN THE COMING 12 TO 18 MONTHS.

Nagengast We have quite an extensive portfolio of new products in our development pipeline covering a wide variety of applications. We have developed a family of products we refer to as Active Flying leads. These are subsea interconnect solutions that allow for the conversion of power and communication formats such as fiber optic to electrical Ethernet, extended CANBus, power conversions and more. These are revolutionizing subsea interconnections and provides our customers with flexibility in subsea field architecture as well as providing lower cost alternatives. We continue to develop and release advanced subsea sonar imaging solutions that are world leading in performance. We are most excited about our current efforts to integrate our various subsea solutions into smaller, lower cost and higher performance products that will allow our customers to select the best all-around product to meet their particular needs as opposed to buying individual products for each specific function. An example would be an integrated equipment to provide navigation, station-keeping and control to an ROV with one packaged solution and one seamless software package versus the current practice of buying and installing individual components and then trying to sew the various software packages together.

Teledyne Marine Instruments

Teledyne Benthos designs and manufactures rugged, reliable oceanographic instrumentation and sensor solutions for marine environments. Products include: acoustic releases, acoustic telemetry modems, hydrophones, remotely operated vehicles (ROVs), glass flotation spheres and instrument housing, and locating devices. **Contact:** Teledyne Benthos, 49 Edgerton Drive, N. Falmouth, MA 02556; Tel: +1-508-563-1000 | E-mail: benthos@teledyne.com | www.benthos.com

Teledyne CDL Systems & Solutions is a specialist in the development of custom solutions for unique marine applications. Utilizing off-the-shelf products and existing components, tailored units can be provided with multiple options, highly specific to the end-user application. **Contact:** Teledyne CDL, 10661 Shadow Wood Drive, Houston, TX 77043; Tel: +1-281-710-7276 | E-mail: CDL.info@teledyne.com | www.teledyne-cdl.com

Teledyne Cormon designs and manufactures subsea and surface erosion and corrosion sensors, as well as flow assurance monitoring systems. **Contact:** Teledyne Cormon, Unit 12/Balmacassie Commercial Centre, Ellon AB41 8QR, UK; Tel: +44 1358 280480 | E-mail: cormon@teledyne.com | www.cormon.com

Teledyne Oceanscience see listing under Vehicles.

Teledyne RD Instruments is the industry's leading manufacturer of Acoustic Doppler Current Profilers (ADCPs) for current profiling and wave measurement applications, and Doppler Velocity Logs (DVLs) for precision underwater navigation applications. The Citadel line of CTDs rounds out their product offerings. **Contact:** Teledyne RD Instruments, 14020 Stowe Drive, Poway, CA 92064; Tel. +1-858-482-2600 | E-mail: rdisales@teledyne.com | www.rdinstruments.com

Teledyne TSS is a leader in the design, manufacture, and support of marine products for applications including marine navigation, motion compensation, positioning, and subsea pipe and cable survey. **Contact:** Teledyne TSS, 1 Blackmoor Lane, Croxley Green Business Park, Watford, Hertfordshire, WD18 8GA, UK; Tel: +44 1923 216020 | E-mail: tsssales@teledyne.com | www.teledyne-tss.com

Teledyne Marine Imaging

Teledyne BlueView is the leading provider of state-of-the-art compact acoustic underwater measurement and imaging solutions for defense, energy, civil engineering, transportation, and port security applications worldwide. **Contact:** Teledyne BlueView, 18702 North Creek Parkway Suite 100 Bothell, WA 98011; Tel: +1-425-492-7400| E-mail: swa_sales@teledyne.com | www.blueview.com

Teledyne Bowtech specializes in the design and manufacture of highly innovative underwater vision systems, including color and monochrome cameras, LED lights, strobes, and accessories. **Contact:** Teledyne Bowtech, ABZ Business Park, International Avenue, Dyce, Aberdeen, AB21 0BH; Tel: +44 1224 772345 | E-mail: bowtech_sales@teledyne.com | www.bowtech.co.uk

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Teledyne Benthos see listing under Instruments.

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Teledyne Impulse designs and manufactures high-reliability electrical and optical interconnection systems, motorized power transfer switches, and custom insert molded compression connectors for a broad range of harsh environment applications. **Contact:** Teledyne Impulse, 9855 Carroll Canyon Road San Diego, CA 92131; Tel: +1-858-842-3100| E-mail: impulse@teledyne.com | www.teledyneimpulse.com

Teledyne Impulse-PDM is an established supplier and manufacturer of electrical and optical interconnect, and designs and develops molding and encapsulation solutions for underwater applications. **Contact:** Teledyne Impulse-PDM, 4-6 Alton Business Centre Omega Park, Alton, Hampshire, England GU34 2YU Tel: +44 (0)1420 85848| E-mail: pdmsales@teledyne.com | www.teledyneimpulse-pdm.com

Teledyne ODI is a world leader in subsea electrical and fiber optic interconnect systems for offshore oil and gas, oceanographic, and defense applications. **Contact:** Teledyne ODI, 1026 North Williamson Blvd. Daytona Beach, Florida 3211; Tel: +1 386 236 0780| E-mail: odi@teledyne.com | www.odi.com

Teledyne Cable Solutions, an alliance formed of Teledyne Storm Cable and Teledyne VariSystems, provides bulk wire and cable, and custom overmolded cable assemblies to the oil and gas, marine, defense, and transit industries. **Contact:** Teledyne Cable Solutions, 9215 Premier Row Dallas, TX 75247 (214) 637-1381| E-mail: cablesolutions@teledyne.com | www.teledynecablesolutions.com

Seismic

Teledyne Marine Seismic, comprised of AG Geophysical, Bolt, Real Time Systems, and Geophysical Instruments, supplies the world's marine seismic fleets with high-quality ruggedized submersible connectors, seismic energy sources, seismic source management systems, and complex hydrophone systems for defense, seismic survey, and other marine market applications. We also provide instrumentation engineered for reliable performance in the harshest of ocean conditions. **Contact:** Teledyne Marine Seismic, 5825 Chimney Rock Road, Houston, TX 77081, +1 713-666-2561| E-mail: TeledyneMarineSeismic@teledyne.com

'X' Marks the Spot

When it comes to inspiring innovation

Image: XPrize

*The XPrize is seeking to incentivize innovation to spur a new era of ocean discovery, as **Jyotika I. Virmani**, Ph.D. explains.*

We are living in an age of rapid innovation. Over the past 150,000 years we have evolved primarily in a local and linear world where most of our activities happened within a day's walk. Life was relatively constant, millennium to millennium. The Industrial Revolution and the advent of the Steam Engine saw a shift from this predominantly arable and local lifestyle, to an era of global exploration.

But approximately 70% of the world still remained out of reach. The ocean, with its harsh, opaque saltwater, eluded the rapid pace of exploration and discovery we saw on land. But today, this is changing, and it is changing at an increasingly rapid pace.

Our world is not linear and local anymore, it is exponential and global. The power and capabilities we have with the technology that we use is doubling every year. For example, in the 1950s, our data storage capability was 5 MB at a cost of $120,000. In 2005, 128 MB cost $99. Today, we can purchase 128 GB for $40, with Terabyte storage capacity becoming the new norm. Today's average low end computer calculates at a rate of 1011 calculations per second – about

the equivalent capacity of the brain of a mouse. Scientists estimate that we are rapidly approaching the rate of calculations needed to equal that of the human brain (1016 calculations per second). As faster computers help us design better technologies, we can incorporate these technologies into our lives and have a substantial potential impact on changing our lives for the better.

As technology gets faster, cheaper, and smaller, a single individual can have access to things today that only the biggest governments had access to in the past. We are seeing exponential advances in sensor technologies, artificial intelligence, robotics, synthetic biology, virtual reality, 3D printing to name a few. Collectively, we are poised to be able to address some of the greatest challenges we face through these advances in technology. In keeping with innovations in other fields, marine technology has also been evolving rapidly and will continue to do so as more of these exponential technologies are adapted for use in the marine environment.

Less than 5% of the ocean has been explored, but with exponential technologies on the rise, we can look forward to changing that in the next few years. Imagine a world where we know, with the same level of detail, what is at the bottom of the ocean as we know what is on land.

Prizes have long been used as a mechanism to incentivize the development of breakthrough technologies to tackle grand challenges and address market failures. For example, in 1714, the Longitude Prize resulted in the marine chronometer; in 1795, a Prize offered by Napolean for food preservation resulted in the canning process; the Prize offered in 1919 by Raymond Orteig kick-started the private aviation industry; and, the Ansari XPrize won in 2004 started the private space flight industry, now valued in excess of $3bn.

The Shell Ocean Discovery XPRIZE, launched in December 2015, is a $7 million competition incentivizing teams to develop autonomous technologies for high-resolution deep-sea floor mapping and high-definition imagery. One of the recognized market failures in mapping the deep-sea (or, in fact, in collecting any meaningful and extensive data at scale from the deep-sea) has been the expense of operating vessels at sea. The Shell Ocean Discovery XPrize is allowing only shore-based and aerial deployments; encouraging innovations in existing deployment techniques and incentivizing the development of emerging air-sea drone technologies. Such technologies will provide us faster and easier access to areas that are remote from the coast. Another area where exponential technologies are being encouraged for adaptation to the marine environment is in imaging. How we view an object and capture it for posterity is evolving rapidly as virtual reality, augmented reality, and 3D printing become more prevalent.

Included in the Shell Ocean Discovery XPrize is a National Oceanic and Atmospheric Administration (NOAA) $1 Million Bonus Prize, to develop pioneering technology that can autonomously track an underwater biological or chemical signal to its source. Merging possible advancements in lab-on-a-chip, in material sciences, and in artificial intelligence, such underwater robots could be deployed from the shore in the future on search missions to locate hydrothermal vents, biological hotspots, or even find planes and vessels lost at sea.

The Shell Ocean Discovery XPrize is part of the XPrize Ocean Initiative – a commitment that XPrize made to launch five ocean prizes to incentivize the development of technologies we need to put us on an unstoppable path to a healthy, valued, and understood ocean. In 2010, within 15 months of the

launch of the Wendy Schmidt Oil Clean-Up XChallenge, numerous technologies were developed that could clean up oil at least 3 times faster than before the competition.

In 2013, the Wendy Schmidt Ocean Health XPrize was launched for accurate and affordable pH sensors. Within 22 months of launch, deep-sea tests to depths of 3000m were successfully conducted on the 5 final sensors (until then, most pH sensors operated at a maximum of 2000m depth).

Prizes are being offered by others too. The World Climate Research Programme and Prince Albert II of Monaco Foundation announced the Polar Challenge to incentivize autonomous underwater sensing capabilities under ice. On the 300-year anniversary of the original Longitude Prize, the New Longitude Prize was launched to address the issue of antibiotic resistant drugs.

XPrize is currently running an additional 6 XPrize competitions to spur technology in the fields of artificial intelligence, education, environment, medicine, and space.

It is exciting to be living in a time when the pace of innovation will allow us to fully explore our planet and beyond. This truly is a new era of ocean discovery.

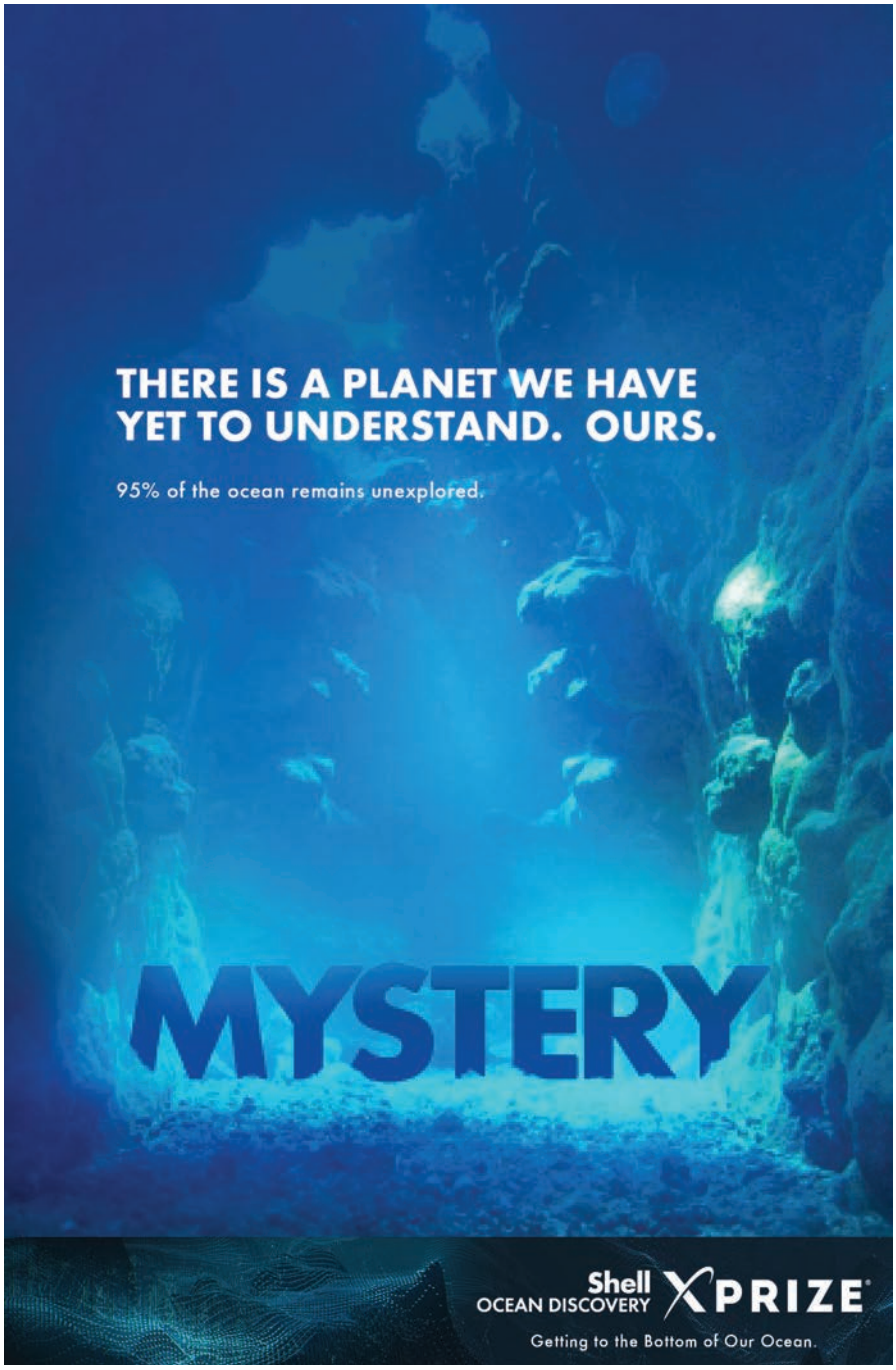

Image: XPrize

About the Author

Dr. Jyotika Virmani is a Senior Director for Energy and Environment at the XPRIZE Foundation and leads the Shell Ocean Discovery XPRIZE. Dr. Virmani has over a decade of professional experience in oceanography. She has a PhD in Physical Oceanography and a MS in Atmospheric Science.

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Rising Subsea Stars

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While Norway is down (courtesy of a two-year oil & gas slump) it certainly is not out. The Norwegian maritime and subsea pedigree extends centuries, and despite a momentary bump in the aquatic road, ***William Stoichevski*** *uncovers some Rising Subsea Stars.*

The merging in May of installation and equipment giants Technip and FMC into TechnipFMC eclipsed some news, so you might have missed the brilliance of wellhead, tubular and downhole stars shining from the depths. Beyond the success of TechnipFMC business, Forsys, there's the entrepreneurial activity of brilliant new and established older players as well as some locally based engineering dynamos and their company-sized ideas.

Forsys Subsea

The largest ever subsea asset deal featured the parent companies of engineering outfit Forsys, an outfit fresh from winning the job of designing subsea operator Statoil's Trestakk development offshore Norway. The subsea tieback to the Aasgard A floating production storage and offloading vessel includes all systems and related services from the FPSO's hanging risers to the wellhead, including umbilical, riser, flowlines and the installation and readiness of the subsea production system. The ability to do combine service and equipment with less seabed sprawl is touted as a key cost-cutting effect deriving from the combination of Forsys's 50-50 parent entities. Using "next-generation" subsea architecture, Forsys Subsea's business model is to cut the total imprint of subsea umbilical, riser and flowline systems (SURF) and subsea production systems (SPS). The same is now being

More Stim: jack-ups like the Maersk Gallant (seen from the business end) might soon be completing more wells with Fishbones stimulation technology.

Photo Ole Jørgen Bratland - Statoil

said of TechnipFMC, an alliance said to address the disparity between $29 oil and well costs that had overrun the $100 million mark. At Forsys's creation, Subsea production systems, risers and flowlines and installation had become 35 percent of an offshore development. Topsides to control production and drilling and well completions had reached 60 percent of that number, Forsys leadership says. The company says getting in early with its front-end engineering; staying the course with its condition and performance monitoring (CPM) and joint R&D are core to its cost-cutting offering.

Fishbones

Houston small business award winner Fishbones has found a missing-link niche in stimulating wells to produce as much as possible — quickly. Fresh from OTC Spotlinght honors for the drilling solution Dreamliner MST, the company's new Fishbones MST solution is "something customers have been waiting for," says Fishbones' CEO Eirik Renli, a former Baker Hughes country manger. "When you ship it to the rig, it almost looks like a regular liner," he says about the company's Dreamliner multilateral drilling stimulation technology, or MST. The tech uses diffuse pressure and acid to extend a series of nozzle-ended pipes (like the ribs of fish bones) from the casing along a length understood to be a max of about 10 m. Tiny discs prevent early deployment of the 18 millimeter rods which "wash" themselves into the reservoir using 3,000 dpi of pressure.

A Society of Petroleum Engineers paper at the end of May 2016 reported on Statoil's first-ever pilot trial of the MST at the Smoerbukk South multilateral production well, where production was made possible in tight sandstone by the Fishbones completion, a feat "previously regarded as not feasible" due to variable reservoir quality that ranged from "bricks to tiles", according to Statoil, a nod to this new ability to tap low porosity stone's for hydrocarbons. A drive shaft spins fluid and then tiny turbines at the end of the "ribs" to create sideways stim. The completion method simultaneously makes large numbers of laterals out of one wellbore. Not yet an option for shale, the system is ideal for tight sandstone or carbonate akin to that found in the North Sea and the Middle East.

"We can cover the whole 360 degrees around the reservoir … It's only limited by the hydraulics calculations," Renli says. At the end of the Fishbones tool, an anchor holds things in place to prevent the system's sideways movement. The anchor is a shoe fitted with a disc that "bursts open" at the right pressure with normal drill fluid.

"In two to three hours, you've stimulated a well," he says. Time isn't just a factor for the operators. Fishbones is

Deceptive: Subsea Design's humble factory front 30 minutes from Oslo hides a hive of invention that includes pipe connector's and wellhead support.

Photo: William Stoichevski

Subsea Design

getting by on trials, loans and a grant and needs some real business soon to keep the offer available to an industry in need of stim alternatives.

Subsea Design SeAlign

While all good things, it might be argued, contribute to IOR, calculations that identify time lost on "simple" but costly things — like connecting pipelines not about to meet in perfect alignment — are not always prized.

Subsea Design from unsung scrap-metals town Drammen is acutely aware of the industries struggles with aligning connections not in alignment, so they've come up with their trademark SeAlign: a tool that precludes the need to position massive "pipe-bending" structures or pricy connection equipment.

Subsea Design's patent for solving misalignment is called a "self-aligning" connector and cuts stress on tubulars and space on the pipe spool, since less pipe is needed as slack. SeAlign is installed at the platform or template and at the end of infield pipe by an ROV using a trademarked connection system. The ensuing savings are said to have contributed to the massive cost reduction operator Statoil is reporting at its giant Sverdrup field development, for which 72 SeAlign connectors have been ordered in 8", 12", 14" and 16" sizes.

Subsea Design WLR

For that other overarching priority in today's industry, heightened safety, Subsea Design has also engineered a wellhead load-relief system, or WLR, to carry the weight of whatever is brought to bear on a well, but especially risers, blowout preventers (BOPs) or containment equipment. Already tested by stately Statoil between 2014 and 2016, the WLR was found to cut "inert and dynamic bending and loading" by up to 90 percent. This "shock-absorber" for taking on wellhead weight also extends the operating weather window for drilling by granting a bit more rig drift. Images show the WLR installed on a BOP and looking flexed to buttress its load. Four to eight lines of clamps wires and advanced tensioners secure the BOP in place atop the wellhead or x-mas tree. Trial analysis included seabed compression and casing studies, and (judging by the PowerPoint) fatigue life or "allowable days of drilling (completions or re-entry)" increased (with the WLR) by from 50 to 5,000 days!

DNV GL

It was at Subsea Valley in April 2016, that a DNV GL wells expert revealed that new, "alternate" plug and abandonment strictures were on the way. The new recommended practice is based on a risk-based abandonment assessment.

Norway is part of a $5 billion well P&A market, a source told MTR, and this high cost of decommissioning was the driver of the new RP. The Norwegian market is "35% of that estimate." Much of the cost is related to getting a jack-up rig above subsea wells with supplies of cement. The other windfall is the time saved leaving an exploration well.

Risk-based abandonment

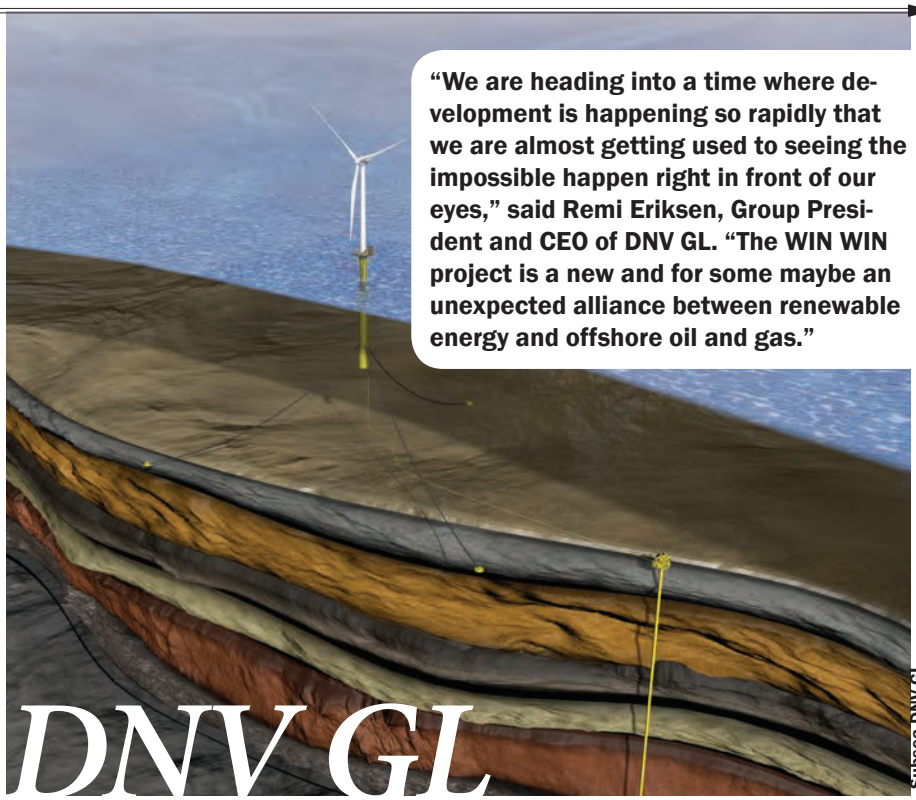
"Do all wells need the same requirement," the Class man asks somewhat rhetorically. DNV GL is hoping to foster site-specific regulation for P&A that would even the playing field, as Norwegian P&A rules require filling a 100-meter top-hole plug, although 8 m is enough in other oil provinces. The RP includes marine wells based on ISO 31000 standards. The recommendation follows a P&A project at the Huldra field, where Statoil learned that one double barrier was as good as five single barriers and would earn a savings of 100 million kroner on the test wells involved. Some 3,000 wells on the Norwegian continental shelf need P&A work, so many are quietly excited about the RP. Although he didn't specify, the DNV GL man said new technology — not just cement pours — would also help bring the cost of P&A down

Wind-Powered Oil Recovery

As classification societies go, DNV-GL is perpetually on the cutting edge either along or via Joint Industry Projects (JIP) to push the envelope and deliver seemingly futuristic technical solutions to some of the world's more vexing maritime and subsea problems. Courtesy of a DNV-GL-led WIN WIN JIP, the organization has delivered again, announcing an innovative solution designed to both help the environment as well as the profitability of the beleaguered oil and gas industry: Wind-Powered Oil Recovery. Specifically the plan is designed to use floating wind turbines to power a water injection system. **JIP partners include ExxonMobil, ENI Norge, Nexen Petroleum UK Ltd., Statoil, VNG Norge, PG Flow Solutions and ORE Catapult.** "We can now see renewable energy as a large scale source of power to offshore oil & gas operations. By using the recent developments of floating offshore wind turbines this concept can offer a clean, reliable, and cost effective alternative for powering

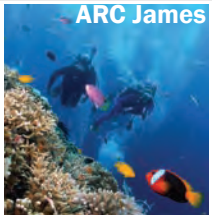
water injection in offshore locations," said Remi Eriksen, Group President and CEO of DNV GL.

The costs for wind powered water injection have been compared with a conventional alternative where water is injected via a flow line from the host platform. While the WIN WIN technology has higher operational expenditures (OPEX) compared to a conventional alternative, the significantly lower capital expenditure (CAPEX) means that it compares favorably over the long term. WIN WIN is therefore a commercially competitive alternative in a range of cases, particularly when host platform capacity is limited or injection wells are located far away. The savings will vary widely based on the project and the installation, but the JIP has estimated possible cost savings of approximately 20%.



"We are heading into a time where development is happening so rapidly that we are almost getting used to seeing the impossible happen right in front of our eyes," said Remi Eriksen, Group President and CEO of DNV GL. "The WIN WIN project is a new and for some maybe an unexpected alliance between renewable energy and offshore oil and gas."

Subsea DNV GL



Halls of Higher Learning

The subsea industry and the institutes, institutions, universities and colleges are inextricably linked. Picking just five to feature in our MTR100 was no easy feat, but our U.K.-based contributor ***Kira Coley****, as always, gave it her best shot.*

Scripps Institution of Oceanography - UC San Diego

Topic: Education & Outreach
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Address: 9500 Gilman Drive, La Jolla, CA 92093
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Email: scrippsnews@ucsd.edu
www.scripps.ucsd.edu

Since 1903, Scripps Institution of Oceanography at UC San Diego has evolved into one of the world's most influential centers for marine biology, ocean, atmospheric and earth research. The award-winning institution and culture of collaboration spark innovation which has shaped science over the last century and driven economic impact in today's society. The Scripps mission is to seek, teach, and communicate scientific understanding of the oceans, atmosphere, Earth, and other planets for the benefit of society and the environment. As such, the institution places the next generation of scientists in the frontline of cutting-edge research and, through exceptional educational programs, applies and communicates that knowledge to the public. Their successful commitment to outreach is demonstrated by the annual presence of almost half a million visitors to Birch Aquarium at Scripps, the public exploration center for the institution. Scripps also has one of the largest academic research fleets in the world. These floating laboratories have led to fundamental observations generating a legacy of priceless data—including Argo and the CalCOFI observations of the California Current ecosystem. Over the past five years 304 separate research missions have been completed, supporting 4,526 scientists, students, engineers, and explorers from 425 different research institutions and laboratories around the world.

As Scripps continues to inspire and educate, the institution has also prioritised the development of solutions to meet new challenges to the health of the planet.

Through the emergence of four main strategic themes, Scripps Institution of Oceanography will focus future projects on Climate Change Impacts and Adaptation, Resilience to Hazards; Human Health and the Oceans and Innovative Technologies to Observe the Planet.

The journal Nature ranked the academic institution of UC San Diego first in the United States and fourth worldwide in earth and environmental research. QS World University Rankings 2016 in Earth & Marine Sciences placed UCSD as 14th in the world.

NOC

The National Oceanography Centre (NOC)
Topic: Marine Technology
Address: University of Southampton, Southampton, Hampshire, SO14 3ZH, UK
Tel: +44 (0)23 8059 6666
www.noc.ac.uk

A merger in April 2010 between Liverpool's Proudman Oceanographic Laboratory and Southampton's National Oceanography Center, gave rise to the UK's leading institution for ocean research and technology development. From the coast to the deep ocean, the National Oceanography Center (NOC) has led advancements in marine technology and ocean exploration. The organization hosts two Royal Research Ships and an impressive array of deep submersibles, advanced ocean instruments and sensors. It is also home to the global mean sea level data archive, the UK's sea level monitoring system for flood warning and climate change, the national archive of subsea sediment cores and the British Oceanographic Data Centre. In 2015, a $4.2 million center was opened to develop new technology for the emerging marine robotics sector. The Marine Robotics Innovation Centre, designed to be the hub for businesses developing autonomous platforms, will be the future birthplace of novel marine observation technology that will be used to cost-effectively cap-

National Oceanography Center

ture data from the world's oceans.

Already, the NOC has demonstrated its world leading position in marine technology through dozens of projects and expeditions. This includes the testing of new technologies for blue mining and assessments into the future role of autonomous systems for the monitoring of deep-water and coastal Marine Protected Areas (MPAs). A recent $13m investment from the Natural Environment Research Council (NERC) has been given to the NOC to ensure the UK remains at the forefront of global marine science and technology innovation. The development of a new 1500m depth-rated Autosub Long Range (ALR1500) and a 6000m depth-rated autonomous underwater vehicle (Autosub6000 Mk2), will support future under-ice and deep-ocean science.

AWI
The Alfred Wegener Institute
Topic: Polar Science
No. of employees: circa 1,100
Address: Alfred Wegener Institute,
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Tel: +49 (0)471 4831-0
Email: info@awi.de
www.awi.de

Situated across several locations throughout northern Germany, the Alfred Wegener Institute (AWI) has grown from humble beginnings in the 1980s with only a handful of people to one with over a thousand, investigating regions from temperate to the world's most extreme. Named after the German polar explorer who discovered the continental drift, the AWI has quickly established themselves as one of the top research institutes in the world and one of the very few that are equally active in both polar regions. As the Helmholtz Centre for Polar and Marine Research, the AWI work closely with numerous national and international partners and, as such, is the headquarters for dozens of national, European and international projects such as the "Polar Prediction Project" and the Helmholtz Alliance "Robotic Exploration of extreme Environments." With a focus on long-term observations, the AWI carry the responsibility for collecting and maintaining high-quality observation data for the global research community, including the long-term measurement of Arctic sea ice thickness. It also develops, maintains and operates high-value research infrastructure, including research vessels, polar stations, aircraft, laboratories, and observatories to facilitate field research, including the Antarctic Research Station "Neumayer-Station III" and research aircraft Polar 5 and 6. Combining innovative approaches, outstanding research infrastructure and years of expertise, the AWI actively seeks to unravel the complex processes of the "Earth System" – from the atmosphere to the ocean floor – and progresses towards meeting the scientific challenges of tomorrow. The Helmholtz Association of German Research Centres ranked 2nd in the world and 1st in Europe in the 2016 journal Nature Index for its contributions to Earth & Environmental sciences. Germany was ranked 3rd top country for its contributions to the journal.

James Cook
ARC Center of Excellence for Coral Reef Studies, James Cook University
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No. of employees: ~3,000
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Alfred-Wegener-Institut/Stefan Hendricks

James Cook

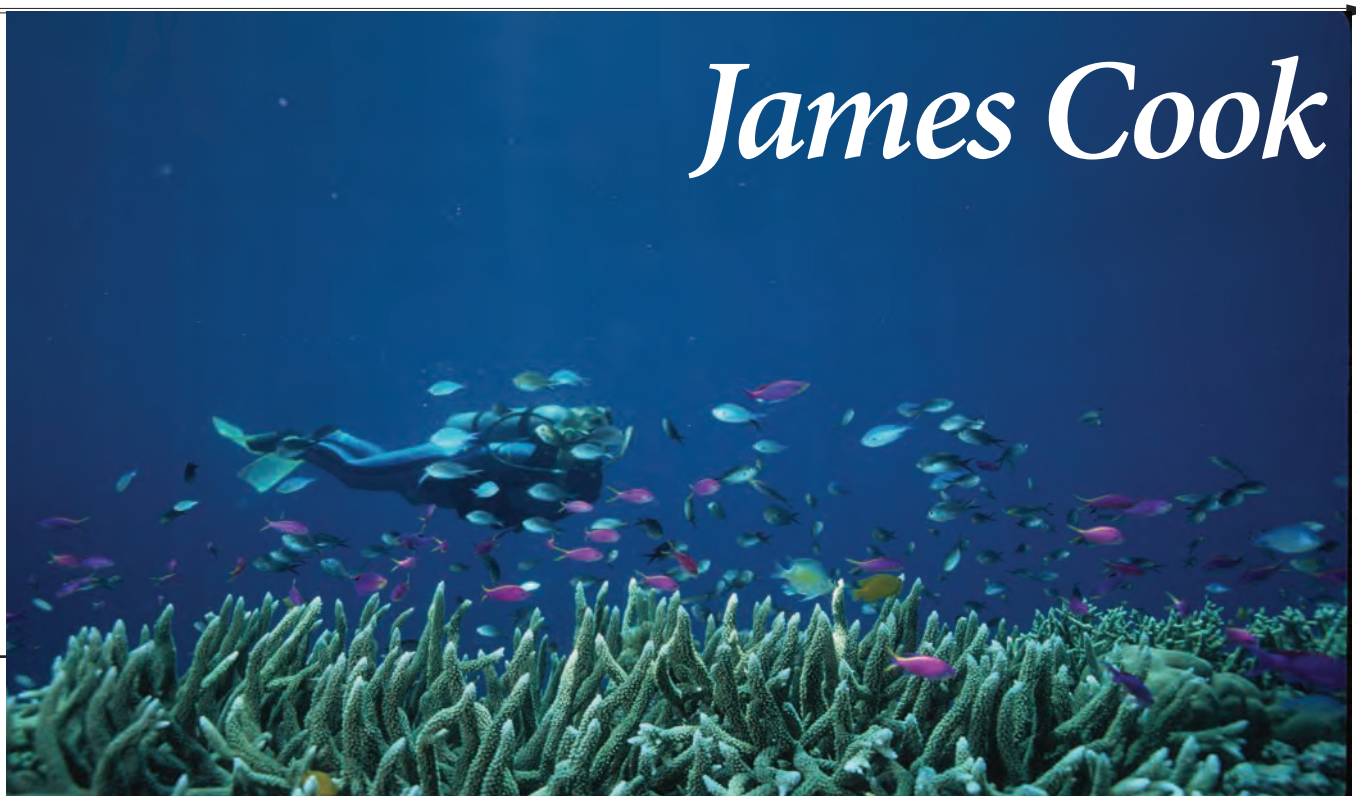

Photo: ARC Centre of Excellence for Coral Reef Studies

The ARC Centre of Excellence for Coral Reef Studies undertakes world-leading integrated research for sustainable use and management of coral reefs. Funded in July 2005 under the Australian Research Council (ARC) Centres of Excellence program this prestigious research centre is headquartered at James Cook University (JCU), Australia. The ARC Centre is a partnership with JCU, the Australian Institute of Marine Science (AIMS), the Australian National University (ANU), the Great Barrier Reef Marine Park Authority (GBRMPA), the University of Queensland (UQ) and the University of Western Australia (UWA).

The ARC Centre of Excellence cements Australia's leading contribution to coral reef sciences and fosters stronger collaborative links between the major partners and 24 other leading institutions in nine countries. Collectively, the ARC Centre creates the world's largest concentration of coral reef scientists.

The ARC Centre of Excellence takes a leading role in multi-national research, focusing its efforts on three research areas: People and Ecosystems, Ecosystem Dynamics: Past, Present and Future and Responding to a changing world.

It is the largest single institutional contributor to the Global Coral Reef Targeted Research Program, funded by the World Bank, and is an Institutional Member of the Resilience Alliance. The Centre of Excellence has strong links to the Census of Marine Life project, and to coral reef management agencies worldwide, particularly the Great Barrier Reef Marine Park Authority in Townsville, Australia.

According to ISI Essential Science Indicators, four of the ARC Centre's major research partners rank in the top 20 institutions world-wide for citations for coral reef science with JCU ranking 1st (among 1644 institutions in 103 countries).

Woods Hole Oceanographic Institution (WHOI)

Topic: Oceanography
No. of employees: ~1,200
Address: 266 Woods Hole Road, Woods Hole, MA 02543-1050 U.S.A
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Email: information@whoi.edu
www.whoi.edu

With more than 85 years of research and exploration, the Woods Hole Oceanographic Institution (WHOI) is the world's largest, independent ocean research institution. Their research spans theory, exploration, field observation, computer modeling, technology development, and practical applications to real-world problems. WHOI brings together ocean experts with engineers to build innovative new technologies and tools necessary to advance ocean science.

Since 1964, WHOI has operated the National Deep Submergence Facility, a federally-funded center that designs, builds and operates deep-sea exploration vehicles—Human Occupied Vehicle (HOV) Alvin, Remotely Operated Vehicle (ROV) Jason, Autonomous Underwater Vehicle (AUV) Sentry—for the benefit of the entire U.S. oceanographic community.

The Institution is also the lead organization on the coastal and global nodes of the NSF-funded Ocean Observatories Initiative. WHOI designed, built, deployed and maintains the coastal Pioneer Array off New England and four global arrays (off Alaska, Greenland, Chile, and Argentina) and have also begun operation of the Neil Armstrong, the nation's newest and most advanced research vessel.

The Institution has produced major contributions to the fields of oceanography and marine sciences, including most recently studying impacts of the great 2015-16 El Nino on corals and exploring strategies to conserve vulnerable reefs. WHOI has also developed a set of new tools for tracking and learning about animals in the wild, such as real-time acoustic buoys for whales, and the SharkCam, and TurtleCam vehicles.

The future of WHOI ocean research will be focused on investigating marine microbiomes; combining advanced sensors and underwater vehicles for exploration and data collections in remote or harsh environments, and improving our understanding of climate impacts on coastal environments and resources.

The journal Nature ranked WHOI as 11th in the United States and 14th worldwide in earth and environmental research.

EvoLogics

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Phone: +493046798620
Email: info@evologics.de
https://evologics.de/
CEO/President: Dr. Rudolf Bannash,
Dr. Konstantin Kebkal
Number of Employees: 40

Founded in 2000 by a group of international scientists and R&D experts, German high-tech enterprise EvoLogics GmbH specializes in underwater acoustic communications, acoustic positioning equipment and innovative solutions for robotics. The Berlin-based company says its mission is to develop innovative technologies for maritime and offshore industries through interdisciplinary cooperation between engineering and life sciences.

EvoLogics designs and manufactures underwater information and communication systems based on bionic concepts, combining state-of-the-art engineering with the best ideas found in nature.

EvoLogics are experts in cutting-edge underwater communication and positioning systems, as well as novel robotic solutions. The company's advanced spread-spectrum technology delivers optimal results for various subsea applications. Its products include several series of underwater acoustic modems, underwater acoustic positioning systems (USBL, LBL), as well as the Sonobot autonomous USV for bathymetric surveys.

EvoLogics' products are designed to offer highly reliable, flexible and cost-effective solutions for multiple underwater communication, positioning, navigation and monitoring applications. EvoLogics' developments are based on the patented S2C (Sweep Spread Carrier) technology the hydro-acoustic telemetry based on dolphin communication physics that provides an independent bi-directional data link along with positioning, broadcasting and networking capabilities. S2C devices can simultaneously facilitate telemetry and navigation of unmanned underwater vehicles.

They enable retrieving information from various sensors and allow for control of complex processes by seamlessly combining communication with accurate positioning. Moreover, EvoLogics caters to the needs of scientists, developers and commercial customers with a series of underwater acoustic devices and software tools that offer an open development and testing framework, providing endless opportunities for new implementations. S2C systems have been carefully designed for operations in harsh underwater environments and enhanced with special algorithms for signal processing and data management. The company's extensive experience with sensor integration allows it to provide customers with turnkey solutions ranging from initial deployment up to recovering the equipment.

Its S2C R and S2C M series of underwater acoustic modems deliver excellent performance, resistant to the challenges of a dynamic subsea environment. Self-adaptive algorithms adjust the S2C parameters to maintain the highest bit rate possible in current conditions. The S2C R series offers a selection of short- mid- and long-range devices for shallow or deep water applications. Each product is available in a variety of configurations to offer the best-fit solution for a particular scenario. The S2C M-series offers the full benefits of the company's patented S2C (Sweep-Spread Carrier) communication technology in a light and compact design. The S2C M-series is fully compatible with EvoLogics standard S2C R and S2C R USBL series and includes a selection of directional and non-directional short- and mid-range devices that fit various application scenarios, especially those where size and weight are critical. Every S2C Underwater Acoustic Modem was designed as a reliable tool to solve multiple communication tasks. It implements advanced data delivery algorithms, supports addressing and networking and is easy to control with a comprehensive set of commands and software-configurable settings.

SubCtech GmbH

The privately owned SubCtech holds a 26-years tradition in ocean and subsea technology for industry and science. It solves customer demands with its own R&D, and develops maritime technologies for industry and science, in the areas of:

"Ocean Monitoring:" Measurement systems for vessels and buoys, e.g. high precision CO2 analyzers.

"Ocean Power:" Highly efficienty, reliable and safe Li-Ion batteries, specialized for Offshore Oil & Gas applications.

The SubCtech team develops and produces optimal solutions in all project phases, based on customer specification and demand. It also has an internal development department to offer state-of-the-art solutions. Our solutions for challenging tasks reach new markets. Our expertise networks realize interdisciplinary solutions for broad markets.

Email: marx@subCtech.com
www.subCtech.com

Subsea Global Solutions

Global underwater maintenance and repair service provider Subsea Global Solutions LLC provides maintenance and inspection services as well as large equipment and weld repairs. From in-water surveys, propeller polishing and in-water hull cleaning, to complex class-approved permanent ship repairs (propellers, rudders, thrusters, shell plates, seals), Subsea Global Solutions is a global resource for vessel maintenance and repair diving services, delivering cost effective, efficient solutions in the water as opposed to dry dock The company also provides underwater marine

Tritech International

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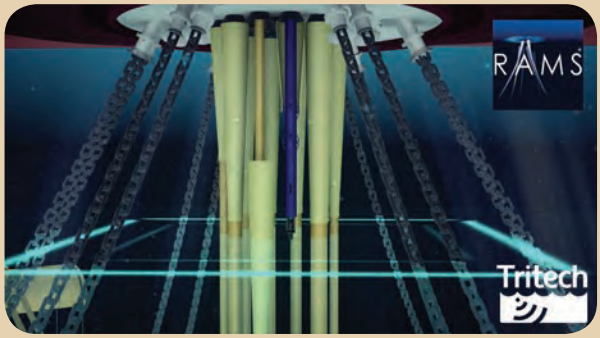
Email: sales@tritech.co.uk
Managing Director: David Bradley
Engineering Director: Jeff Chambers
Sales Director: Scott McLay
Sales Manager: Mike Broadbent

Tritech has provided reference standard products for subsea operations for over 25 years with products that are tried, tested and relied upon in ROV/ AUV markets. Tritech has grown its business to reflect new technologies and expanded territory opportunities, extending the company's credibility and commitment from very humble entrepreneurial beginnings.

Established in 1991, Tritech International Limited, a Moog Inc. company, began with the aim of producing an innovative range of subsea products for the offshore oil and gas industry, military and other world-wide subsea markets. Tritech specializes in high-performance acoustic sensors, sonars, video cameras and mechanical tooling equipment, serving professional underwater markets, including defense, energy, engineering, survey and underwater vehicles.

Today, Tritech remains an industry leader as a provider of sensors and tools for ROV/AUV markets, a reputation achieved from over 25 years of delivering expertise through key industry-standard products such as the Super SeaKing mechanically scanning sonar and now the Gemini suite of imaging and now profiling sonars. From the company's imaging ranges (mechanical and multibeam), to bathymetric sensors, to hydraulic and mechanical equipment, Tritech is able to support many subsea applications from the traditional ROV/ AUV markets to



aquaculture and cave diving.

Tritech offers its Gemini multibeam imaging sonar to monitor and often track mammals and marine objects around marine current turbines and more recently to detect sharks and ultimately protect human life around beaches. Tritech's technology has also been applied in law enforcement and SAR operations where then Gemini, along with Tritech's shallow-water side scan, has enabled ease of rescue missions. The common thread in all these working environments is usually low-visibility and the requirement to detect, track and analyze, often in very shallow or very deep water; elements which the Gemini and the latest model (Gemini 720is) can address.

Recent investments in new premises in Ulverston, Cumbria for the design, repair, service and manufacturing of products has provided greater test facilities including; two test tanks and a new high-pressure test chamber, both critical to ensure equipment reliability in the harsh subsea conditions in which Tritech's customers operate.

construction services.

With a large wholly owned group of offices with vetted partners globally, Subsea Global Solutions is a corporation consisting of the assets and personnel of Miami Diver LLC, Miami Diver Panama, Miami Diver International, and Parker Diving Service LLC. With a dedicated staff situated globally, Subsea Global Solutions has revolutionized the methods of repair for ships and advanced the methodology used in underwater marine construction.

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www.subseaglobalsolutions.com

Turner Designs

Turner Designs provides innovative optical-based solutions for environmental research and monitoring, water quality analysis and pollution control analysis. Having a unique focus on fluorescence instrumentation for over 40 years and customers throughout the world, Turner Designs is a leader in filter fluorometer design, manufacture and support. Turner Designs offers submersible, field, handheld, laboratory and online optical instrumentation varying in functionality, size and price.

Turner Designs develops instruments to address changes in the environment. Harmful Algal Blooms garner tremendous scientific focus as their negative effect on communities and their economies increase. In response, Turner Designs is introducing CyanoFluor providing PC/Chlorophyll ratios in a portable package, Enviro-T2 for inline monitoring of cyanobacteria, and FluoroSense for quick field measurements of phycocyanin, a marker pigment for cyanobacteria. CyanoFluor is a field instrument which, in a single cuvette, quickly performs ratio calculations between phycocyanin (PC) and Chlorophyll providing information for identifying cyanobacteria, a primary HAB-forming group of algae. Offering a simpler, quicker measurement is the handheld PC FluoroSense which, when dipped in water, quantifies the amount of PC with a push of a button. In addition to these tools, Turner Designs introduced Enviro-T2 for inline monitoring of cyanobacteria in water treatment plants.

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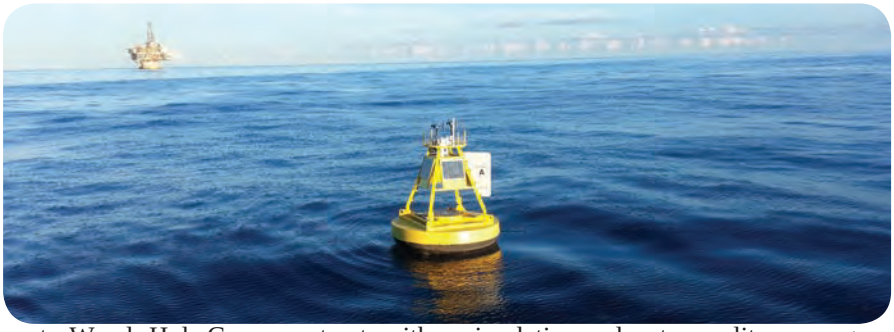
/www.turnerdesigns.com
CEO/President: James Crawford

Woods Hole Group

Woods Hole Group addresses environmental problems worldwide focused on engineering and environmental challenges from the deep ocean, the coastal zone, and into wetland and terrestrial environments. The company has proven the ability to evolve and sustain a business incorporating marine technologies for more than 30 years.

Headquartered in Falmouth, Mass., Woods Hole Group has satellite offices in Dover, Del.; Jacksonville, Fla.; and Houston, along with partners in 20 nations. Woods Hole Group focuses on water and sediments, and works in diverse environments from the deep ocean, through beaches and estuaries, and into wetlands, rivers and the terrestrial setting. Specialties include: coastal engineering and geology; numerical modeling; physical oceanography; real-time metocean rig, buoy and moored systems; field installation, operation and maintenance services; climate change vulnerability assessments and sustainability; and ecological risk/impact assessment and remediation planning. Expertise is applied to perform measurement programs for offshore energy, and operate port and harbor monitoring systems. The company also supports coastal infrastructure, including shore protection projects, dredging and dredged material management/disposal, site assessments, as well as remediation and habitat restoration including sustainable living shorelines.

Woods Hole Group focuses on applied ecology and sustainability; coastal sciences, engineering and planning; and oceanography and measurement systems. Ocean observations are at the heart of Woods Hole Group's technology profile, including real-time data for safe and efficient marine operations. Teams design, build, deploy and operate meteorological/oceanographic buoys, moorings and platform-based systems. The WatchDog metocean system improves data quality and reduces maintenance



costs. Woods Hole Group contracts with individual port operators and NOAA to measure water level, current speed, water quality and bridge air gap to ensure safe navigation and improve maritime commerce. Archived data provide the basis for engineering design criteria and scientific data analysis. Woods Hole Group has proprietary software to turn raw data into the information required by maritime decision-makers. As a turnkey engineering company for coastal infrastructure (beach nourishment, coastal structures, wetlands restoration and dredging), numerical models are applied to understand existing conditions and optimize engineering designs. Modeling technologies are offered for tidal current circulation and water quality, wave generation and transformation, sediment/contaminant transport and fate, and storm surge/sea level rise simulations. Water/sediment sampling and testing technologies also are applied to characterize ecological impacts and risks.

The group maintains metocean instrument and hardware equipment for lease; measurement systems testing and integration laboratory and facility; field sampling and testing equipment; machine shop and mooring/buoy assembly shop; and Beowulf networked computing cluster for high-performance parallel numerical simulations.

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www.woodsholegroup.com
CEO/President: Robert P. Hamilton, Jr.

Yunzhou Tech

With a focus on USV development, China's Yunzhou-Tech offers solutions for applications such as water environment sampling and monitoring, hydrographic survey, oceanographic survey, nuclear radiation monitoring and water surface cleaning. Yunzhou-Tech autonomous boats already serve clients from industry, government, research institutes and universities worldwide. The latest Ocean USV Platform can be used for hydrology research, scientific exploration, hydrographic survey, emergency search and rescue, security patrol and other work on the sea.

Yunzhou Tech's Autonomous Sampling and Monitoring USV integrates with multi parameters sondes to perform online water quality monitoring and it is also equipped with obstacle avoidance sensors and real-time video transmission. The boat is 1.15 x 0.75 x 0.43m and weighs 57 lbs. The body is made of high-strength glass fabric composite material. The smallest model is 128 cm long weighs 21.5 lbs., making it "man-portable." The whole survey system includes the simple beam depth finder, side-scan sonar system, double-frequency GPS attitude instrument system and a data radio station used for data real-time transmission measurement. Since the draft of our survey boat is only 20cm, it gives good for survey performance in offshore and shallow water area.

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Fugro

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Netherlands 2264 SG
Phone: +31 (0)70 311 1422
Email: media@fugro.com
www.fugro.com
CEO/President: Paul van Riel
Number of Employees: 12,000
Annual Sales: $2,667,000,000.00

Dutch geotechnical, survey, subsea, and geoscience services firm Fugro creates value by acquiring earth and asset integrity data, managing the data and providing associated consulting and advisory services. The company provides essential data, intelligence and solutions for the design, construction, installation, operation and eventual decommissioning of projects. Fugro also provides mapping and natural resources exploration services. Providing the people, equipment, expertise and technology that support the exploration, development, production and transportation of our world's natural resources, Fugro also offers the technical data and information required to design, construct and maintain structures and infrastructures in a safe, reliable and efficient manner. As an independent services provider Fugro's aim is to de-risk major investment decisions. Its services are specifically designed to support engineering design and large structure building projects and they include the provision of information and advice about the best way to locate and build foundations of production platforms, wind farms, large buildings and infrastructures, as well as how to strengthen levees. The company also undertakes related inspection, maintenance, repair installation and light construction support services. Fugro's services are mostly provided locally and are supported by a global knowledge base and resource pool of experience personnel. Fugro is familiar with working in locations around the globe in varying operating environments, which require a wide range of services. To provide comprehensive support, the company operates a large, regionally organized, global network of offices and facilities. Fugro strives to achieve strong market positioning based on technologies that are mostly developed in house, high-value services and strong international or regional presence. With a sharper-than-ever focus on the offshore oil and gas industry's requirements for cost efficiency, safety and ease of operation, Fugro continues to invest in new technological developments. Its range of pioneering initiatives includes innovations such as OARS, Subsea LiDAR, 3Direct, Fugro Roames, NorthStar and Echoscope Sonar.

- OARS provides remote monitoring through globally distributed, centralized command centers that are manned 24/7 by Fugro's qualified surveyors, with direct access to offshore survey projects. OARS potentially eliminates the need for onboard surveyors, optimizing project crewing, safety and efficiency.
- Subsea LiDAR collects detailed and accurate three-dimensional point clouds of complex subsea components using non-contact, laser technology.
- 3Direct provides accurate and continuous hands-off positioning through video stream tracking of 3D structures to enhance safety and operational control during lifting and lowering operations.
- Fugro Roames reliably simulates and predicts how assets and environments will change over time, enabling significant optimization of IRM programs and the safer utilization of infrastructure.
- NorthStar is a wide range of forecasting and monitoring techniques in one Fugro service, supporting floating asset integrity management.
- Echoscope Sonar is an advanced multibeam echosounder that can provide a wide area, real-time visualization of subsea operations in zero visibility.

Valeport Ltd.

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Phone: +44 1803 869292 / Email: sales@valeport.co.uk
www.valeport.co.uk
CEO/President: Matt Quartley
Annual Sales: $11.5m
Sales Manager: Kevin Edwards
Number of Employees: 84 / Square Footage: 28,000

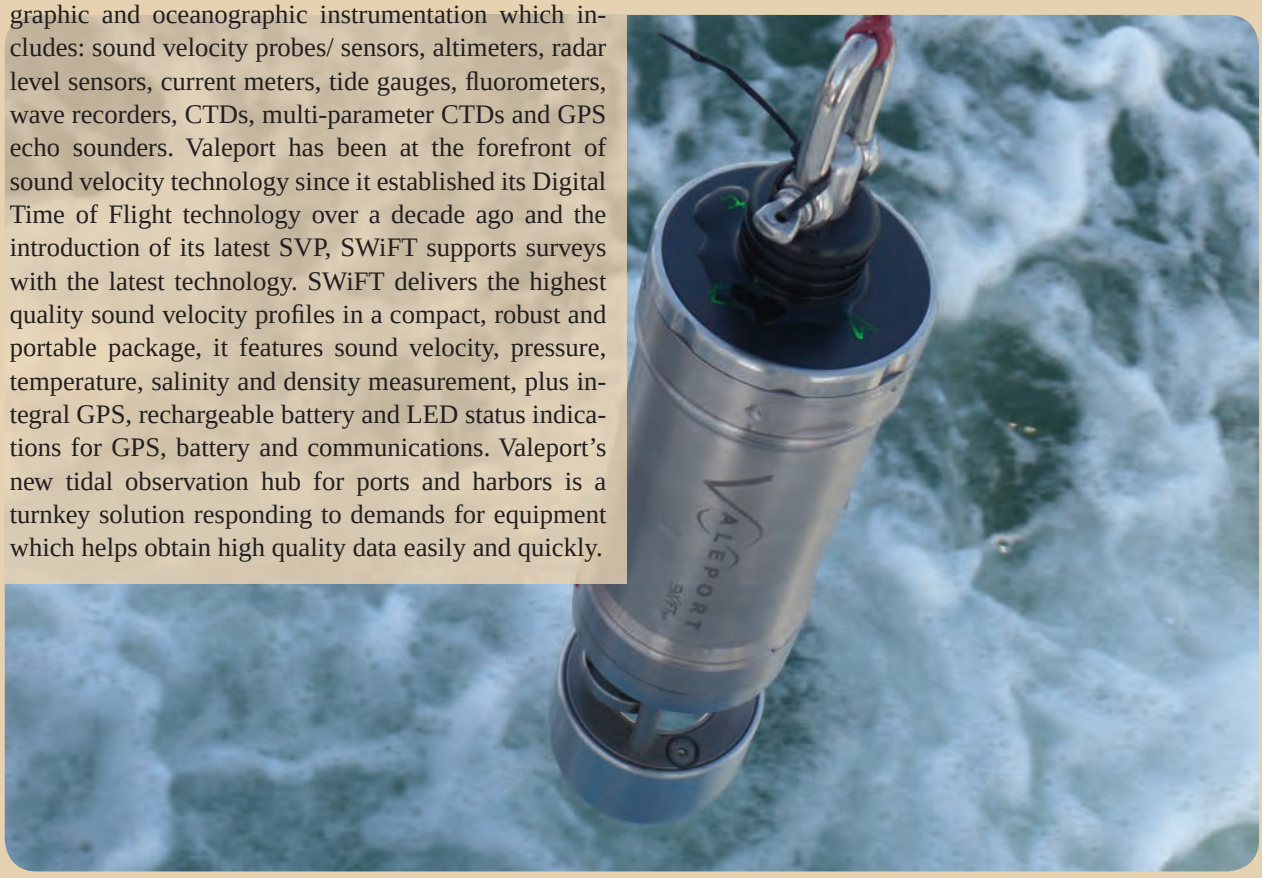
Established in 1969, Valeport is an independent, family owned business based in the Southwest U.K., where it designs and manufactures underwater measuring equipment for use in shallow water or down to full ocean depth. Its market base is very broad, covering commercial, academic and military. That said the company has seen positive growth in 2016, especially on the hydrographic and scientific sector. Aside from standard products, Valeport's OEM side of the business is also growing with specific sensor development and supply for third parties and other manufacturers.

Valeport said it remains positive about the future requirements of its products and opportunity for diversification of technologies, planning new developments in optical sensor technology to enhance product capability and allow entry into previously untapped markets. The business now employs around 84 staff, and continues to reinvest heavily both in new product development and facilities.

Valeport is the U.K.'s leading manufacturer of hydrographic and oceanographic instrumentation which includes: sound velocity probes/ sensors, altimeters, radar level sensors, current meters, tide gauges, fluorometers, wave recorders, CTDs, multi-parameter CTDs and GPS echo sounders. Valeport has been at the forefront of sound velocity technology since it established its Digital Time of Flight technology over a decade ago and the introduction of its latest SVP, SWiFT supports surveys with the latest technology. SWiFT delivers the highest quality sound velocity profiles in a compact, robust and portable package, it features sound velocity, pressure, temperature, salinity and density measurement, plus integral GPS, rechargeable battery and LED status indications for GPS, battery and communications. Valeport's new tidal observation hub for ports and harbors is a turnkey solution responding to demands for equipment which helps obtain high quality data easily and quickly.

This summer, Valeport launched TideStation, which offers a choice of sensors and communications for tide monitoring tide and weather parameters where the main electronics are housed in a GRP cabinet for quick installation. Valeport's newest example of profiling technology innovation is the rapidCTD, which was developed primarily to interface with Teledyne Oceanscience RapidCAST winch and allows oceanographic data to be profiled from a moving vessel without compromising the quality of the data.

Valeport retains all aspects of the development and manufacturing processes in house, allowing the company complete control over every aspect of its products. In 2013 Valeport invested $3.6 million to expand into a purpose built 16,000sq.ft facility which houses the entire production facility with a fully equipped CNC workshop, state of the art calibration laboratory using unique techniques and equipment for calibration of ultra-high-accuracy sound velocity sensors and two floors of ESD protected assembly workshop.



MacArtney Underwater Technology

FOCUS 3: the 3rd generation FOCUS vehicles in the family of ROTV systems designed, developed and manufactured by MacArtney (Image: MacArtney)

MacArtney A/S (Headquarters)
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info@macartney.com

Niels Erik Hedeager, Group Managing Director/CEO;
Hans-Jørgen Hansen, Vice-President, Sales & Marketing;
Steen Worsøe, Vice-President, Technology
Bjarke T. Ovesen, Vice-President, System Solutions
Lasse Rasmussen, Vice-President, Engineering
Number of employees worldwide: 300 in group companies, 160 in associated companies.

The MacArtney Group is a global supplier of underwater technology products and systems specializing in design, manufacture, sales and service of a wide range of systems to offshore oil and gas operators, surveyors, the renewable energy sector, ocean science institutes and navies across the world. The company offers an extensive variety of advanced and reliable products and system solutions which are designed and tested to supply high quality, efficiency and dependable performance in challenging underwater environments. All MacArtney systems and components are backed by an international network of subsidiaries and representatives providing local access to global support.

MacArtney has been supplying products and engineering solutions for almost 40 years and is a privately owned corporation with group headquarters in Esbjerg on the west coast of Denmark. From its head office, the company has been providing logistical, technical, financial and marketing support to all of the companies within the group since 1978. The MacArtney Group supplies and services a wide range of integrated systems and products designed, developed and manufactured by MacArtney. It is also trusted representatives of leading manufacturers of underwater products. MacArtney supply includes SubConn, OptoLink, TrustLink and GreenLink connectivity, cable and termination solutions, advanced NEXUS and EMO fiber optic telemetry systems, electric CORMAC and MERMAC winch, handling and LARS systems including active heave compensation (AHC) winches for ROVs. The MacArtney range of fast and precise remotely operated towed vehicles (ROTV) includes the MacArtney FOCUS 2, FOCUS 3, TRIAXUS and FLEXUS vehicles. Moreover, MacArtney supplies a versatile range of LUXUS underwater cameras, lights, media controllers, pan-and-tilt units and accessories. System design and integration by qualified, experienced engineers is an important part of the MacArtney portfolio. Combined with a wide range of products and systems, MacArtney can provide turnkey solutions designed specifically for requirements and installed ready for use wherever needed. The cornerstones of the MacArtney fields of operation are:

Oil and Gas: solutions from seabed to surface, supplying the entire value chain

Defense: supplying connectivity products, instrumentation, deck- and-over-the-side handling equipment

Ocean Science: handling scientific equipment and data, instrumentation

Renewable Energy: supplying state-of-the-art solutions to wave, tidal and offshore wind applications and projects

Civil Engineering: providing underwater technology products and solutions to a wide range and variety of projects, operators and developers

Diving: underwater cameras, lights and media controllers for the professional professional diving industry.

MRV Systems LLC

MRV Systems provides profiling floats and autonomous underwater vehicles (AUVs) geared for measuring the oceans' physical properties. MRV products are designed to be low-cost and high-endurance, to enable efficient exploration of the oceans, particularly in areas where observations by traditional methods are not practical, covering areas from the surface to 6,000m depths. Some are specially designed for ease of air deployment. MRV Systems was founded in 2010, as a spin-off from the Scripps Institution of Oceanography, with a license to manufacture the SOLO II profiling float. Since then, MRV has refined the original SOLO II design to the MRV S2-A, and expanded its product line to include an A-size profiling float, the Air Launched Autonomous Micro-Observer (ALAMO). MRV works with the Scripps Institution of Oceanography and the Woods Hole Oceanographic Institution as suppliers to the international Argo Program, under the auspices of the United Nations. Today, the MRV flagship product S2-A constitutes nearly 50 percent of the of the United States commitment to provide replacement autonomous profiling floats to the Argo program. MRV also provides profiling floats to the U. S. Naval Oceanographic Office and NOAA's Pacific Marine Environmental Laboratory. MRV has research and development contracts with the U.S. Office of Naval Research to support their scientific and military needs.

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www.mrvsys.com

Multi-Electronique (MTE)

Located in Rimouski, QC Canada and serving worldwide, Multi-Electronique (MTE) Inc. is renowned for the quality of its products and its effective after-sale service. The company offers a large and diversified range of product for oceanographic community. The main devices are µAURAL, AURAL-M2, and instrumental oceanographic buoys conceived and developed in collaboration with Fisheries and Oceans CANADA.

The AURAL devices are autonomous underwater recording systems. It can numerically record underwater sounds over a period up to a year with total autonomy. It is mainly used for the listening of marine mammal's noises, but also for underwater noise pollution, methane bubbles and the Grand North ice cracking as examples. At the same time, it records pressure and water temperature. These instruments have been deployed all around the globe, by Fisheries and Oceans CANADA, National Oceanic and Atmospheric Administration, ENSTA Bretagne, as well as many universities and research contractors for a wide range of acoustic application. The Instrumental Oceanographic Buoy has been conceived to accommodate the use of many instruments in order to satisfy the oceanographic researchers' needs.

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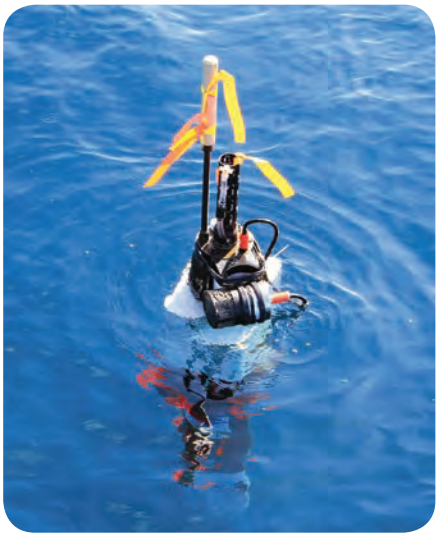
http://multi-electronique.com



nke Instrumentation

nke Instrumentation designs, manufactures and sells instruments and systems for water measurements and environmental monitoring. Its fields of application are ocean, deep sea, coastal, which the company serves with a range of products including data loggers, autonomous buoys, deep floats, sediment sensors and profiling floats. nke Instrumentation is involved in several research projects, both nationally and internationally, and works in partnership with scientific institutions such as Ifremer and CNRS.

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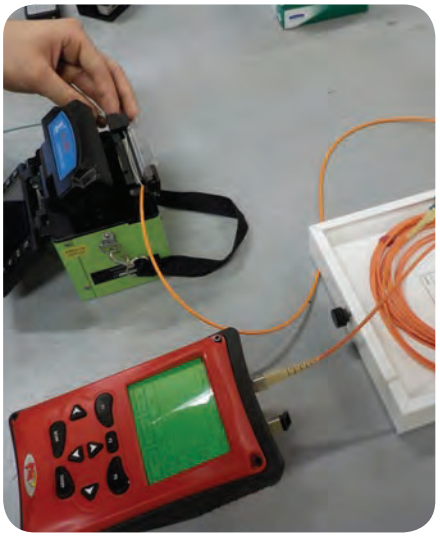
Novacavi

Novacavi is an Italy-based privately owned company established in 1975 that designs and manufactures in-house custom cables for a variety of specialist applications. The company's specialties are custom cable design and manufacturing, high standard products and technical support, fast response time, solid delivery performance and great experience in subsea application. Novacavi has been expanding its production of specialist cables with Aquancable, a range of unique bespoke cables for maritime and underwater technologies including high performance tow cables, ROV cables, fiber optic hybrid cables, umbili-



cals, armored cables, as well as subsea detection and instrumentation cables. Novacavi is also focusing on its range of custom marine coax tow cables. Among them both heavy steel armored coax tow cables for harsh specialist applications and lightweight, neutral, positively or negatively buoyant coax tow cables for underwater environment.

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www.novacavi.it

OceanGate, Inc.

OceanGate Inc. provides subsea manned submersible services for industry, research and exploration. Its five-man submersibles are geared for site survey and inspection, research and data collection, film and media production, and as deep sea testing platform for hardware and software. Since 2009, OceanGate has served the marine subsea market with manned submersible solutions developed from innovations in engineering, material science and technology. The company's fleet of untethered, self-contained manned submersibles enables teams of experts to collaborate at depths of 500 meters while performing a variety of industrial projects, scientific research, film projects, and exploration tasks. The maximum depth of these projects will extend to 4,000m with the debut of Cyclops 2 scheduled for 2017. OceanGate's team of professionals brings expertise in multiple disciplines including submersible operations around the globe, marine engineering, and oceanography – along with a proven track record of safe, successful expeditions – including diving in three oceans with the same team and same submersible in a 30-day period.

OceanGate has made a significant investment in the research, development and manufacturing of a new class of manned submersibles to serve the evolving commercial, research and exploration markets. In 2016, OceanGate began developing Cyclops 2, the first of its 4,000-m capable manned submersibles to provide access to more than 50% of the ocean's resources. The construction of Cyclops 2 is currently underway, with the submersible scheduled to debut in 2017. Aboard Cyclops class submersibles is technology provided by strategic partners iXblue and Teledyne Blueview. iXblue recently provided its PHINS inertial navigation system for underwater navigation and positioning during

OceanGate's recent Andrea Doria Survey Expedition. Teledyne Blueview provided multi-beam sonar hardware and software for capturing detailed, close-up sonar images of the iconic shipwreck. OceanGate has also developed a Mobile Subsea Launch and Recovery System (MSLARS) for delivering, launching and recovering manned submersibles.

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Ohmsett

Managed by the U.S. Department of Interior's Bureau of Safety and Environmental Enforcement's (BSEE), Ohmsett – The National Oil Spill Response Research and Renewable Energy Test Facility is part of its oil spill research program ensuring the best and safest oil spill detection, containment and removal technologies are available to protect the U.S. coastal and ocean environments. The facility is maintained by MAR (MD) LLC through a contract with BSEE. At Ohmsett, research and testing is conducted in a realistic setting to produce the most accurate and reliable results generally without scale modeling. Many of today's commercially available oil spill cleanup products have been tested at Ohmsett and a considerable amount of performance data and information on mechanical response equipment has been obtained here. In addition, the test tank can accommodate alternative energy devices, in particular wave energy conversion mechanical devices, in a controlled environment at meso-scale. The advantage is that arduous scaling considerations are minimized, and validation testing is more realistic. For government agencies, private industry, and oil spill response organizations from around the world, Ohmsett is the premier training site for their emergency response personnel. With this hands-on training using real oil, participants are able to increase proficiency using booms and skimmers, practice removing spilled oil in harbor

MetOcean Data Systems

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Email: kburton@metocean.com
www.metocean.com
CEO/President: Tony Chedrawy
Number of Employees: 54
Annual Sales: $15m
Sales Manager: Emily MacPherson

Established in 1985, MetOcean Data Systems has been a world leader in the ocean technology industry for over 30 years as a developer and manufacturer of data acquisition and telemetry systems. MetOcean, an ISO 9001 registered company, specializes in the production of air-deployed and ship-deployed drifting buoys, search and rescue buoys, oil spill tracking buoys, ice platforms and acoustic systems and defense and security systems.

The company's head office is located in Dartmouth, Nova Scotia, Canada. The proximity of its facility to the Atlantic Ocean is of prime importance to its operations. Both the Bedford Basin at the head of Halifax Harbor, and the nearby open ocean provide a test facility no lab or test tank can duplicate. MetOcean's facilities have recently expanded to occupy a facility of over 40,000 sq. ft. of space that is divided into offices, labs, prototyping facilities, electronics assembly/storage and mechanical assembly, with approximately 20,000 sq. ft. of space is strictly dedicated for use as manufacturing space.

MetOcean also owns the NOVATECH brand and NOVATECH beacons and flashers, products that have been proven throughout the world's oceans and trusted around the globe for over 40 years. The iBCN is the next-generation of MetOcean's NOVATECH satellite beacons, designed for tracking and locating your assets up to full ocean depth (12,000m). The self-contained submersible beacons use the bi-directional capabilities of the Iridium satellite telemetry system, allowing the end user to receive real-time GPS location of their asset and also change and send various reporting parameters to the beacon. The MetOcean Iridium iSLDMB is an innovative, rugged, and compact A-size Self Locating Datum Marker Buoy. The iSLDMB was designed and tested to meet the stringent performance requirements of coastguards for Search and Rescue (SAR) operations in the open ocean. MetOcean products are used to help save lives when unexpected accidents occur.

Voith Turbo

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Email: Javier.Suarez@voith.com
http://voith.com/en/markets-industries/industries/marine-technology-221.html
CEO/President: Dr. Hubert Lienhard
Number of Employees: 20,000
Annual Sales: $5B

Combining innovation and experience, Voith sets standards in advanced maritime solutions. Focused on technology that makes dynamic positioning more precise, safer and faster, Voith develops custom-made propulsion systems such as the Voith Schneider Propeller and Voith Inline Thrusters featuring RIM drive technology.

Voith Turbo specializes in the design, manufacture and servicing of high performance driveline equipment. From drive components to electronic drive systems, technology from Voith Turbo impacts a wide variety of markets and industries including oil and gas, energy, mining and mechanical engineering, ship technology, rail and commercial vehicles. Voith Turbo's advanced technologies are uniquely designed to transmit and control powers under extreme conditions maximizing safety and resources for customers around the world. Incorporated in the United States in 1976, Voith Turbo's expertise connects customers to power transmission solutions for a number of products – from complete units to spare parts and material – including: bus transmissions and light rail transmissions, axle drives, torque converters, universal joints, hydrostatic pumps, constant speed fluid couplings and variable speed fluid couplings, and Safeset torque limiting couplings. Voith Turbo is a member of the Voith group of companies, a nearly 150-year-old German business that is one of the largest family-owned companies in Europe. Voith is a global leader for innovative technologies across a variety of fields and the company's global manufacturing footprint, research and development efforts impact five essential market areas: energy, oil and gas, raw materials, transport and automotive.

Technology Profile

Vessels fitted with Voith Schneider Propeller (VSP) propulsion offer unparalleled dynamic position performance – a key function for subsea duties. The unique VSP generates stepless thrust in all directions with precision and speed. Propulsion and steering are combined in one unit, allowing unmatched accuracy for dynamic positioning. No other propulsion system can match such precise performance. VSP-equipped vessels also provide increased operational availability, run more days annually than other vessels with different propulsion, and improve dynamic positioning performance with the Voith Roll Stabilization System to increase comfort and safety onboard. With a power of 1.5 MW, Voith has built one of the world's largest RIM DRIVE transverse thrusters, equipping the largest number of vessels in the industry. The Inline Thruster creates a more efficient transmission of electric drive power, thanks to the absence of gears and shafts, and creates higher thrust efficiency compared to conventional thrusters. Vessels equipped with this technology operate with greatly reduced noise and vibration levels. The Voith Linear Jet is a new propulsor combining the best properties of conventional propellers with the best properties of conventional waterjets. This combination makes the low maintenance propulsor the ideal solution for ships with mixed operating profiles up to 40 knots. The Linear jet is a fully submerged, custom shaped deceleration/acceleration nozzle with a stator section aft of the rotor.

chop and wave conditions, and analyze skimming performance after collecting and measuring recovered oil.

Ohmsett's outdoor saltwater wave/tow tank measures 203 meters long by 20 meters wide by 2.4 meters deep and is filled with 10 million liters of crystal clear saltwater. A crow's nest is mounted on the main bridge 9.1 meters above the water, providing an excellent vantage point for mounting test equipment, such as sensors, to remotely detect oil spills, as well as for video documentation of a test. The facility is equipped with a computerized wave generator that is capable producing wave characteristics of 59 cm height (H1/3 at 7 meter wave length), 83 cm height (H1/3 Harbor Chop), and wave length up to 30 meters.

Ohmsett's testing capabilities include equipment tow bridges, a data collection system capable of recording up to 32 channels, programmable wave generator, fully equipped machine shop, on-site oil/water lab, oil distribution and recovery system, and a dispersant application system. The experienced staff assists clients with product evaluations, improvement recommendations, and acceptance testing of equipment. Testing specialties include test protocol development; containment booms; oil spill skimmer systems; remote sensing equipment; dispersant testing; behavior of dispersed, weathered and emulsifies oils; cold weather and broken ice conditions, sorbents; temporary storage devices; viscous oil pumping and oil/water separators.

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Novan Research

Concept: The Icebreaking Submarine

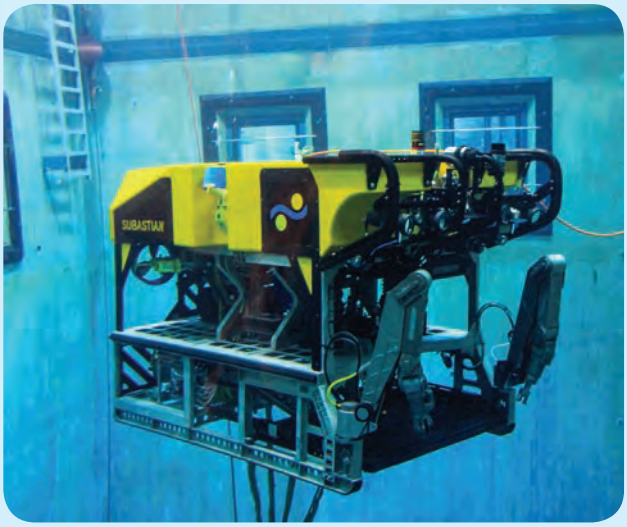
104 Ramona Avenue, Buffalo, NY 14220
Phone: 716-826-2177
Email: dlham@prodigy.net
Website: http://novan.info/research.htm
Inventor: Donald Louis Hamilton
Number of Employees: 2

Donald L. Hamilton, owner of Novan Research said that he has invented a new concept in icebreaking technology that uses a specially designed submarine to break through the ice fields. This new type of submarine is designed for icebreaking operations in the ice clogged polar regions and frozen lakes of the planet using the tremendous power of buoyancy to break the ice. The submarine's hull is specially designed for breaking ice and strong enough to withstand breaking through the polar sea ice as it moves forward or backward. "At the present time as far as I can determine there are no other ships like this in the world," Hamilton says. The submarine is not yet designed for very deep dives nor for carrying armament, so it should be relatively economical to build and operate, Hamilton said.

One of the advantages of using this unique technology is the submarine icebreaker's capability to travel swiftly to its destination when submerged under an ice cap in contrast to a surface icebreaker that has to slowly break a path through the ice pact to reach its destination. A surface icebreaker ship needs tremendous power and weight to move forward to break thick ice while the submarine icebreaker only needs to adjust its buoyancy and may need less powerful engines to break ice. Power options could include gas powered turbines, conventional diesel electric systems or nuclear power.

The submerged submarine icebreaker can rise to the surface breaking through the ice above by using its buoyancy power to rise. It can then be propelled using its propulsion power and buoyancy to break a path through the ice as it moves through the ice field. The submarine icebreaker is not designed for the military, but instead mainly to perform such duties as icebreaking, rescue operations, gathering intelligence, research, surveillance, and supplying bases at any time of the year.

Schmidt Ocean Institute



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CEO/President: Eric Schmidt
Number of Employees: 76
Vice President: Wendy Schmidt

Advanced operational, informational and technical support is essential to the success of ocean science. Schmidt Ocean Institute (SOI) was established as a 501(c)(3) private nonprofit operating foundation in 2009 to raise the standards of critical seagoing research infrastructure and provide more ocean access to scientists and engineers. SOI seeks to work with the best innovators to accelerate the pace of ocean science aboard its global research platform, R/V Falkor. SOI's research expeditions return unprecedented amounts of open-access data, which it openly shares with the public. SOI has completed more than 32 research cruises that have resulted in many discoveries including the third deepest hydrothermal vent, the world's deepest fish and several new underwater seamounts. In five years, R/V Falkor's advanced multibeam system has mapped over 400,000 km² of ocean floor, an area larger than most European countries. Research onboard Falkor has also focused on poorly understood areas such as the Mariana Trench Back-Arc. As a result of the cruises conducted, over 72 publications have been produced since 2013 and more than 3,000 individuals have been reached through virtual classroom connections as part of SOI's Ship-to-Shore Program. Engaging students from around the world has been an exciting part of Falkor's mission, providing opportunities to see what the practice of ocean science looks like from on board, in the classroom or online.

SOI showcases breakthrough ocean research made possible with advanced technologies, such as marine robotics, high performance computing, telepresence and broadband ship-shore connections. The abilities it has developed give SOI the chance to accelerate scientific understanding of ocean systems, and increase public awareness. This is demonstrated by the high definition video provided by SOI from ROV dives in remote areas. In March, scientists used new imaging equipment to reconstruct a hydrothermal vent site in 3D with virtual reality technology. The ROV dives that take place off of Falkor are made available in YouTube, adding to SOI's video collection that has received more than 11,000 viewers. SOI is working to revolutionize how visual data is stored and shared with the development of a new open-source data annotation program. Working with such advanced computing systems, there is a need for large storage. R/V Falkor can now house up to 1.1 petabytes of information with our high performance computing system.

Committed to continuous innovation of shipboard scientific systems, SOI this year has **completed its first underwater 4,500 m capable remotely operated vehicle (ROV), SuBastian.** The ROV's imaging system includes cience cameras, capable of both 4K video and 20 megapixel still images. The ROV SuBastian will be integrated with the ship and tested in waters off of Guam this summer. R/V Falkor is the only research vessel with a high performance computing system made freely available to scientists to run complex oceanographic numeric models to inform field observations and test hypothesis while research cruises are in progress. Thus far the computer has supported four separate cruises modeling 3D reef and vent systems. R/V Falkor's adaptable system has also allowed for scientist to create on-board laboratories. Earlier this year a science team implemented the first large-scale deployment of a new protein biomarker technology. The "targeted metaproteomics" approach will be used to diagnose marine microbial populations and their interaction with ocean chemistry. Additionally, R/V Falkor is used as a testing platform for engineering of new vehicles and robotics. Last year, SOI hosted its first coordinated robotics cruise with seven underwater vehicles deployed simultaneously.

SBG Systems

SBG provides MEMS-based inertial motion sensing solutions. The company provides a wide range of inertial systems from miniature to high accuracy. Combined with cutting-edge calibration techniques and advanced embedded algorithms, SBG Systems products are geared for aerospace, land, and especially marine – surface and subsea – projects such as vessel motion monitoring, ROV and AUV control, hydrography and buoy positioning.

SBG Systems delivers high performance and cost-effective MEMS-based Motion Reference Unit (MRU) and Inertial Navigation Systems (INS) to the Marine industry, representing approximately half of the company's turnover. Its products are mainly used in offshore, marine, and underwater applications, including hydrography, USV, AUV and ROV navigation and motion monitoring

SBG Systems designs, manufactures and calibrates all of its products. SBG Systems adds value to its inertial systems by designing specific data fusion algorithms and calibration techniques to enhance sensors' performance. The company's Apogee Series is the most accurate line of inertial navigation systems based on the robust and cost-effective MEMS technology. Apogee sensors are also the smallest and lightest at this level of accuracy. It provides a roll and pitch accurate to 0.008° in real-time and integrates the last generation MEMS sensors and tri-frequency GNSS receiver for centimeter-level position and GNSS-based heading, not sensitive to latitude. The INS also deliver a real-time heave accurate to 5 cm in real time and 2 cm with the delayed heave feature.

SBG Systems has developed advanced testing and calibration techniques for bias, gain, linearity, misalignments, cross-axis, gyro-g over. Every product is intensively tested, temperature calibrated, and shipped with its individual calibration report. The company owns a full calibration lab including shakers and rotary tables with environmental chambers.

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www.sbg-systems.com

OceanServer Technology

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Email: kirk@ocean-server.com
President: Bob Anderson
Marketing & Sales Manager: Jim Kirk
AUV Product Manager: Daryl Slocum

OceanServer Technology, Inc. is a manufacturer of man-portable Autonomous Underwater Vehicles (AUVs), with more than 250 AUVs deployed worldwide. The Iver3 AUV is an affordable, COTs vehicle used for general survey, subsurface security work, MCM applications and serves as a research platform for a variety of applications.

The Iver3 AUV is a rugged, simple to operate AUV system that incorporates open software architecture and a well-defined hardware interface that enable researchers and OEMs to quickly adapt the Iver for a variety of applications. The vehicle comes standard with OceanServer's VectorMap Mission Planning and Data Presentation tool and common payloads included High Resolution Side Scan Sonar (SSS), Doppler Velocity Log (DVL), Acoustic Doppler Current Profiler (ADCP), Conductivity, Temperature and Depth (CTD) sensor, Bathy Systems, Magnetometers and advanced navigation solutions. Users can choose from one of the Iver3 standard systems or the Expandable Payload (EP) model that includes a second CPU and intuitive API for remote helm command or sensor development.

Hydroid

(Photo: Eric Haun)

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Email: glester@hydroid.com
Website: http://www.hydroid.com
CEO/President: Duane Fotheringham
Number of Employees: 162
President: Duane Fotheringham
Marketing Director: Graham Lester
Engineering Director: Sandor Becz
Facility:
• 40,000-square-foot state-of-the-art facility – opened October 2014
• An additional 15,000 square foot building is currently being built. Opening is planned for end of 2016.
Square Footage: 40,000-square-feet

Hydroid, Inc. – a part of Kongsberg Maritime's autonomous underwater vehicles (AUV) group since its acquisition by Norwegian technology conglomerate Kongsberg Gruppen in 2008 – is a manufacturer of AUVs, including its signature REMUS vehicles. Hydroid founder Christopher von Alt's knowledge of the intricate technology has been integral to the products' development and widespread adoption. After years of fabricating and developing the REMUS vehicle at WHOI, in 2001 von Alt co-founded Hydroid, creating an independent company to commercially manufacture, support and further develop the REMUS systems. It now offers advanced, diversified and field-proven REMUS AUVs that provide innovative and reliable full-picture systems for the marine research, hydrographic, commercial offshore/energy and defense markets. The REMUS AUV is the culmination of 16 years of leading-edge R&D and boasts a proven track record for reliable and consistent field operations. Helping to facilitate and advance comprehensive ocean exploration, Hydroid's REMUS AUVs can glide along the surface, dive to deep depths, explore shallow waters or hover in hazardous areas where navigation is difficult. Hydroid AUVs have reduced the high costs of ocean exploration and sampling while increasing the availability, quality and quantity of scientific marine data. Using Hydroid AUVs for undersea mine reconnaissance has helped save lives by eliminating human divers from mine fields, and the customizable robots have helped solve plane and ship disaster mysteries. Hydroid AUVs also provide scientists data on pressing global issues including climate change, the world's declining fish population and environmental disasters. REMUS AUVs are offered in three vehicle classes: the man-portable REMUS 100 (depth rated to 100m); the highly versatile, modular REMUS 600 (depth rated to 600m or 1,500m); and the REMUS 6000 (depth rated to 6,000M), a deep-water workhorse. In March of 2016, Hydroid introduced the New Generation REMUS 100 AUV, which combines the reliability of the original REMUS 100 AUV that customers know and trust with 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.

All REMUS AUVs are built on a common technology base incorporating the intuitive vehicle interface program (VIP); this keeps vehicle maintenance, mission planning, checkout, data analysis and cross-vehicle training seamless across the model line. The vehicles can be equipped with many different instruments including a GPS-aided inertial navigation system; Doppler velocity log; varying sensors; conductivity and temperature monitors; varying sonars; video camera module; turbidity sensors; and an electronic still camera. In June 2016, Hydroid unveiled its new subsea Hyperbaric Testing System (HTS) at its manufacturing facility in Pocasset, Mass. The testing system simulates hydrostatic pressures found at depths up to 6,000m and will be used to test Hydroid's autonomous underwater vehicles (AUVs) and other marine robotics products to ensure their integrity at rated depth. The Hyperbaric Testing System is 10,000 psig Maximum Allowable Operating Pressure (MAOP), and features built-in safeties with secondary pressure containment, rapid turnaround time and full electrical and hydraulic interfaces to test the assemblies while at pressure.

Rockland Scientific Inc.

Rockland, which recently celebrated its 10th anniversary, designs and manufactures high-accuracy instrumentation for oceanographic research, focusing on sensors and methods for turbulence measurements. Ocean turbulence is a key area of interest because it influences climate, greenhouse gas deposition and pollutant dispersal. The tidal energy industry has also identified turbulence as a significant factor in the commercial and technical viability of tidal power generation infrastructure. In 2011, Rockland formed a strategic partnership with JFE Advantech, a major oceanographic instrumentation manufacturer in Japan, covering distribution and new sensor technologies. In 2013, Rockland formed a strategic partnership with Partrac, a marine data acquisition company specializing in oceanographic surveys. Partrac utilizes Rockland's technology and expertise to provide turbulence measurement solutions for the U.K. tidal energy industry. Such information is useful to the optimization of turbine design, site selection and turbine layout assessment. Rockland Scientific offers a wide range of turbulence measurement systems for operation in the upper ocean and down to 6,000 m. The product lineup falls into three categories: vertical profiling instruments; the MicroRider sensor package for deployments on AUVs, gliders, moorings, the Wirewalker and other autonomous platforms; and the MicroPod small-scale modular sensor packages for field measurements and the characterization of turbulent flow in laboratories. The vertical profilers come in a variety of sizes and depth ranges, each optimized for deployment in various environments; from lake, estuarine and coastal zones to deep ocean areas. The flagship profiler is the VMP-6000, a completely autonomous profiling robot that can can prove turbulence levels in the deep ocean down to depths of 6000 m. The MicroRider is routinely used on AUV platforms such as Hydroid's Remus AUVs and glider platforms such as the Teledyne Webb Slocum Glider. A recent application of the MicroRider is the integration with the Del Mar Oceanographic WireWalker platform, which makes it possible to autonomously observe marine turbulence evolution that

varies rapidly in depth and time. The MicroPod laboratory measurement system can either be deployed in the field or installed and manipulated in a laboratory tank or flume. The MicroPods have been integrated with the Kongsberg Seaglider, submarine vehicles, floats and mooring systems with the DataHub installed within the autonomous platform.

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McLane Research Labs

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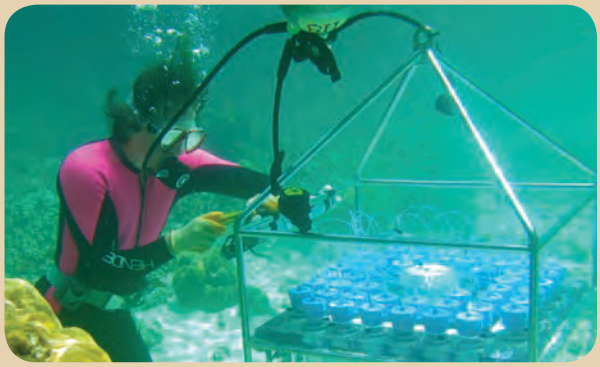
Email: mclane@mclanelabs.com
www.mclanelabs.com
CEO/President: Susumu Honjo (CEO)
Number of Employees: 16

McLane Research Laboratories is a leader in-situ time-series oceanographic profilers, samplers, and flotation. In addition, McLane's in-situ labs support emerging genomic and optical research methods for automated time-series oceanography and limnology.

Founded in 1983 to provide advanced time-series samplers and engineering design services to the international oceanographic community, McLane Research Laboratories, Inc. strives to help worldwide investigators to achieve their research and scientific goals by providing advanced, cost-effective instrumentation. Through its long-term research and development programs and long association with diverse researchers and projects, McLane has established a significant base of knowledge and proven technology in support of its objective.



McLane produces three main product lines: profilers, samplers and flotation – each of which is designed to withstand the rigors of open ocean and freshwater deployments. Within profilers, McLane offers the Ice Tethered Profiler (ITP) and the McLane Moored Profiler (MMP). Samplers include our Sediment Traps, as well as the RAS, ESP, IFCB, PPS, ZPS, and Large Volume Pumps. McLane also manufactures glass and steel flotation, as well as custom instrument housings.

Deep Ocean Engineering

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CEO: Li Fang
VP, Sales & Mktg.: Raul Enrique Pena
VP, Engineering: John Bergman
VP, Operations: Mike Takeda
No. of Employees: < 50

Located in Silicon Valley, CA, Deep Ocean Engineering, Inc. reflects the spirit of technological innovation and collaboration consistent with the region. Deep Ocean Engineering takes pride in its 35 year heritage as an early leader in the manufacture and engineering of underwater robotics, and is continuing its legacy with its commitment to continuously improve its solutions to better meet the unique needs of its end-user clients.

The focus of Deep Ocean Engineering is on responding to the unique, specific needs of its clients in various markets, and to build custom solutions that address those needs. Deep Ocean Engineering's in-house engineering team in Silicon Valley creates solutions that utilize their proprietary drone vehicles as a platform, and equips them with best in class components from a variety of manufacturers of third party software, video, sonar and manipulators.

Deep Ocean Engineering specializes in engineering and designing inspection class underwater and surface drones, including its full line of Phantom remotely operated vehicles (ROV) and unmanned surface vehicles (USV).

Recently, Deep Ocean Engineering introduced the Phantom T5 Defender, an ROV equipped with an Explosive Ordinance Disposal device that can disable an EOD by firing a shotgun blast of a high-powered water projectile at point-blank range, thereby eliminating the threat without risk of injury to divers.

SubConn

SubConn Inc., supported internationally by the MacArtney Underwater Technology Group, manufactures and delivers industry standard, reliable and affordable connectors and cables worldwide, supplying its leading range of underwater pluggable electrical connectors to the underwater industry for over 30 years. A provider of universal wet mate connectivity solutions for underwater technology applications, SubConn offers a product range that has been developed over the years to meet demands for shallow water use to full ocean depth rating. The company's range of connectors is continually being tested and reviewed to ensure the highest quality and suitability to the underwater and offshore markets, and is regularly extended to meet new individual or industry requirements.

(Image: MacArtney)

bca@macartney.com

Seco Seals, Inc.

Jim Scott, who was instrumental in the development of the conical seal in the 1950s, founded Seco Seals, Inc. in 1969 to fill the need for conical seals for 37 degree flared tube fittings. Since then, the company has become the standard for 37 degree flared tube fitting seals for every application, from aerospace and race cars to petroleum, and continues to grow and bring innovative new solutions to fluid connections.

Now a world leader in specialty manufacturing of high pressure tube fitting gaskets, including its industry standard SECO7 product line, Seco Seals is an ISO 9001:2008 and AS9100C certified gasket manufacturer who aims to put an end to leaks in most environments – from subsea to aerospace.

In its effort to remain on the leading edge, Seco Seals has expanded its capabilities for "build to print" sealing solutions for extreme pressure and temperature applications made of the highest quality metal foils.

Email: sales@secoseals.com
www.secoseals.com

Shark Marine

Canada-based Shark Marine Technologies Inc. develops and delivers innovative technologies for commercial diving, scientific research, survey firms, film production companies, search and recovery organizations and some of the most elite military and law enforcement agencies around the world, and has recently secured a pair of naval references.

The company supplies video systems, ROVs and accessories, diver held systems, diver delivery systems, software, sonar systems, magnometers, tether management solutions, connectors as well as other custom products. Shark Marine's MAKO diver delivery system was recently chosen by the Royal Navy. The recent acquisition of the system fully equipped with a Shark Marine Navigator diver-held sonar and navigation system, provides the user with the ability to conduct underwater investigations, reconnaissance and object identification. The system allows the operator to select the tools needed for the task at hand. Multi-beam sonar capabilities for safer operation in poor visibility; navigation capabilities for mapping and tracking the divers progress; video recording capabilities for inspection and identification purposes as well as autonomous operation capable of completing activities with or without a diver. Hot swappable, neutrally buoyant batteries allow the MAKO continuous operation.

The Danish Navy selected Shark's Navigator diver-held sonar and navigation system. Divers will be able to cover expansive MCM area searches as well as shallow water security operations.

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www.sharkmarine.com

Forum

Forum Energy Technologies, Inc., an oilfield products company serving the subsea, drilling, completion, production and infrastructure sectors of the oil and natural gas industry, has expanded its specialist syntactic foam manufacturing capabilities with the opening of a new plant in Bryan, Texas near Houston.

The new six-acre facility brings Forum's Syntech product line closer to clients in the oil and gas industry and has the capacity to support future growth. Syntech will share the property with another of Forum's brands, Dynacon, to create a production hub with an enhanced engineering capability and streamlined process.

Forum Syntech is one of world's largest original equipment manufacturers in the niche ROV market for syntactic foam. The product is used to provide buoyancy modules for use in ROVs and other submersible equipment. The new plant not only allows the expansion of Forum's ROV flotation manufacturing capabilities, but also includes the expansion into manufacturing larger installation buoyancy modules, rigging buoyancy and custom/project specific flotation modules.

Forum Energy Technologies' products include highly engineered capital equipment as well as products that are consumed in the drilling, well construction, production and transportation of oil and natural gas. Forum is headquartered in Houston, with manufacturing and distribution facilities around the globe.

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VideoRay's Mission Specialist Series.

(Photo: Eric Haun)

VideoRay

Established in 1999, VideoRay introduced its first ROV in 2000 and has since gone on to become one of the world's largest volume producers of underwater ROVs, with more than 3,500 units delivered to a diverse range of organizations for a wide assortment of missions. Today hundreds of VideoRays are in use daily throughout the world to help prevent terrorism, find and retrieve objects, inspect infrastructure both inland and offshore and keep divers safe from hazardous conditions, among a number of other missions.

Since the first VideoRay systems were delivered, users have tried VideoRays in increasingly challenging situations and environments, and owners have learned to trust them to perform in a growing number of industries. Known for its compact and versatile vehicles, VideoRay is a leader in observation ROV technology, delivering portable, affordable, flexible and reliable solutions for underwater operations, such as surveys, offshore inspections, search and recovery, homeland and port security, science and research, fish farming and other unique applications.

The company has worked with technology and mission partners throughout the world to develop and prove the small ROV tool for a wide range of applications, and underwater accessory manufacturers now develop sensors around the size and payload capacity of VideoRays, meaning users can choose from a large array of sonars, positioning systems, metal thickness gauges, cathodic protection, water quality and radiation measuring devices, and many other underwater tools and sensors. The ROVs' plug-and-play technology allows users to quickly attach sensors and accessories in the field.

VideoRay's new Mission Specialist Series features modular components to enable optimized vehicle configurations for specific applications. Customization and flexibility are key, with each system fitted to the sensors, tools, depth rating and thrust needed for the job at hand, rather than retrofit accessories to a standard ROV. Available modules include cameras with a wide range of resolutions, LED lighting, powerful thrusters capable of up to one horsepower operation, power systems ranging from 75 to 1,600 Volts as well as an on-board battery option, different manipulators, positioning and sensors for radiation, water quality, and more.

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www.nortek.no
CEO/President: Atle Lohrmann
Number of Employees: 100

Nortek designs, develops and manufactures scientific oceanographic instruments that are used to measure the movement of water in its different forms. For 20 years, the company has produced acoustic Doppler instrumentation, employing innovative processes in its product development and production. Its Doppler Velocity Logs (DVL), used for subsea navigation, and Acoustic Doppler Current Profilers (ADCP), used to understand physical processes in the ocean such as waves and currents, are utilized by scientists, researchers and engineers at institutions worldwide.

A product of thousands of engineering man-hours, the AD2CP is Nortek's broadband Doppler signal processing platform (US Patent 7,911,880) and includes a series of innovative elements, which will open doors to new applications and inspire exciting research possibilities. AD2CP broadband combines frequency-modulated transmissions with fast sampling rates and adjustable bandwidth. The result is unparalleled performance in both standard and specialized applications. AD2CP hardware can alternate between multiple measurement modes. One instrument replaces several by offering concurrent or alternating measurements of currents, turbulence, waves and ice. AD2CP recorders will store all raw Doppler and sensor data. Improve data quality by removing contamination from fish or other influences.

OSIL

Data buoys and monitoring systems manufacturer Ocean Scientific International Ltd. (OSIL) provides integrated systems for environmental monitoring in all marine applications, including MetOcean, Dredge, Coastal and Environmental Monitoring. The U.K.-based oceanographic systems company's fully instrumented data buoys and monitoring platforms are tailored to customer requirements and operational needs, and may feature a range of instruments including Multiparameter Sondes, Current Meters/Profilers, CTDs, SVs and Meteorological sensors. OSIL offers a wide variety of sediment coring equipment, from off-the-shelf grabs and box (spade) corers, to bespoke coring systems such as the Gravity Corer, Piston Corer (available in lengths from 3m to 42m), Vibrocorer for dense or compacted sediments or the industry standard Multiple Corer for undisturbed sediment sampling. OSIL are the world leading experts in the field of salinity measurement, operating the IAPSO standard Seawater Service using the world standard in salinometers, as well as offering a range of other calibration

and nutrient standards. OSIL also has an in-house Marine Instrument Service and Calibration Centre which offers calibration, servicing, repair and technical support for many of the laboratory and in-situ marine instruments that it supplies.

www.osil.co.uk
osil@osil.co.uk

Rowe Technologies Inc.

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Email: rmahrjr@gmail.com
http://rowetechinc.com
CEO/President: Dan Rowe
Number of Employees: 20
Annual Sales: $5m
Vice President: Steve Rowe
Marketing Director: Ray Mahr
Sales Manager: Ron Hippe
Engineering Director: Dr. Sai Sarangapani

Rowe Technologies Inc. designs and manufacturers ADCPs and DVLs used for measuring currents, directional waves and underwater navigation for shallow coastal environments to full ocean depths. RoweTech provides dual frequency ADCP/DVL and high resolution velocity measurements (0.01 cm/s). RoweTechs' core team is centered on advanced electronic engineering and signal processing development, as well as acoustic transducer design and development of traditional and multi-frequency piston products and planar arrays.

RoweTechs' modern electronics platform for ADCPs and DVLs allows for a compact form factor, as well as the flexibility of up to 16 signal processing channels, and a high resolution velocity measurement. RoweTechs' dual frequency instruments (offered in Piston and Planar Arrays) provide the industry's only high-resolution near field and long-range low-resolution current velocity measurements on the market.

A vertical beam can be added to both a single set of Janus-configured beams [SeaWAVE ADPC] or to two sets of Janus-configured beams [SeaSEVEN ADCP]. With RoweTechs' experience of advanced electronics platform facilitates the development for new and novel applications in underwater acoustic data collection, accurate positioning and surveillance.

Fran Rowe, a pioneer in the development of ADCP, is a technical advisor to the company, whose electronics design is combined with advanced acoustic transducer technology to provide ADCPs that are powerful, compact and extremely flexible. These core technologies, combined with multiple frequency and packaging options, provide a cost effective and capable platform to handle a variety of acoustic Doppler applications. The SeaWATCH ADCP product lines are self-contained (SC) units that operate on battery power and are meant to be deployed for extended durations, while the SeaPROFILER ADCPs are direct-reading (DR) units used for real-time, tethered applications.

The SeaTRAK vessel-mount family of products consists of a low-frequency Doppler Array (150 kHz, 75 Hz, or 38 kHz) with integrated sonar electronics, interface cable, and a rack-mount power interface unit. The SeaPILOT family of Doppler Velocity Logs (DVLs) uses the same core electronics and transducer technologies as described above, to provide a versatile platform capable of producing precise bottom-referenced velocity measurements for ROVs, AUVs and other manned/unmanned submersibles.

The company also offers OEM packages for custom AUVs and ROV applications.

N-Sea

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Phone: +31 (0)111 456000
Email: info@n-sea.com
www.n-sea.com/
CEO/President: Gerard Keser
Number of Employees: 125
Vice President: Roddy James, COO
Marketing Director: Rienk de Vries, CCO
GM: Patrick Feeleus (Offshore)
Engineering Director: Edwin Smits

With more than 50 years' subsea-specific experience, N-Sea offers a wide range of assurance and maintenance services to the oil and gas, renewable and civil contracting communities. With bases in the Netherlands, U.K., India, Africa and the Middle East, integrated subsea infrastructure services provider N-Sea serves all major North Sea operators and service companies, supporting customers through survey, inspection and assessment of their assets. N-Sea also installs, inspects, repairs and maintains infrastructures throughout the entire lifecycle, in addition to near shore, offshore and survey services.

The company's personnel and fleet deliver a range of subsea activities and subsea interventions including: air diving services and the innovative TUP Diving System (Transfer Under Pressure); construction and positioning support; excavation services; inspections by diver/ ROV; pipeline and cable inspections using WROV; geophysical survey and geotechnical investigations; UXO management. N-Sea is particularly known for its safety innovations within the diving sector. The TUP Diving System (Transfer Under Pressure) is a modular system consisting of a three-man closed diving bell, launch and recovery system, triple-lock decompression chamber, gas diver control (air/mixed) and hyperbaric rescue craft. N-Sea also deploys a modern fleet of ROVs/ROTVs and vessels for survey, diving and construction purposes. The DPII DSV and Survey/ROV support vessel the Noordhoek Pathfinder accommodates 40 people and is equipped with a 25 metric ton offshore crane, single and multibeam echosounder. This survey spread can be supplemented by ROTV mounted sidescan sonar and/or multibeam echosounder, geotechnical equipment and\or ROVs as required. The DPII DSV Siem Stork is a dive, multi-support and construction vessel equipped with azimuth thrusters for economic operations. The vessel is fitted with complete air and nitrox diving spread and diving daughter craft.

The ship, with its diesel electric propulsion system and optimized hull lines, is designed for low fuel consumption and excellent seakeeping. N-Sea utilizes a fleet of specialist diving and intervention craft ideally suited for shallow and restricted area access around offshore vessels, platforms and mobile offshore drilling units where many vessels have limited access for maintenance and surveys.

N-Sea is an acive member of the IMCA and is certified according to Lloyds Register for the ISO 9001, 14001, OHSAS18001. N-Sea invests significantly in in-house technology, equipment and fleet to deliver flexible subsea solutions, combined with cutting edge health and safety innovation, for the most technically challenging work scopes.

Remote Ocean Systems

For more than 40 years Remote Ocean Systems (ROS) has been an industry leader in the development and manufacture of camera, lighting and positioning systems for extreme oceanographic, industrial, commercial and military applications and environments.

ROS' staff includes experts in video engineering, mechanical design, reliability engineering, EMI resistivity and radiation resistance design, and its product line includes underwater video cameras, lights, rugged pan and tilt positioning systems, video inspection systems and control systems manufactured primarily for the oceanographic, nuclear and defense industries. The firm's custom product development partnerships with leading ROV manufacturers foster new product designs in deep water camera technology and new LED lighting ideas and provide a positive challenge to its engineering and manufacturing capabilities. Today's ROS product line reflects the latest technology and operational reliability our customers demand and need – whether it's the latest LED lighting design or an ultra low-light camera for deep water inspections.

Email: sales@rosys.com
www.rosys.com

Outland Technology

From its inception in Gretna, La. in 1984, Outland Technology Inc. has strove to design and manufacture a broad range of high quality video and audio products using high volume components adapted for specific applications. Today Outland's product line is expanding, and its worldwide presence continues to grow. The company provides high quality complete dive systems worldwide for primary customers in marine, military and industrial markets, and it continues to innovate and expand its product line, which has resulted in expanding facilities and staff. Outland moved into its 6,000 sq. ft. building in Slidell, Louisiana in 1196, and has since expanded that building to 9,000 sq. ft., and now again this year to 12,000 sq. ft. Outland has spent a considerable amount of R&D monies for new product development.

Email: jeff@outlandtech.com
www.outlandtech.com

RJE International

RJE International manufactures sonar beacons, diver navigation, diver sonar and underwater relocation products. RJE is a leader in acoustic marking and re-location systems, diver navigation, sonar underwater communications and small boat navigation for the military and divers worldwide. The company carries a broad range of products and also has the design and engineering capabilities to develop custom solutions..

RJE International sources and manufactures locally in the U.S. for customers in more than 45 countries worldwide with a focus on underwater relocation/tracking and diver navigation and sonar systems. RJE specializes in underwater sonar and navigation technology and is growing its engineering and R&D capability to expand and improve its product offering. The firm is currently working on several research projects which will enlarge its IP and growth potential.

Email: Sales@RJEInt.com
www.RJEInt.com

Open Ocean

Open Ocean has conceived and developed Metocean Analytics, the first online offer for metocean studies on-demand. Metocean Analytics allows to obtain in just a few minutes all the necessary metocean data and statistics to characterize the offshore site, design their infrastructure and plan their long term operations.

Open Ocean is an innovative startup company based in Brest and Paris, France, which conceives since 2011, online decision-making solutions for industrial marine activities. Its team of oceanographers, trained in the best research oceanographic institutes of the world (UPMC, IFREMER, University of Washington) specialize in high resolution modeling, statistical analysis and big data mining. After having acquired several key references in the wave and tidal as well as offshore wind sectors, Open Ocean has approached the oil and gas sector to present the innovative solution Metocean Analytics.

Metocean Analytics is the first online offer for metocean study on-demand. It provides on-demand access to metocean data, statistics and reports through essential analytics and display tools. It can give quickly a complete site characterization for an informed decision making during the planning and operational phases of offshore projects. For each project, users can instantly pick their offshore points of interest around the world, obtain the exact statistics they need and generate reports with various content depending on the intended readers.

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Point Richmond, CA 94801
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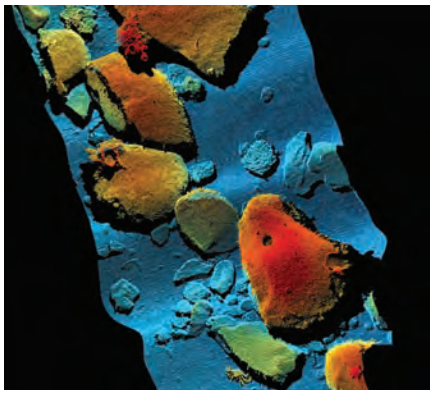
Email: karen@deepflight.com
/www.deepflight.com
CEO/President: Adam Wright
Number of Employees: 8
Vice President: Robert Chamberlain
Sales Manager: Robert Chamberlain
Engineering Director: Adam Wright

DeepFlight has innovated a new class of personal submarines that apply the dynamics of flight underwater and incorporate advanced composite materials, significantly reducing the weight of its vehicles and removing the barriers to safe and easy operation of personal submarines.

DeepFlight is a privately held company that was founded to develop innovative technologies to expand human access into the oceans. The company has made significant technological breakthroughs, including creating a new class of personal submarines that apply the principles of flight underwater. In 2012, the company transitioned from a R&D organization to focus on commercializing its series of personal submarines for the adventure tourism, superyacht and recreation industries. The company has introduced six generations of the DeepFlight submarines. Its newest models are Super Falcon and DeepFlight Dragon. Super Falcon uses a patented inverted wing design to dive, and Dragon uses a patent-pending quad copter design. DeepFlight submarines have been used for science and exploration, and the company is now preparing to offer DeepFlight dive experiences to resort guests at various locations around the world.

DeepFlight has completely redesigned the concept of a personal submarine through its innovative use of composite materials, and by applying the principles and dynamics of flight underwater. The use of composites has allowed the company to build submarines that are lighter weight than all conventional submarines, enabling easy beach and shore launches. The flight characteristics ensure that DeepFlight submarines offer greater speed, longer range and unprecedented maneuverability. Additionally, all DeepFlight craft are permanently positively buoyant, offering the unique safety advantage of automatic return to surface. Whereas, all conventional submarines operate using a variable ballast system, DeepFlight submarines use the principles and dynamics of flight. In 2016, DeepFlight entered into a working relationship with Lloyd's Register (LR) to certify DeepFlight personal submarines in accordance with LR's Rules for the Construction and Classification of Submersibles and Diving Systems. DeepFlight submarines will be the first composite-hulled personal submarines to undergo certification.

2G Robotics



Designer and manufacturer of underwater laser scanning and imaging equipment for 3D modeling and measurements, 2G Robotics, founded in 2007, has established a global presence in the subsea industry. The company's laser scanners – which can be diver deployed or integrated with ROVs or AUVs for dynamic scanning – generate true-scale submillimeter resolution 3D models of subsea structures and environments in real-time, and have been used on all seven continents at extreme depths for a range of underwater inspections, including the high-profile Costa Concordia salvage operation and HMS Erebus exploration. The high point density of the data effectively resolves fine-scale dimensional features that traditional methods fail to capture, allowing for detailed and efficient inspections of complex underwater structures and environments.

Email: info@2grobotics.com
www.2grobotics.com

Aquabotix Technology

Aquabotix Technology Corporation, developer of smart technology for ROVs, has helped to create a new breed of ROVs: the ROV/AUV hybrid. Its HydroView and newly launched Endura ROVs are remotely controlled via a tether with the added functionality of autopilot commands.

Endura, which employs the latest software and hardware innovations, has been engineered for dependability and functionality across a wide range of underwater applications. It outperforms other mini ROVs in thrust, dependability and software performance. Endura is easy to use, ready for the water in three minutes, and basic driver competency is developed in about three hours with professional proficiency achieved in three days. Endura is intelligent – a full computer is built inside the vehicle and auto controls are available in the software. Endura is high performance – with hydrodynamic design for ultimate control in the water and powered by high torque motors for up to 5 knots of thrust.

Aquabotix' iPad and laptop applications are intuitive driving systems for underwater ROVs.

Email: durval@aquabotix.com
www.aquabotix.com

Cellula Robotics

Cellula Robotics is an engineering solutions company specializing in turnkey design and production of seafloor intervention and subsea robotic systems. Its products are primarily used for geotechnical and geophysical applications. Through its team of engineers, designers and technicians based in Vancouver, Canada, Cellula has developed experience in projects that require integrated mechanical, electrical, hydraulic, and software elements in a subsea environment. Cellula has been involved in projects deployed offshore from the U.K to Japan, Papua New Guinea to the Gulf of Mexico. Cellula supports these international projects with offshore personnel, on-call staff and a network of agents.

Cellula Robotics has grown from designing subsystems for client-built vehicles to supplying complete turnkey subsea robotic solutions with an emphasis on autonomous operation. In the last three years Cellula has built several highly automated seafloor drills. Its latest, the CRD100, is state of the art, self-contained, remotely operated geotechnical analysis tools that can drill, case, core and provide real time CPT data up to 150m below the seabed in water depths of 3,000m.

In addition, Cellula has recently supplied a subsea excavator, deep water, high capacity plankton sampler and several well intervention valve packs. Cellula offers a range of subsea components including pressure tolerant electronics, smart valve packs, water and ground fault detection.

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www.cellula.com

Deep Trekker Inc.

Deep Trekker produces portable ROVs and pipe crawlers for the subsea inspection landscape, from its flagship product, the DTG2 ROV, to the new DTX2 ROV and DT340 pipe crawler. Deep Trekker ROVs feature a patented pitching system to aid maneuverability. The ROV's outer shell rotates, granting the main thrusters to rotate a complete 180 degrees, allowing the ROV to drive straight up and down, side to side, forward and backwards using the same thrusters. All ROVs are built with anodized cast aluminum to withstand harsh ocean environments and impacts. The internal camera can rotate from within the ROV for a full 320 degree field of view. The super-bright viewing screen is integrated within the handheld controller to view live what the ROV sees. The DTG2 model can reach depths of 150m and operate in currents of up to 2.5 knots, while the DTX2 is larger with 4 vectored thrusters for improved lateral movement and can reach depths of 305m and operate in currents of up to 3.5 knots.

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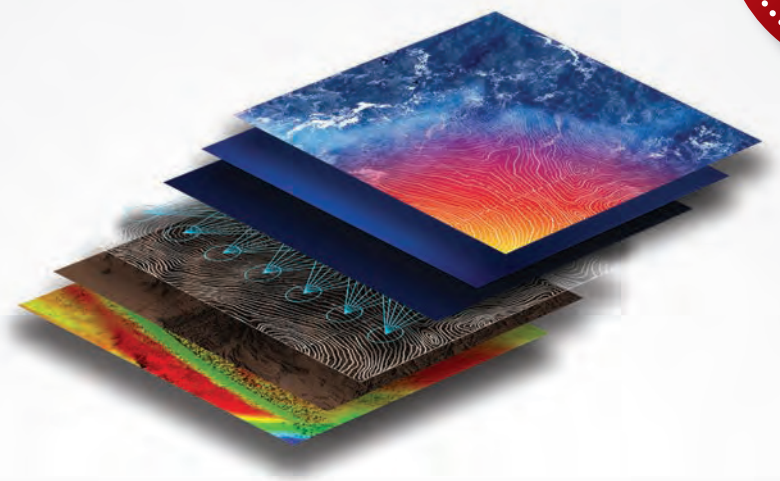

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