MARINE TECHNOLOGY REPORTER

July/August 2015 www.marinetechnologynews.com

10th Annual MTR 100

VideoRay

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Your success drives everything we do. That's why we've engineered every aspect of our ROV systems with you in mind. VideoRay offers affordable, reliable, and robust ROV systems that get the job done right the first time. There's a reason why more customers have chosen VideoRay inspection class ROVs than any other ROV solution on the market. From our unparalleled customer service to our innovative training programs, VideoRay gives you confidence underwater.

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Newfoundland Labrador
CANADA

July/August 2015

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Volume 58 • Number 6

MTR 100

WORLD LEADERS IN MARINE INSTRUMENTATION

Individually we are world leaders, **together** we are world class.

Today, the faster a company can develop new technology and deliver new products to the market, the better. By combining our sales teams, Teledyne TSS and Teledyne CDL aim to do just that.

Teledyne TSS has more than a century of experience in marine navigation and survey. Teledyne CDL has earned a reputation for innovative subsea instrumentations and systems – now two world leading companies share sales experience and knowledge to offer world class product ranges that meet all the needs of our customers.

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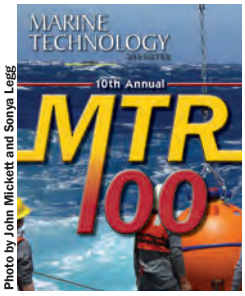

Photo by John Mickett and Sonya Legg

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The compilation and presentation of the MTR100 is easily my favorite – and least favorite – editorial task of any given year. It is my favorite because it affords me the opportunity to sit back and gain a thorough read on some of the happenings within the halls of some of the true industry innovators serving this field; to catch up on the works of some familiar faces, and discover the works of some relatively unknowns. While the editorial staff of *MTR* is quite mobile, it is impossible to be everywhere all of the time, so this is a great opportunity to invite you into the fold.

It is my least favorite mainly because with each passing year – and this is the 10th Annual Edition of MTR100 – the selection process becomes that much more difficult. As you peruse the pages (and before you pick up the phone to question the functionality of my grey matter), remember that the first caveat this and every year is that "you must apply to be considered." Applications for the "100" were up 20% this year over last year's record, so I know that this message and the considerable amount of promotion we generate to support it is getting through.

This edition unlike any other sparks conversation, debate and emails to and fro, and I certainly welcome your comments on this year's collection of companies and technologies. As an editor, objectivity in coverage is a core principle essential to our operation, and I never play favorites. But I'm human, too, and if you want to see one of my favorites turn to page 55 and read up on the works of Blue Robotics, Inc. In serving this industry for a decade, I am struck more than any other industry I've seen by the entrepreneurial and engineering spirit, the fostering of young talent in a meaningful way. I certainly don't know the Blue Robotics team personally, but we found their application for the MTR100 and their early business success as a true embodiment of the spirit of innovation in the subsea sector.

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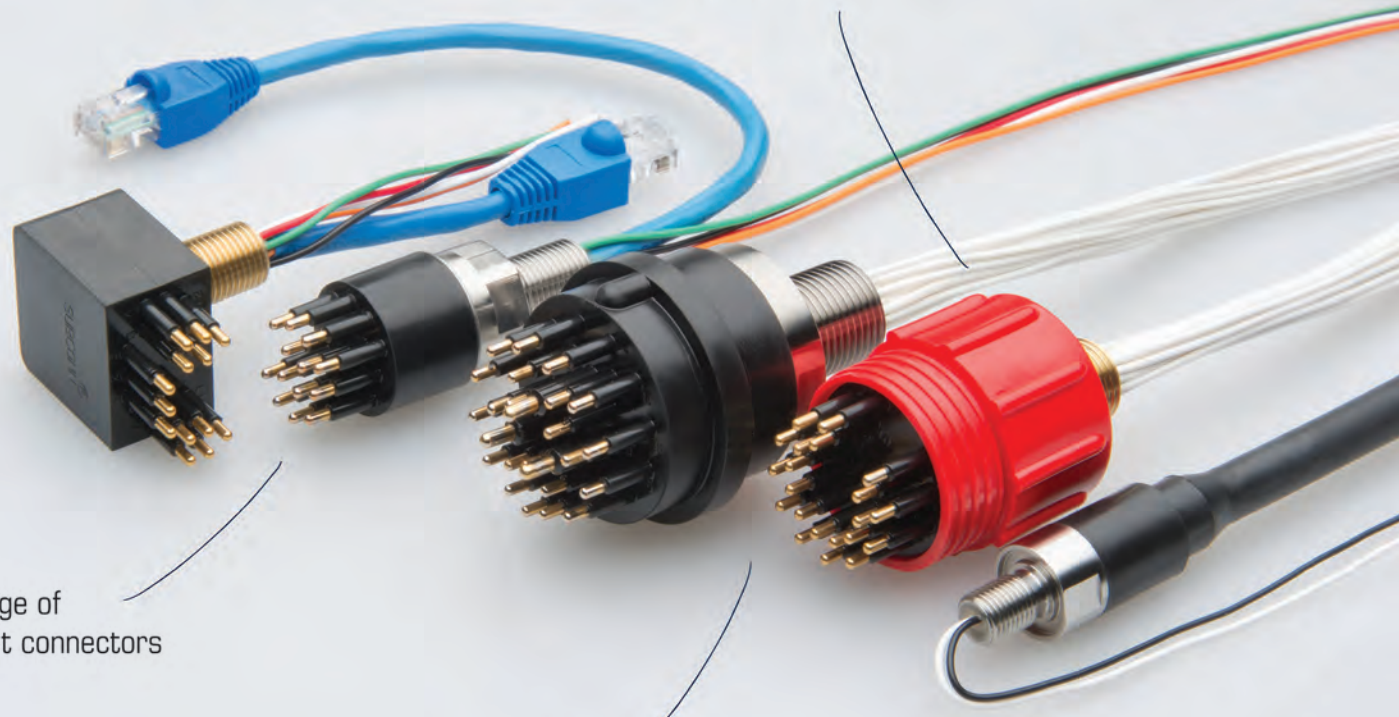

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Drydocks World

World's Largest Turret

Drydocks World completed the world's largest turret mooring system. At almost 100m high, weighing over 11,000 tons and with a diameter of 26 m, the turret is for the Prelude floating liquefied natural gas (FLNG) facility.

Drydocks World has built the world's largest turret for SBM Offshore, Technip and Shell. Drydocks World has delivered five modules for the Shell FLNG turret mooring system and delivery of module five represents the completion of the crown jewel of this project, with the turret being the heart of the Prelude FLNG.

Jebsen & Jessen Offshore Pte Ltd.

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CEO/President: Aw Chin Leng
No. of Employees: 500

Jebsen & Jessen Offshore is part of the Jebsen & Jessen SEA Group that the parent company has close to a 120 years history with more than 6,500 employees worldwide.

Jebsen & Jessen Offshore provides a toolbox of solutions to support customer's marine and offshore needs. Its 400 strong workforce includes in-house engineering, project management teams and a dedicated service and response unit. The company is one of the largest manufacturers of offshore winches, cranes, A-frames, and complex deck machinery systems in Asia.

In Singapore, the company has three

facilities situated by 11 Tuas Crescent. This Tuas facility carries out the final assembly and FAT of AHC Cranes/ Winches; Offshore Cranes; LARS and other offshore equipment that has testing for crane of up to 6,000MT and winches to 600 Ton SWL respectively.

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- Work shop crane with lifting capacity such as 2 x 100-ton overhead cranes at open yard and 3x30-ton overhead cranes in sheltered work shop;
- Enclosed specialized hydraulic workshop (Hose Clamping,Pipe Bending, Flushing);
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UTEC Survey Inc.

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CEO/President: Martin O'Carroll
No. of Employees: 457

Since the company was founded in 2006, UTEC has achieved sustained, remarkable growth.

Ambitious global growth and revenues continue on a positive, upward trend. UTEC, an Acteon company, provides a wide range of services including offshore positioning and construction support, metocean, geophysical and AUV surveys, geotechnical sampling and consulting services to the oil, gas and energy industries.

With a focus on people, performance, excellence and ethics the company also offers dimensional control surveys, laser scanning and 3D modeling.

UTEC has offices located around the world including Australia, Brazil, Canada, Singapore, Indonesia, UAE, UK and USA.

UTEC has a global reputation for supplying technology in a streamlined, cost-effective and time-efficient way with people and safety always at the top of the agenda.

Key arenas include construction support services where UTEC is a market leader in the provision of

capabilities such as AUV, ROV positioning, rig moves, rig positioning, heavy lift projects, trenching support, salvage and decommissioning to name but a few.

UTEC remains at the forefront of industry technology and this is underlined by a growing global client base.

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VideoRay

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CTO:	Marcus Kolb
VP, Sales & Mktg.:	Chris Gibson
VP, Product Mgmt & Documentation:	Tom Glebas
No. Of Employees:	**45**
Square Footage:	40,000

Testing Capabilities
Testing capabilities have always been an integral part of VideoRay's facilities. Its headquarters in Pottstown, Pennsylvania includes a 5,000 gallon test tank and a pressure chamber. Every VideoRay ROV system and accessory undergoes a thorough inspection and in-water testing by one of our Quality Control managers before it is shipped. VideoRay's Research & Development facility also contains several additional testing capabilities, including an outdoor pond.

The Case

VideoRay ROVs incorporate the latest underwater technology, and VideoRay continues to be the choice for the most challenging underwater operations, including the Costa Concordia salvage project and an 18-month deployment in the North Sea.

The Company

VideoRay is a leader in observation class Remotely Operated Vehicles (ROVs) and the largest volume producer of ROVs in the world. With more than 3,500 units delivered to a wide range of organizations for a wide range of missions, hundreds of VideoRays work every day throughout the world underwater for port security, finding and retrieving objects, inspecting infrastructure both inland and offshore, and keeping divers safe from hazardous conditions.

Since the first systems were delivered in 1999, users have tried VideoRays in increasingly challenging situations and environments. Today, VideoRays can be found on every continent, and owners in a growing number of industries have learned to trust them for a variety of underwater inspection, location, and recovery applications where reliability is a necessity. There are many reasons for VideoRay's consistent success in a market that we essentially created – we pride ourselves on providing highly portable, rugged and reliable ROVs capable of accomplishing assigned tasks in a wide variety of operating conditions and mission objectives. Our systems are designed for professionals demanding easy to use, portable, versatile, and cost effective technology that can make them successful.

The Tech

The VideoRay Pro 4 incorporates the latest ROV design and technology, making it an advanced, capable, and versatile small ROV. Driven by a sleek, intuitive, and powerful software platform called VideoRay Cockpit, the Pro 4's technology and advanced internal features make it a sector leader.

The Pro 4's size, power, and minimal mass allow it to conduct missions that no other vehicle could perform in conditions that no other vehicle would attempt. Thanks to its compact size, comparatively low weight and ultra-low power requirements, the Pro 4 offers unparalleled remote deployment capability. Equipment set-up takes minutes, but missions can last as long as the operator is willing. The VideoRay Pro 4 allows the customer to select accessories that work best for each specific operation. With the Pro 4 hardware in position, operators can easily incorporate a variety of tools, software, and sensors developed specifically around the Pro 4's size and capability. Options include vehicle autonomous control, manipulator arm for retrieving objects and cutting lines, and sonar imagery and positioning systems for navigation, target marking, and target acquisition and reacquisition. VideoRay's ROV systems and accessories are all "plug and play," meaning capabilities can be added or removed with either a simple software update or a quick hardware add-on in the field.

FULL SPEED AHEAD

Caterpillar marine diesel engines deliver impressive performance throughout a wide speed range with exceptional power density. That means they're as smooth and efficient when you're pulling into dock at an idle as they are when you're heading up the river or out to sea at full throttle.

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Fischer Connectors

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W: http://www.fischerconnectors.com
CEO/President: Dominique Glauser
No. of Employees: 400

For more than 60 years, Fischer Connectors has been innovating to help device manufacturers attain rigorous quality objectives with high performance push-pull connectors and cable assemblies that work effectively under pressure in harsh environments.

Fischer Connectors' marine product lines – like the Fischer Core Series and UltiMate ranges – have been designed and tested to withstand extreme conditions. They have waterproof sealing to IP68/IP69 mated and unmated. Their three independent sealing barriers minimize permeation and ensure long-term reliability over a wide temperature range. Their ability to withstand high shocks and vibrations, and resist corrosion, has been demonstrated on MOD70 racing yachts, and SUBSEA TECH's Mini-ROV Observer 3.2 – a robot for deep sea inspection.

Miniaturization is the key to packing more functionality into smaller devices. The Fischer MiniMax Series, a high-density miniature signal and power solution, is ideal for capturing high-resolution images, sound or video while braving wind, rain and shocks. It is available in 19 and 24 pin configurations, with a choice of push-pull, screw lock and quick release locking systems. The Fischer FiberOptic Series provides robust optical performance, making it ideal for large data transfer in harsh environments. These connectors are especially easy to operate, clean and maintain.

Turner Designs

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CEO/President: James Crawford
No. of Employees: 30

NEW: FluoroSense, a small, handheld device which enables quick field s ampling in the water stream.

Turner Designs provides optical-based solutions for environmental research and monitoring, water quality analysis, and pollution control analysis. Having a unique focus on fluorescence instrumentation for more than 40 years and customers throughout the world, Turner Designs is a leader in filter fluorometer design, manufacture and support.

Turner Designs is known for providing rugged, reliable, stable instruments, offering submersible, field, handheld, laboratory, and online optical instrumentation varying in functionality, size, and price to fit any type of user need.

The Turner Designs applications team provides pre-sales support helping customers identify instrument requirements as well as post-sales support assisting with implementation. Its modular designs enable us to easily adapt instruments for custom applications and integrations. Its on-site manufacturing team with an average tenure of 20 years provides lead times as short as one week while still meeting our committed delivery dates over 98% of the time.

Turner Designs designs instruments focused not only on performance and reliability, but also cost. With modular designs, it is able to use parts across several platforms, minimizing costs as well as lead times. A prime example is its recently announced FluoroSense, a small, handheld device which enables quick field sampling in the water stream. This past year Turner Designs also introduced Cyclops. Integrator, a small package which easily integrates into vehicles to provide up to three optic channels for detection of fluorescent materials or turbidity. And the Ballast-Check 2 was launched to provide a small, simple handheld for quick indicative checks of ballast water.

Turner Designs provides numerous standard fluorescence configurations: in vivo and extracted chlorophyll; blue-green algal pigments such as phycocyanin and phycoerythrin; active fluorescence for determining yield; dissolved organic matter (algal as well as terrestrial); ammonium; optical brighteners and tryptophan for wastewater monitoring; dye tracers; crude and refined oils as well as infrared wavelengths used to detect turbidity. Custom optical configurations are also available. Package configurations include submersible, handheld, field, laboratory, online, and ready for integration into vehicles. In addition, two years ago we expanded our product family beyond fluorescence to include absorption and pCO2 sensors.

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I-1650

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- LiDAR

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- Live HD Video
- Realtime Data

- Autonomous or Manually Controlled
- Cost Effective

Remotely Operated Vehicles

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

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

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

DEEP OCEAN ENGINEERING

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RECAB

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"RECAB is a provider of rugged computers; we are a hardware company," said Bjørn Espen Aase, Managing Director, RECAB Norway. "We create innovative computer systems for demanding applications, and that includes rough environments found at sea."

We met with RECAB at the recent Norshipping in Oslo to catch up with this fast-growing computer integrator, a company which sees its business spread across many industries that demand high-performance rugged computing. "We are a typical subcontractor for the big players like Kongsberg and Rolls-Royce, for example. We are enabling world-class applications so they can put their software on top and integrate with the sensors. Stable hardware platform; that's our business," said Aase.

Central to the RECAB business plan is building computers and systems that literally are on the move, whether on the ground, in the air or at sea. Its four major markets served include Maritime & Offshore; Avionics; Defense; and Communications.

In particular the company specialized in building Advanced Modular Computers, scalable system with mega processing power for use in scientific, engineering or subsea arenas. According to Aase, about 30 to 35% of its business comes from the combined maritime niche, with the subsea industry and its thirst for advance computing solutions a ripe market for penetration.

At Norshipping in Oslo earlier this year RECAB-sealed the deal via a contract with AKVA group ASA for delivery of embedded computer systems for its world leading solutions to the global fish farming industry. "We have developed pilot series with great success, and this agreement formalizes a long-term relationship with AKVA group which is a world leader in its market," said Michael Ullskog, CEO of RECAB Embedded Computers AB.

The broad product portfolio of products from RECAB includes Embedded Servers, Vehicle-PCs, Medical-PCs, Ruggedized COTS, MicroTCA, ATCA, ATR-systems, CompactPCI, VME, communications servers, rackmount systems and solutions designed and built to customer's specifications. The products are often designed and tested to meet harsh environmental conditions including, dust, humidity, extended temperature, shock, vibration, and EMC-requirements.

RECAB MPU (Maritime Processing Unit)

The RECAB MPU (Maritime Processing Unit) is designed to be versatile; easy to change or add hardware functionality such as AIS or other GPS system modules. This flexibility enables deployment in several other application areas.

- Compact and scalable fanless high performance Maritime Processing Unit using Intel Ivy Bridge Core i3.
- Flexible design enables a range of optional modules and functionality to be added.

Examples include DGPS, AIS receiver, UHF radio with Diplexer through a Single Antenna connector.

- Optional Power over Ethernet 802.3af interface, and standard PC I/O interfaces.
- Recessed IP-65 shielded compartment for USB dongle and/or service port.
- Designed and tested for Maritime applications, including oil & gas sector.
- Wide operating temperature range: -10 to +60° C ambient temperature.
- Completely sealed unit, water resistant using rugged IP-65 connectors.
- Wide range DC input (9–30 VDC). Power supply designed for harsh maritime environments with unstable power sources.
- Modular backpack-solution with optional touchscreen.

InterMoor Inc.

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W: www.intermoor.com
CEO/President: Tom Fulton
No. of Employees: 270

InterMoor is a leading mooring, foundations and subsea services provider delivering innovative solutions for rig moves, mooring services and offshore installation projects. It supports operators and contractors worldwide with Engineering, Fabrication, Shore Base, Survey & Positioning and Inspection services to provide customized solutions focused on reducing cost, time and risk.

For operators and contractors who require rig moves or who need to anchor FPUs, MODUs, TADs, barges and other floating structures, InterMoor mooring services are integrated solutions as they include the design, provision and installation of both temporary and permanent moorings. InterMoor manage preset mooring campaigns in 10 countries with the largest stock of equipment in the world.

Contractors and operators worldwide know the benefits of having one point of contact throughout the length of the project.

InterMoor is known for its innovative approach of each project, from developing customized installation aids to adjusting the design to fit specifications and optimize cost. Recent developments have included:

- A new joint-venture in Nigeria
- A new Port Acu base in Brazil
- Selected to work on the largest projects in the Gulf of Mexico including Heidelberg, GulfStar, Delta House and Julia, to name a few.

Sparton Corporation

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W: www.sparton.com
CEO/President: Cary Wood
No. of Employees: 1500
Annual Sales: $336m

Sparton Corporation (NYSE:SPA), now in its 115th year, is a provider of complex and sophisticated electromechanical devices. Its capabilities span the product lifecycle, including: concept development, industrial design, design and manufacturing engineering, production, distribution, field service, and refurbishment. Primary markets served are Medical & Biotechnology, Military & Aerospace, and Industrial & Commercial. Headquartered in Schaumburg, IL, Sparton currently has 12 manufacturing locations and six engineering design centers worldwide.

Sparton's Engineered Components and Products (ECP) Segment specializes in the rapid development of COTS and custom solutions for use in rugged and demanding environments. The ECP Segment has delivered over 6 million products to Navies and Maritime markets worldwide. Technologies are developed through a broad range of engineering disciplines, including: systems, electrical, RF, software, mechanical and oceanographic.

Within the ECP Segment there are three product platforms. Undersea Warfare (USW) Solutions provides full service design and manufacture of engineered solutions for the USW market. Precision Sensing & Measurement develops high-accuracy products and solutions for detecting, recording and responding to a wide range of physical properties and conditions. The Rugged Electronics platform provides displays, computers and related solutions for defense, industrial, marine and other harsh environments.

Sparton USW Solutions has a design and manufacturing center in DeLeon Springs, Fla., which maintains a wide variety of technical skills in product design, engineering and manufacturing. The company dubs itself an expert in communications between sensor packages, transmitters, receivers and beyond. Its primary products include passive and active undersea motion and sound detection devices, air and undersea deployment systems, and undersea-to-air deployment systems.

Sparton has designed and manufactured Sonobuoys for Navies worldwide for over 60 years. Sonobuoys are integral to the detection, localizations, identification, and tracking of potential hostile submarines or other targets of interest. Sonobuoys provide underwater signaling, bathythermography, and active and passive acoustic sensing.

A sonobuoy is generally packaged in an 'A-sized' (4.75 inches by 36 inches) package, and is dropped by a Maritime Patrol aircraft.

JouBeh Technologies

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CEO: Tony Chedrawy
No. of Employees: 20

JouBeh provides satellite communication services for the oceanographic and scientific markets, and is a leading Iridium satellite Value-Added Reseller focused on data services. JouBeh's focus is in supporting tracking and monitoring solution developers with modems, airtime, IT engineering and technical support for the environmental, commercial, research, and defense sectors. It supports a wide range of applications from ocean science, wildlife tracking, and search/rescue to automatic vehicle location, surveillance, and aviation.

LinkQuest Inc.

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CEO Ning Xiao, Ph.D.

LinkQuest manufactures precision acoustic instruments for offshore oil exploration, construction, drilling, survey, environmental study and other oceanographic applications. Its acoustic communication and positioning products are based on the Broadband Acoustic Spread Spectrum (BASS) Technology and are widely used worldwide. LinkQuest's high speed underwater acoustic modems transport more than 95% of the world's acoustic communication data. These systems have set a series of technical performance records in field deployments all over the world. LinkQuest's line of TrackLink Acoustic Tracking Systems provide highly robust, accurate and cost-effective Ultra Short Baseline (USBL) solutions.

Battelle

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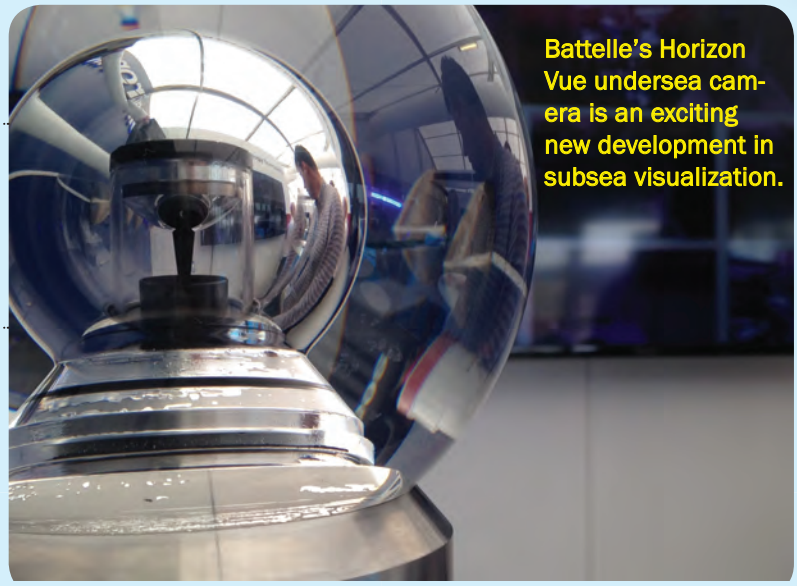
CEO/President: Jeffrey Wadsworth
No. of Employees: 100
Annual Sales: $20 million



Battelle's Horizon Vue undersea camera is an exciting new development in subsea visualization.

At major technology centers and national laboratories around the world, Battelle conducts cutting-edge research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Battelle, the world's largest independent research and development organization, is headquartered in Columbus, Ohio. Founded in 1929, Battelle operates in three broad areas: National Security; Energy, Health and Environment; and Laboratory Management. It offers a full service line of products and system development to enhance the efficiency and affordability of maritime operations. It provides engineering solutions and systems for maritime and underwater applications. Its high-speed data communicators, oil spill detection and tracking systems, and autonomous sensor systems are just some of the maritime technologies that help provide safe, accurate exploration and monitoring in harsh environments. A wholly owned subsidiary of Battelle, Bluefin Robotics, manufactures unmanned undersea vehicles (UUVs) and batteries.

- **Submersibles:** Battelle's strengths are technology development and fielding customized systems. Battelle leverages extensive experience in engineering undersea vehicles and components to offer nearly limitless possibilities for undersea vehicles, including greater depth, larger battery size or any number of specialized reconfigurations. The advanced capabilities of our Proteus Dual-Mode Undersea Vehicle platform also enable increased autonomy and endurance for longer and more complex missions.
- **Persistence:** Battelle's UUV Docking and Recharging Station (UDRS) keeps submersibles at depth longer and reduces turnaround time to extend underwater mission performance for safer, more efficient and more discreet operations.
- **Life Cycle Engineering:** Battelle aims to help keep costs down by providing technology refreshment throughout a system's lifecycle and extending system maintenance cycles to maximize long-term investments and reduce total ownership cost of maritime technologies.
- **Sensors:** Battelle designs, manufactures, produces and distributes ocean sensors for a variety of commercial and military applications. Sensors such as Battelle's Seaology pCO2 monitoring system have been used by the National Oceanic and Atmospheric Administration (NOAA) since 2009 to support its Global Ocean Observing System (GOOS) and measure CO2 in maritime environments.

Testing Facilities:

Battelle-owned and -operated facilities for maritime and subsea research are located at six primary locations and involve a variety of testing capabilities, including:

- Columbus, OH: Research pool; pressure chambers to 30,000 psi; wet and spectroscopic analytical chemistry laboratories; shock, vibration and fatigue testing; electronics, electro-optics and software laboratories. Class 100 clean room.
- Norwell, MA: Environmental monitoring, water quality, hydrocarbon forensics
- Quincy, MA: Test fixtures, testing tanks and specialized equipment
- Sequim, WA: Oceanographic modeling, marine toxicology, environmental monitoring; Class 100 clean room
- Daytona Beach, FL: Corrosion and coatings testing
- Dublin, OH: Specialized, low to medium volume, 65,000 sq. ft. manufacturing facility

RJE International, Inc.

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CEO/President: Robert Jechart
No. of Employees: 15
Annual Sales: $5m

RJE International, Inc specializes in creating innovative solutions to solve needs for subsea acoustic relocation of aircraft flight recorders (Black Boxes), ship voyage recorders, subsea vehicles, and offshore equipment moorings. In addition, it also supports the needs of Military Special Forces combat swimmers and EOD clearance divers with navigation solutions and non-magnetic sonars to meet their critical mission needs. Its public safety division supplies pool safety products. Operating on a global scale, RJE International has established distribution points in more than 30 countries that provide sales and service of its products to clients worldwide. In 2014, RJE International moved to a new expanded manufacturing facility and enhanced its Engineering, Production, Quality and Repair departments.

RJE International is FAA approved under TSO-C121 to manufacturer underwater acoustic beacons for flight recorders (Black Boxes). Under the AS9100C Quality Management System, it produces the ELP-363D emergency relocation beacon. To meet the maritime voyage recorder market, RJE International manufacturers the ELP-362M VDR acoustic beacon approved under BHS4542/002/0062788/14. For commercial and military markets, it supplies a broad line of underwater acoustic beacons and transponders for marking and relocating equipment and subsea vehicles.

For recovery, RJE International offers a full line of acoustic directional receivers.

Part I

Teledyne Marine Sensors & Systems

By Greg Trauthwein

Wrapping your arms around the subsea behemoth that is known as "Teledyne" starts at the top of each group, and the man sitting on top of the Marine Sensors and Systems Group is Bill Kikendall, overseeing a collection of 12 companies starting with Teledyne legacy company Geophysical Instruments and including recent acquisitions such as Oceanscience, Bowtech and SeaBotix.

From sensors and seismic systems to geophysical to navigation to subsea vehicles, the Marine Sensors and Systems Group is a broad based group of capabilities backed by the signature Teledyne corporate support.

With a diversity of product, systems and services the Marine Sensors and Systems group serves a similarly broad swath of markets, and Kikendall classifies markets served as such:

- Energy
- Defense
- Natural Resources
- Security and Safety
- Ocean Science, and
- Transportation/Infrastructure.

"This is a very high level, macro perspective and we try to look at the trends that may drive our businesses," said Kikendall. As an example, he cites the ever evolving Transportation Infrastructure market, and specifically the changing consumer patterns and trends globally that mandate, for instance, dredging and other port and harbor construction projects that demand support products, systems and services from his group, and for that matter, the entire Teledyne portfolio.

Diversity of markets served helps the Teledyne Marine Sensors and Systems Group power ahead steadily in times good and bad. Assessing 'what's hot and what's not' is an ongoing challenge in the deployment of valuable resources.

"Certainly energy is very soft at the moment, and when I say 'soft energy spending' I mean primarily oil and gas," said Kikendall – renewables are seeing steady growth. "The question is 'when will Oil and Gas spending recover,' and to determine the residual effects to our other markets."

While the low price of oil has been a drag in many respects, Kikendall said there are certainly areas that are strong and growing at the moment, namely defense, marine surveillance, and natural resources.

"Within natural resources, we support a lot of inland activity in inland water flow and discharge management," said Kikendall. "With water becoming such a precious commodity on a global basis, the ability to precisely understand the watersheds and how they recharge the aquifers, for example, or to precisely know how we can lower waste and make sure we efficiently deliver this precious resource becomes increasingly critical."

Underwater Vehicles

In its march to expand, Teledyne Marine Sensors and Systems Group has built a virtual 'fleet' of diverse underwater vehicle types, from ROVs to AUVS to gliders.

"In regards to autonomous vehicles: as we are able to lower the price points and increase the capabilities, complexity and duration for marine vehicles of a wide variety, that market looks pretty positive for us," summarized Kikendall.

In fact, he points to underwater vehicles in general as one of the defining, leading technologies that has worked to advance the overall subsea industry during his career.

"I think underwater vehicles in general (have been a driver) and for us I would say the modular approach is key, so that a single vehicle – whether it's a glider, a float, an AUV or an ROV – can be configured to serve many different applications."

Multi-tasking, smaller vehicles have enabled companies in general to collect more and better data at a lower price point, driving further use of subsea products and systems.

"So, these vehicles allow much more data to be collected at a much lower price point, and by doing that, essentially, what we do is we increase society's understanding of the marine environment," said Kikendall. "Presumably, when we make decisions, as a society, that impact our environment (and consequently the environment's impact upon us) we do it in a more informed quantitative way. As we increase our sampling of the ocean environment we position ourselves to make better decisions."

The Impact of Oil

It is impossible to have a discussion on the subsea industry without a constructive analysis of the prolonged low price of oil, and the residual impact across the maritime sector. While Teledyne Marine Sensors and Systems Group is diversified, the energy issue is a big one.

"For us the impact is most dramatic in our seismic exploration products businesses and in our work class ROV support business," said Kikendall. "They have softened substantially. And while this does not necessarily reflect our level of business, some of those markets are running at 20 or 25 percent capital spend or lower compared to what they had been in the prior years."

Coming off what Kikendall describes as a "phenomenally strong" five to six year run in offshore oil and gas, the last

"Many would agree that the ocean is a highly under sampled environment. We see our role as facilitating good decision-making by providing the instruments and platforms that allow society to collect as much accurate and quantitative data as possible, at as low of a cost as possible in order to facilitate more informed decision making."

Bill Kikendall
Teledyne Marine Sensors & Systems Group

year has been soft and past six-months been sobering, but also instructive in building a stronger group, a stronger company, moving forward. "Our business planning is based on forecasts and outlooks and as is the case for any business, we have to adjust to those market conditions. And we certainly recognize that those markets are very difficult at the moment," said Kikendall. "For us, it's ever more important to develop products that help our customers achieve their objectives in the most efficient ways possible so that they can perform in these (tough) market conditions."

"It is always important for us to identify and bring to market new technologies that are efficient and cost efficient. Our goal is to develop and introduce products (instruments and platforms) that allow our customers to collect more, high quality data, in a more cost effective manner."

The Power of the Corporation

The growth of Teledyne has been well documented, and while each of the Groups has its own focus and strengths, it is the power of the whole that is ultimately considered a 'game changer' in the subsea space.

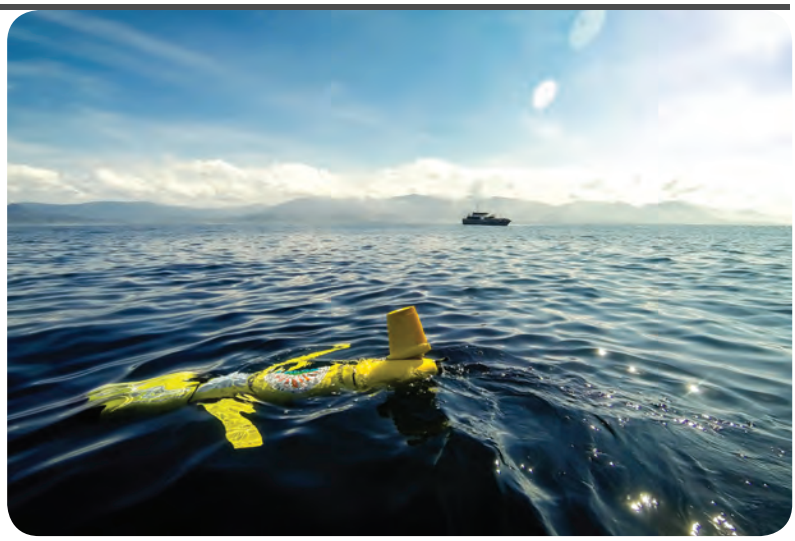
"I believe (our strength is) our range of offerings or products as well as people. It's our representative network. It's our reputation. And really it's some of the unique resources that Teledyne as a corporation has," said Kikendall.

When discussing the company's unique resources, he pointed out three specifically that he sees as instrumental towards enhancing the solutions package:

- **The Teledyne Science Center** on the West Coast, which formally was part of the Rockwell Corporation's Research Center, staffed with a number of PhDs that are conducting applied research, providing science-based solutions to a wide variety of our products.
- **Teledyne Brown Engineering**, which is a large systems engineering and program management business, which, for example, manage a big Navy program. "Teledyne Brown Engineering provides a great internal partner for some of those bigger programs."
- **Teledyne Dalsa in Canada**, with an expertise in MEMS. "It is potentially a great partner for us as we look at MEMS-based sensor technologies in the future and how those might apply into our various business units."

Teledyne Marine Systems

Teledyne Marine Systems enables customer optimized data collection with the most comprehensive and innovative suite of undersea vehicles and infrastructure available. The portfolio includes low logistics high performance unmanned marine vehicles, sensor agnostic towed systems, undersea positioning and telemetry, and deep sea infrastructure. The Teledyne Marine Systems group includes Teledyne Benthos, Teledyne Gavia, Teledyne SeaBotix, and Teledyne Webb Research, all with rich histories in the marine industry. Teledyne Marine Systems product lines draw upon shared leadership in engineering and manufacturing and a coordinated sales team that connects modems to gliders and more. Four strategic business units come together as an integrated provider of advanced undersea systems.



(Courtesy Blue Ocean Marine)

- **Teledyne Benthos**

Located in North Falmouth, Massachusetts, Teledyne Benthos is an industry leader with a history of over 50 years of innovation in marine technology. Benthos designs and manufactures rugged, reliable oceanographic instrumentation and infrastructure for marine environments. Teledyne Benthos products include: acoustic releases, acoustic telemetry modems, positioning systems, hydrophones, remotely operated vehicles (ROVs), glass flotation spheres and instrument housings, and locating devices. These tools provide the building blocks of ocean observing systems for diverse users. Benthos technologies were part of the discovery of the RMS Titanic, contribute to astrophysical observatories and provide access to the deepest ocean depths.

- **Teledyne Gavia**

Located in Kopavogur, Iceland, Teledyne Gavia provides turnkey survey solutions to customers undertaking a variety of tasks for defense, commercial and scientific applications. The Gavia Autonomous Underwater Vehicle (AUV) can carry an array of sensors and custom payload modules that make it well suited for any research, monitoring or surveillance task where autonomy, cost and ease of deployment matters. Its modular design allows for rapid sensor reconfiguration and battery re-

placement. While compact and "low logistics" the Gavia is also extremely capable, rated to 1000 meters depth and proven with a variety of sensor systems. As an Icelandic technology and compatible with sensors from other international sources the Gavia AUV is widely exportable and the chosen low logistics AUV of commercial survey firms operating around the world.

- **Teledyne SeaBotix**

Based in San Diego, California, the newest member of the group, Teledyne SeaBotix, is a manufacturer of a suite of underwater observation class MiniROVs designed to perform a multitude of tasks, such as: maritime security, search and recovery, hull and pipeline inspection, hazardous environment intervention, aquaculture, sensor deployment, oceanographic research, and more. SeaBotix continues to deliver revolutionary advancements to a diverse suite of MiniROV systems that are responsive to demanding professional applications.

- **Teledyne Webb Research**

Co-located with Benthos in North Falmouth, Massachusetts, Teledyne Webb Research has been serving oceanographic research, commercial, and government customers for over 30 years. Webb Research designs and manufactures scientific instruments for oceanographic research and monitoring with a focus on extended observations over both time and space. Teledyne Webb Research specializes in three areas of ocean instrumentation: Neutrally buoyant, autonomous drifters and profilers, autonomous underwater gliding vehicles, and moored underwater sound sources. These systems are core to several major ocean monitoring programs including the international Argo array, the National Science Foundation Ocean Observatories Initiative and the US Navy Littoral Battlespace Sensing – Glider (LBS-G) program of record. A Webb Research Slocum glider, the Scarlet Knight, was the first unmanned vehicle to cross an ocean.

ADCP deployment (part of T-Tide Experiment) in the Southern Ocean just east of Tasmania.

Photo by John Mickett and Sonya Legg

Teledyne Marine Sensors

The Teledyne Marine Sensors group is comprised of the largest number of Teledyne Marine companies. These organizations are committed to delivering highly innovative sensors and seismic solutions for a wide array of surface and subsea applications. The companies within this group offer a variety of highly innovative, field proven sensors designed to collect critical data for academic, commercial and defense applications. These solutions span a wide range of technologies from camera and LED lights for Remotely Operated Vehicles (ROVs) to highly intricate precision navigation aiding systems, motion sensors, pipe and cable tracking, current profiling devices, and CTD sensors. Each of these tools can be used as stand-alone solutions or can be integrated into turnkey system solutions.

The Teledyne companies providing sensor technologies include:

- **Teledyne Bowtech** specialises in the design and manufacture of underwater vision systems including: video inspection systems, underwater cameras, underwater LED lights, xenon emergency relocation strobes, custom moulded cable assemblies, pan and tilts, electrical and fibre-optic connectors, fibre-optic multiplexers and slip rings for use in hazardous areas or subsea.

- **Teledyne CDL** is the pioneer of the popular Tiny Optic Gyro System (TOGS) a Fibre Optic Gyro based North seeking compass for use on vessels and Remotely Operated Vehicles (ROVs). Teledyne CDL also provides products that satisfy demanding user requirements for inertial positioning, sensor, telemetry and navigation requirements.

- **Teledyne Oceanscience** supplies the oceanographic, hydrologic and hydrographic communities with deployment platforms for environmental monitoring instrumentation. Major products include turnkey remote hydrographic survey boat systems with environmental monitoring and/or bathymetry equipment; the new rapidCAST system that provides automated, affordable and compact SV profiling from a moving vessel; remotely-operated and tethered instrumentation deployment boats for echo sounders and ADCP's; and the popular Sea Spider and Barnacle seafloor platforms.

- **Teledyne RD Instruments** pioneered the invention of the Acoustic Doppler Current Profiler (ADCP) for current profiling and wave measurement applications, and has delivered over 20,000 of these instruments worldwide for use in environments ranging from shallow streams to the deepest ocean. Teledyne RDI is also the leading manufacturer of Doppler Velocity Logs (DVLs) for precision underwater navigation onboard subsea and surface platforms. Rounding out the company's product offerings is their family of Citadel CTD sensors, ideally suited for a variety of oceanographic applications.

- **Teledyne TSS Ltd** is a world leader in the design, manufacture and support of marine products for applications including navigation, motion compensation, platform stabilisation, and subsea pipe and cable survey. The company has specialist sales and support worldwide through a comprehensive network of distributors and service providers.

In addition to its sensor technologies, Teledyne has also recently rounded out its product offerings for offshore seismic

exploration. Bolt Technology and Real Time Systems were acquired by Teledyne in late 2014, joining Teledyne Geophysical Instruments in this marketspace. Collectively, these organizations deliver a full spectrum of seismic technology ranging from small highly reliable hydrophones and intricate towed arrays, to innovative sound sources and data synchronization systems.

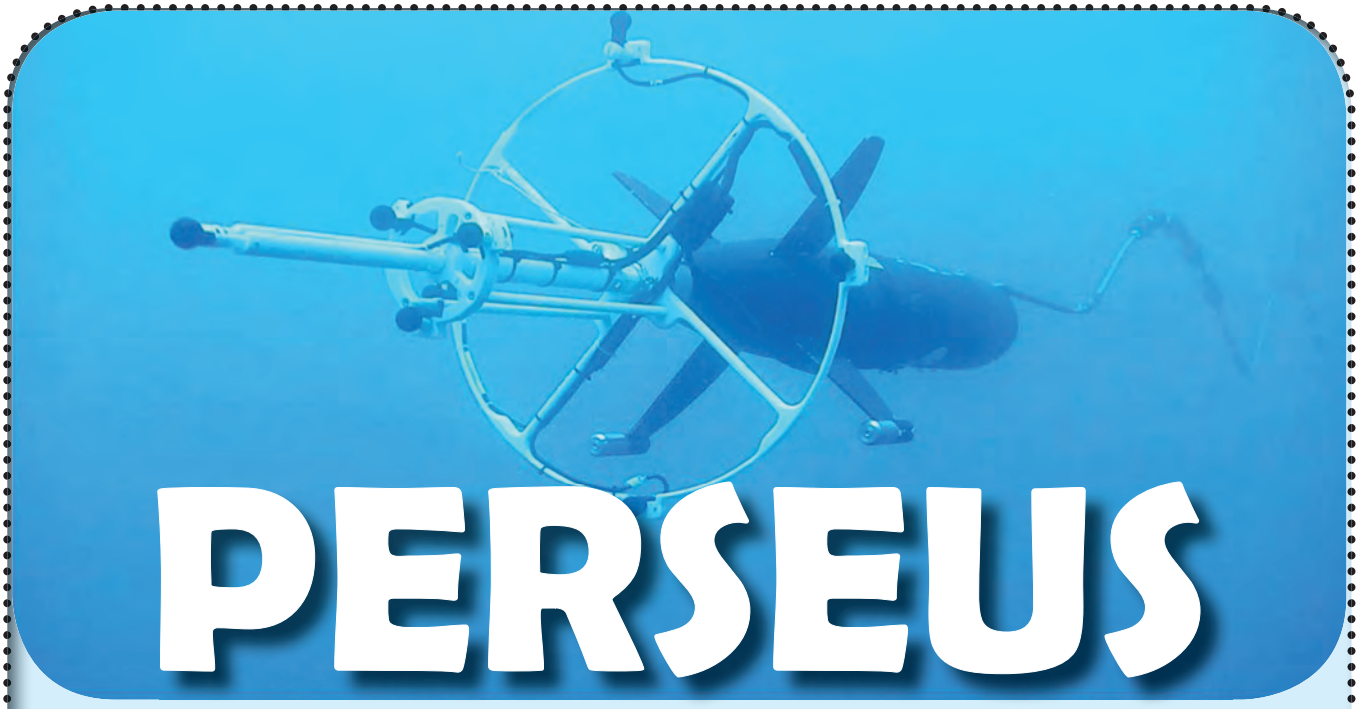
- **Teledyne Geophysical Instruments** is a global organization delivering high-quality, high reliability, marine seismic exploration technology for the oil & gas exploration industry and complex hydrophone technology systems for defense, survey and marine market applications. Used aboard more than one-third of all commercial seismic research vessels, Teledyne Geophysical designs, manufactures and services sensors, sensor arrays and streamer cables for subsurface geological structure mapping to identify features likely to contain hydrocarbon deposits; listen for the "signatures" associated with ships and submarines; and conduct research associated with the marine environment.

- **Teledyne Bolt** is a leading designer and manufacturer of seismic energy sources. In 1993 Bolt introduced the LONG-LIFE Air Gun, which has become the world's most widely used air gun for marine seismic exploration.

Teledyne Bolt, Inc. in conjunction with WesternGeco recently developed a new marine air gun based on a revolutionary design.

The eSource is the first bandwidth controlled impulsive marine seismic source that addresses ocean noise. In addition to marine air guns, Teledyne Bolt, Inc. supplies a range of Down Hole Air Guns used for reservoir characterization, transition zone surveys and onshore and offshore VSP surveys.

- **Teledyne Real Time Systems** provides shipboard and in-water instrumentation required to manage marine seismic energy sources for all types of seismic exploration. Teledyne RTS source synchronizer systems are used extensively for open-water projects 2D/3D/4D, VSP drilling profile work, transition zone projects, and any land-based project that requires an in-water impulsive energy source. Customers report that Teledyne RTS's engineering development and technical support are the best in the industry.With the new introduction of two industry-changing products, Teledyne RTS is poised to continue for years to come as a leader in seismic exploration manufacturing and technology.



PERSEUS

Autonomous, Real-time Maritime Surveillance

The Center provided innovative concepts in the field of unmanned passive monitoring as part of the PERSEUS FP7 European project. Conventional surveillance technologies cannot easily help to detect fast boats, which generally have small radar signatures and do not carry automatic identification systems (AIS). For this reason, the NATO STO CMRE (Centre for Maritime Research and Experimentation) has addressed this problem along with other project partners, as part of the European project PERSEUS.

The PERSEUS project (Protection of European BoRders and Seas through the IntElligent Use of Surveillance), coordinated by Spanish technological company Indra, is one of the most significant initiatives within the 7th Framework Program of the European Commission, and has constituted the flagship of R&D in the maritime security segment.

In the Project's term, ended in June 2015, CMRE scientists and engineers worked to design, develop and demonstrate at sea concepts of continuous, real-time passive underwater acoustic systems for maritime surveillance. The objectives have been successfully met by using innovative solutions integrated on board unmanned mobile platforms, i.e. both on an underwater glider (an autonomous underwater vehicle which uses shifts in mass to steer and changes in buoyancy to dive and surface) and a Wave Glider (an autonomous vehicle with a surface float and a submerged glider, generating forward movement by exploiting sea wave energy).

The embedded cutting-edge passive sonar surveillance system proved to be particularly effective due to its real-time continuous monitoring capability and the availability of several functionalities ranging from detection and localization to vessel classification. Furthermore, the platform/system combination has proven to be persistent and covert with wide area coverage and minimum environmental impact.

Real-time detections and localizations have been made both on board the underwater glider and the Wave Glider, and the detection/tracking results have been disseminated to both CMRE and national control centers for display and further analysis. Also, target classification algorithms have been applied successfully in near real-time during at-sea demonstrations.

Adaptation of the Wave Glider for shallow coastal waters has also been tested by adding low-cost add-ons for above water sensing, in the form of inexpensive daylight and thermal cameras, and radar detection devices. This technology may help enabling the detection of anomalous behaviors of marine traffic by fusing the above and the underwater picture.

CMRE has been the first to demonstrate a complete system for underwater acoustic surveillance with highly persistent mobile robots. In the future, these systems could be used within a network to continuously monitor maritime areas of interest.

Rowe Technologies

Rowe Technologies Inc. (RTI), a customer-centric oceanographic company designs and manufactures innovative and robust Acoustic Doppler Current Profilers [ADCPs] and Doppler Velocity Logs [DVLs]. These are used for measuring currents, directional waves, and underwater navigation from shallow coastal environments to full ocean depths. RTI provides the only dual frequency ADCP/DVL, the highest resolution velocity measurements (0.01 cm/s), and 12 independent profile configurations for these markets: the oceanographic, intercoastal waters, river waterways, renewable energy, Remote Operated Vehicles [ROVs] and Autonomous Underwater Vehicles [AUVs].

Tech Profile

RTI's 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. Our core competencies are:

- Underwater Acoustics
- Acoustic Imaging
- Embedded Signal Processing
- Advanced Electronic Design
- Complex FPGA Design
- Transducer Development and Manufacturing
- Deep Ocean Design

RTI's electronics platform for ADCPs and DVLs is unique in the industry. The products have processing channel flexibility of up to 8 signal processing channels and high resolution velocity measurements. RTI's dual frequency instruments (offered in Piston and Planar Arrays) provide high-resolution near-field and long-range, low-resolution current velocity measurements on the market. RTI's experience with this advanced electronics platform facilitates the development for state-of-art applications in underwater acoustic data collection. RTI's accurate positioning and surveillance instrumentation provides the latest and most innovative solutions in the ADCP/DVL industry.

McLane Research Labs

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CEO/President: Susumu Honjo
No. of Employees: 15

McLane Research Laboratories, Inc. was founded in 1983 to provide advanced time-series samplers and engineering design services to the international oceanographic community. The objective of McLane Research Laboratories is to enable investigators to achieve their research and scientific goals by providing advanced, cost-effective instrumentation. Through its long-term R&D programs and our long association with diverse researchers and projects, McLane has established a significant base of knowledge and proven technology in support of our objective. McLane instruments are all designed to withstand the rigors of open ocean and freshwater deployments. McLane produces three main product lines: Profilers, Samplers, and Flotation. Within profilers, McLane offers the Ice Tethered Profiler (ITP) and McLane Moored Profiler (MMP). Samplers include our Sediment Traps (Mark-8 and Mark-78), as well as RAS, ESP, IFCB, PPS, ZPS, and Large Volume Pumps.

EdgeTech

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No. of Employees: 100

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. Additionally, EdgeTech provides USBL acoustic tracking and positioning systems, transponder beacons, deep sea acoustic releases, shallow water and long life acoustic releases, motion reference units (MRU), underwater acoustic command and control systems and custom-engineered acoustic products. Over the past year EdgeTech started manufacturing and shipping the new 4380 USBL beacon, added a magnetometer interface to the popular 4125 side scan sonar, introduced a new tri-frequency side scan sonar system for AUV, ROV and ASV platforms, and shipped numerous new 6205 Multi Phase Eco Sounders (MPES).

Silicon Sensing Systems Ltd.

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CEO/President: Martin Couch
No. of Employees: 120

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.

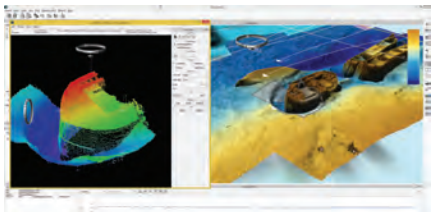
With a heritage dating back over 100 years, Silicon Sensing Systems and its predecessor companies have a unique record in delivering gyroscope systems to the marine industry. Formed in 1910, Sperry Marine was set up to provide practical navigation and stabilization systems based on the newly emerging gyroscope technology, delivering the first North-finding gyrocompass system aboard the Dominion Line's 'Princess Anne' in 1910. Spinning wheel gyros were to dominate the market for the next 50-plus years until the emergence of expensive laser and fiber-optic gyros with their enhanced reliability due to their solid-state non-rotating design.

With Sperry Marine being subsumed into British Aerospace, Silicon Sensing Systems was formed in 1998 as a result of BAE Systems and Sumitomo cooperating to develop and produce the next generation of solid-state gyroscopes, based on a silicon MEMS construction. Silicon Sensing Systems flourished, to enjoy a reputation for the production of low-cost highly reliable gyros. It lead the entry into the consumer car market, producing up to 4M devices per year – and more than 30M to date.

Silicon Sensing Systems Ltd. is based in Plymouth, in the southwest of the UK. The company is now jointly owned by UTC Aerospace Systems, co-located in Plymouth, and Sumitomo Precision Products Amagasaki, Japan. Both companies bring equal strength to the joint venture – inertial expertise from the UK/US 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, greatly 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. Amongst its unique fabrication equipment is a deep reactive-ion etching capability, developed in-house in Japan. In recent years, Silicon Sensing has also chosen to develop and produce a range of sophisticated accelerometers to augment its total inertial capability.

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 fibre-optic systems but at a greatly reduced price.



QPS-US (Quality Positioning Services)

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W: http://www.qps-us.com
CEO: Tomas Hjelmberg
No. of Employees: 50

QPS are specialists in software solutions for marine spatial data. Software products for efficient data collection, advanced post processing and 4D visualization include QINSy, Qimera and Fledermaus. QINSy is a software suite used for various types of maritime geomatic surveys, ranging from simple single beam surveys up to the very complex offshore construction works.

Novacavi

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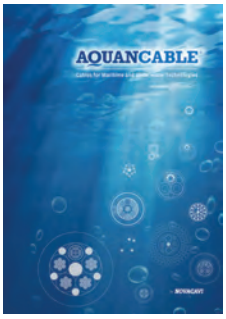
CEO/President: Giuliana Censi
No. of Employees: 28

Novacavi is an Italy-based privately owned company established in 1975. We design and manufacture in-house custom cables and we have a great experience in a variety of specialist applications.

Its 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 further expanding its production of bespoke cables for marine industry.

In 2014 it launched Aquancable , our range of bespoke cables for maritime and underwater technologies including high performance Tow cables, ROV cables, Fiber Optic hybrid cables, umbilicals, armored cables, as well as subsea detection and instrumentation cables.



It also introduced a new range of in-house developed and manufactured custom marine coax tow cables. Among them both heavy steel armored coax tow cables for harsh specialist applications.

Ohmsett

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Program Mgr.: Bill Schmidt
No. of Employees: 18

Ohmsett provides independent and objective performance testing of full-scale oil spill response equipment and marine renewable energy systems. It is the largest outdoor saltwater wave/tow tank facility in North America and the only facility where full-scale oil spill response equipment research, testing, and training can be conducted in a marine environment with oil under controlled environmental conditions.

Managed by the U.S. Department of Interior's Bureau of Safety and Environmental Enforcement's (BSEE), Ohmsett 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, Inc. through a contract with BSEE.

The facility has the capability to test and evaluate oil spill response technologies such as: mechanical recovery systems, chemical agents and dispersants, ice and cold weather climate, remote sensing and detection instruments, sorbent materials, booms, viscous oil pumping units, and oil water separators.

The test tank can accommodate many 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.

In addition, Ohmsett provides a venue for first responders with the most realistic hands-on training available, enabling rapid and efficient response to an oil spill.

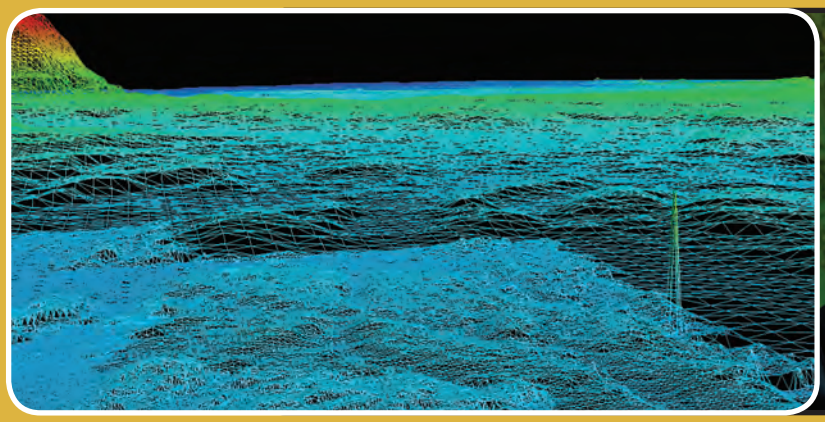
Facilities

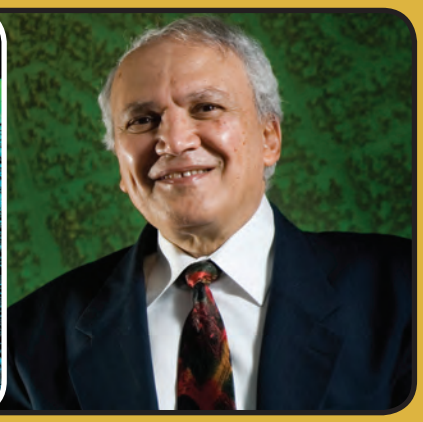
Ohmsett consists of an above-ground concrete test tank measuring 667 x 65 feet wide x 8 feet deep filled with 2.6 million gallons of salt water, machine shop, and oil/water chemistry lab. The wave generator produces random waves that closely approximate waves in the ocean, such as sinusoidal and harbor chop, Pierson-Moskowitz, JONSWAP, and Frequency Modulated Slide, with scalable ocean water depth, wind speed, and model scale factor.

To accommodate cutting-edge technology, BSEE recently upgraded the facility with newly developed equipment to measure oil slick thickness during testing. An acoustic tool adapted to operate from a Remotely Operated Vehicle, detects oil in and under ice, tracks location, and measures thickness. The sensors provide real-time measurements of the slick thickness and include cameras for real-time viewing and recording. To accurately and rapidly assess cold water and ice testing parameters such as total surface oil versus ice area coverage and oil layer thickness, a thermal imaging camera with processing software was developed specifically for use at Ohmsett. The Tactical Rapid Airborne Classification System creates images that separate ice, water and oil of several thicknesses based on differences in the thermal emittance.

To expand the ability for testing in simulated Arctic conditions, BSEE funded the development of surrogate ice modules made of composite materials that can be modified to simulate natural ice in various Arctic conditions."

CARIS





115 Waggoners Lane, Fredericton, New Brunswick, Canada E3B 2L4
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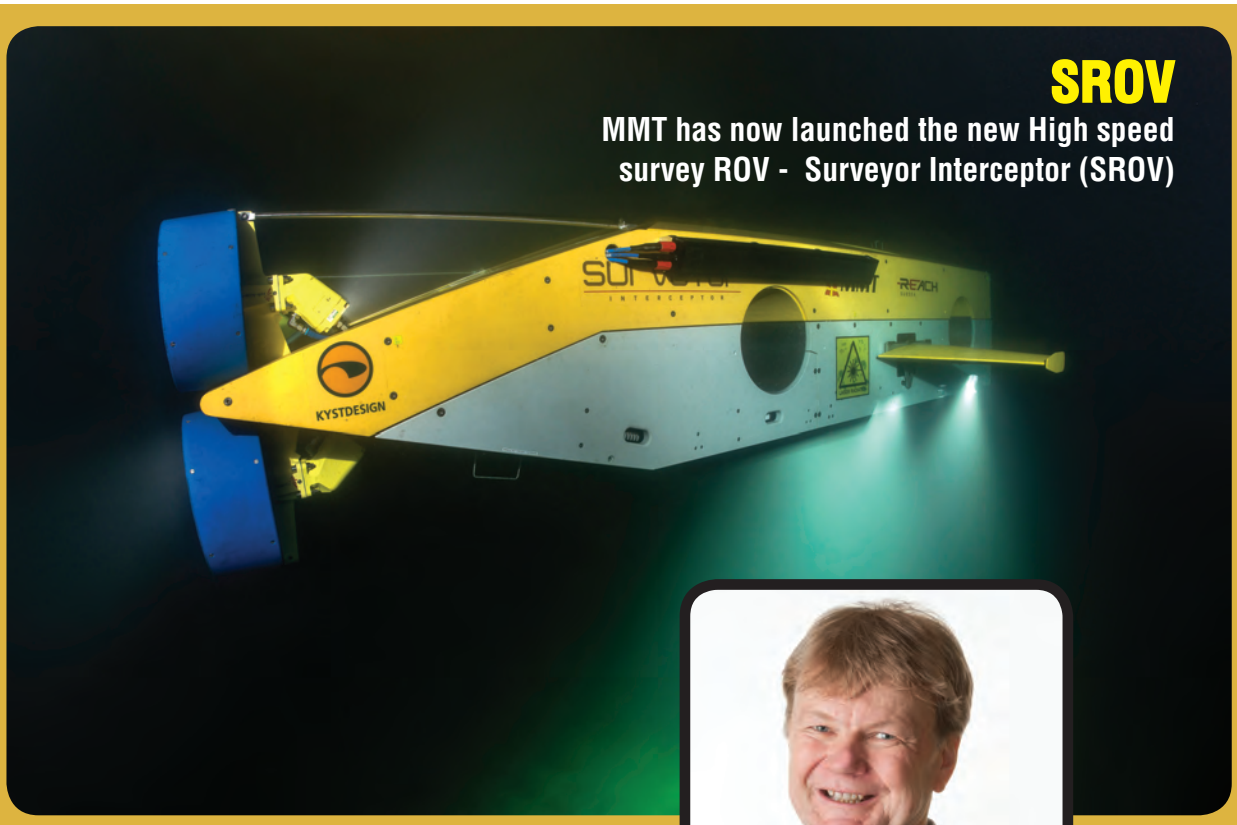
CEO/President: Dr. Salem Masry
No. of Employees: 170

Established in 1979, CARIS is a developer of geospatial software designed to cater the marine GIS community and built on decades of hydrographic experience. CARIS is a privately held company with more than 170 engineering, IT and business professionals employed in its headquarters in Fredericton, Canada, as well as in CARIS offices in the Netherlands, the USA, Australia and the UK. In addition, CARIS has a network of more than 20 worldwide distributors.

CARIS software offers a comprehensive level of support, with training sessions, consulting and a series of courses, as well as technical support via online services, multilingual telephone support and email. 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 CARIS Ping-to-Chart solution is designed to deliver an integrated and seamless solution for the entire workflow of hydrographic information from processing the echo-sounder ping to the production and distribution of the chart. This integrated software solution provides clients with resource optimization and a true operational advantage. The CARIS Ping-to-Chart solution 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. CARIS believes that by automating the repeatable steps in the data processing workflow the focus of the professional can be to ensure that top quality data is being collected. CARIS Onboard utilizes a Control Center where processes can be initiated and tracked and data quality assessed."

MMT



SROV

MMT has now launched the new High speed survey ROV - Surveyor Interceptor (SROV)

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CEO/President: Stefan Eliasson
No. of Employees: 250

Established in 1976 MMT is a survey company offering time and cost efficient solutions to customers requiring high-resolution sea floor mapping and subsea support services. MMT offers assured surveys in bathymetric, geophysical and geotechnical services, from pre-installations surveys to inspection, repair and maintenance works. As part of the risk assessment for all submarine installations, we provide detection, verification, excavation and clearance services for UXO's, both on or below the seabed surface. Using our own vessels equipped with the latest sonars, video cameras and underwater vehicles they scans everything under the surface. The results are presented to the decision makers who can then make assessment of the suitability for marine infrastructure projects, such as pipeline inspections and power transmission. The customers are primarily within marine cables, oil & gas, renewable energy and hydrography industry in Europe and MMT has also been involved in projects in other parts of the world. The staff are specialists in hydrographic surveying, positioning, marine geology, marine biology, technology and shipping and our combined expertise constitutes an enormous competitive advantage for MMT. The head office is located in Gothenburg, Sweden and there is additional offices in the UK and Norway.

After a period with intense research and development work, MMT has now launched the new High speed survey ROV - Surveyor Interceptor (SROV). SROV has been qualified and used on a pipeline inspection project and reach a speed up to eight knots and deliver amazing high resolution data. MMT manage all our clients' projects with the latest state-of-the-art technology, which is handled and operated by our highly qualified personnel. Our specialty is high resolution mapping.

Ocean Sonic

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W: www.OceanSonics.com
CEO/President: Mark Wood
No. of Employees: 12

Ocean Sonics designs and manufactures the icListen Smart Hydrophone, an innovative passive acoustic monitoring system. Like us, most of our users work with ocean sounds; they are scientists, environmental assessment specialists, engineers and field operations personnel. Ocean Sonics combines smart electronics with very high signal performance to deliver an easy to use, high quality package. The icListen Smart Hydrophone records and streams sound data in real units. A key part of the design philosophy is to have the sensor provide data in the form needed by the user.

Sidus Solutions

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CEO/President: Leonard Pool
No. of Employees: 15

SIDUS Solutions designs and manufactures cutting-edge subsea video cameras, lighting and robotic positioning devices for extreme environments. SIDUS also specializes in custom, end-to-end underwater systems including customized controllers and cabling. Its engineering staff provides seamless system integration, design, installation and commissioning of all remote video surveillance systems. From

ocean observation platforms on the sea floor, to anchor bolster surveillance systems for offshore rigs, to thru-hull sonar deployment systems - SIDUS has a field proven solution. SIDUS is a single-source, full-service provider, serving the oil & gas, nuclear, scientific research, military and petrochemical industries. SIDUS has expanded its product line to incorporate internet protocol (IP) communication by offering the Seafloor Observer System (pictured) which is controlled via a single Ethernet cable and the IP Digital Color Video Camera (SS429).

Kongsberg Maritime

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E: subsea@kongsberg.com
W: http://km.kongsberg.com
CEO/President: Geir Håøy
Vice President: Bjørn Jalving, EVP-Subsea Division
# of Employees: 4396 (April 2014)

The Case

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.

Company Profile

The company mission is maximizing performance by providing The Full Picture. Kongsberg Maritime is a global marine technology company providing innovative and reliable solutions for all marine industry sectors including merchant, offshore, subsea, naval and fisheries. Kongsberg Maritime delivers systems that cover all aspects of various maritime applications:

- Subsea survey and construction
- Maritime security
- Environmental monitoring
- Scientific research
- Dynamic positioning and navigation systems
- Marine automation
- Safety management
- Cargo handling
- Maritime simulation and training
- Satellite positioning

Integration of systems is a key driver to the success of Kongsberg Maritime. The Company is dedicated to providing innovative and reliable solutions for all customers and stakeholders that ensure optimal operation at sea and onshore.

Market Segments

Key markets are countries with large offshore, shipyard and energy exploration & production industries. In exploration the Company provides sophisticated underwater and positioning technology and systems for survey vessel operation. In field development, construction and offshore vessels are supported with innovative solutions for operation and specialist applications whilst in production our hardware and software enhances output and minimizes downtime. For maritime transport and offshore vessels, The Full Picture is supplied, including navigation, automation, training and safety systems.

Technology Profile

Kongsberg Maritime develops innovative products using the latest technology and techniques. It develops cutting-edge hydroacoustic survey systems including market leading multibeam and single beam echo sounders, and sonars, connected to positioning equipment, heading and motion sensing instruments, as well as sound velocity sensors and processing software.

Kongsberg Maritime is a leader in the field of underwater cameras and AUV development, counting several navies and the world's leading survey companies as customers of its Seaglider, REMUS, HUGIN and MUNIN AUVs. HUGIN has been a key technology development area since 1990 and is used for a variety of civilian and military applications.

Environmental monitoring solutions are a recent focus at Kongsberg Maritime, with a sophisticated new Integrated Environmental Monitoring System for Statoil,

developed with IBM, DNV and other KONGSBERG Group stakeholders, in addition to a new Modular Subsea Monitoring Network and advanced leak detection environmental monitoring sensors.

Kongsberg Mesotech Ltd, the Canadian subsidiary of Kongsberg Maritime, is a global leader in the underwater acoustic industry. With over 40 years of innovative sonar experience, the company designs and manufactures acoustic instrumentation with superior image resolution. Mesotech supplies a worldwide customer base with sonar for search and recovery, marine engineering, security and surveillance, fisheries and scientific applications.

Venture into the Norwegian

Subsea Valley

All matters maritime and subsea are seemingly intertwined into the Norwegian DNA. For the tenth anniversary of the "MTR100," our Oslo-based contributor William Stoichevski ventures into Norway's "Subsea Valley" for a look at the emerging tech and trends.

DNV GL

Worldwide classification society and technology advisor DNV GL says its Joint Industry Projects, or JIPs, with operators, contractors and manufacturers will bring about three DNV GL Best Practices that targeting subsea safety and cost-cutting.

"Years from now, these will be the standards. There will be no discussion," said Jarl Magnussson, a documentation expert for DNV GL.

The 16,000-strong outfit formed by the merger between Norwegian DNV and Germany's Germanischer Lloyd (GL) Noble Denton says the focus on achieving standard methodologies for subsea documentation, at least, has been "talked about for 20 years but needed now." Recommended practices for subsea documents, forged subsea parts and wellhead fatigue target interchangeability, safe operations and shorter lead times. Also sought are a lower document count and knowledge of wellhead loads due to today's larger and more complicated well designs. Operators in Oslo and Houston are understood to have submitted well histories for fatigue analysis.

He says 200 types of documents were collected during the JIP. "We have reduced that number to 46," Magnussson tells MTR. The documents guidelines are due out in December 2016.

ABB

Swiss-Swedish ABB has grown its Norway oil gas and chemicals business twentyfold since 1989, and its Oslo office, lab and remote-operations center is ready for more business.

Oslo overseas contributions to "100 projects at any given

Wellheads researcher: DNV GLs project manager for wellheads, Lars Tore Haug

Steady leadership: ABB oil, gas and chemicals director, Borghild Lunde

time." The lab is busy testing communications, automation and electrical parts and systems, and the remote operations center — which from the Norwegian capital controls for Shell the giant Ormen Lange gas field in the Norwegian Sea — might soon have another customer.

"Discussions" appear to be underway with Italian major ENI to run the Barents Sea Goliat oilfield from Oslo. Repeating the feat of controlling production from Ormen Lange would be a large feather in the hat of the ABB Norwegian operation.

Meanwhile, the business earns on field decline rates and subsea processing, "the next big thing." Company R&D worldwide now includes 8,500 staff and a $1.5 billion budget. A subsea electrical power JIP with Statoil (akin to GE Oil & Gas's and Nexans's) is understood to be costing $100 million. A 100 MW seabed power supply for large pumps and gas compressors is the goal. Prototype production is underway of a 100 MW transformer and variable speed drive capable of changing loads and able to power a seabed compressor from 100 km. Deliveries are seen by 2019. Operators see $500 million in OPEX savings for the CAPEX, plus greater recovery rates.

OneSubsea

Merging the subsea divisions of Cameron and Schlumberger into "a real company, and not just a marketing arrangement," has created a powerhouse supplier of electric submersible pumps, or ESPs, in OneSubsea, where better business is being anticipated. Process systems VP Jon Arne Svaeren said the 2015 installation by offshore service vessels of a 65-ton subsea compression system for Statoil's Gulfax field is "so important" as the high-water mark of an industry doing more with shipping and with subsea compressors. While crane lifts are bigger, so too is has the lift power in ESPs grown from 100 kWs in the 1990's to today's 5 MW.

A multiphase compressor for wet gas is an envisaged part of Statoil's "subsea factory" vision.

The company's multiphase compressors merge legacy Cameron and Framo controls and link them via satellite so operators and a OneSubsea man on a floating producer can remotely decide which life-of-field date is right to turn on "the extra energy in a reservoir". Gulf of Mexico and Angolan FPSOs helped by subsea compression have seen maximum recovery "six years quicker." Svaeren sees GoM contracts coming and no deep water slowdown.

Marine Cybernetics

The NASA shuttle disaster of 2003 prompted four NTNU professors that year to create university spin-off Marine Cybernetics, said Tom Pedersen, company drilling systems manager.

In disaster's wake, it was learned that a tiny bit of 32 bit code was overlooked by the heavily 64 bit Discovery launch system. Tests prior to launch, said Pedersen, would have provided "safety" of the kind Marine Cybernetics hardware simulations and software tests offer for blowout preventers, or BOPs, dynamic positioning computers, lift controls and topsides.

"You'll find no difference in using the real BOP or testing the BOP with our system," Pedersen said, admitting that sometimes customers "don't know what they've bought."

Subsea processing: OneSubsea's equipment test facility at Horsoy, western Norway.

The system uses hardware-in-the-loop, or HIL, to test critical operational functionality. Already, the big BOP and sheer ram makers are buyers of this software that IDs risk "quite early."

Marine Cybernetics is focused on new-builds at yards, where manual testing can be combined with HIL. Testing for DP systems, too, can be remote. The DP vendor need not be on the vessel. Control software, too, is tested, and tests of third party emergency shutdowns have found "a lot of different things without alarms". DNV GL owns shares in the company.

Nexans

Celebrating 100 years of "cable solutions," the Norwegian business of this Belgian-headquartered firm has won the job of supplying Norway's flagship offshore megaproject, Johan Svedrup, with 44 kilometers of copper pipeline-heating cable.

The company's production plants at Halden and Rognan in southern Norway have been weaving wire, fiber optic and liquids-delivering steel-tube umbilical since the early 70's, and the offshore boom is kept alive by recent orders for Chevron at St. Malo and from Shaw Deniz in the Caspian Sea, where Subsea 7 are customers at the huge BP project, and Nexans has now delivered direct heating cables and umbilical for installations down to 2,700 meters and spans of 145 km.

On platforms, topsides cables and fiber optic distribution frames as well as cable end modules are the new rave, but Nexans is looking to the success of R&D on downhole cables.

"We have worked with BP and Statoil to increase the life of (downhole cables) from months to years," says Ragnvald Graff, sales and marketing director for hybrid subsea cable. Though "early stages," a long-life, downhole prototype is anticipated in 2016.

Rystad Energy

Summer 2015 saw this Norway-based numbers cruncher open a new office in oil town Stavanger, where operators and oilfield services already consume the company's reports.

Founder Jarad Rystad, a mathematician, has grown his business exponentially in a decade. Analysis is now broken down into modules for custom offshore market breakdowns. Much of it appears in the Norwegian government's budget deliberations.

Rystad forecasts have become a soothing read for suppliers anxious about demand: "A clear reduction in shale (oil)" production and refined products to 2016, yet "constant shale" to 2018, when an industry-wide upturn will nevertheless be underway for all but subsea services (equipment bought recently will be installed later). By 2019, Rystad sees a surge in subsea revenues.

By 2020, the influence of U.S. shale — widely blamed for the death of European refineries and lower oil prices — will have waned, as production is halved from today's levels. By 2016, when "demand catches up with supply." oilfield investments will begin a four-year spike to 2020 and reach $400 billion worldwide. Importantly, it'll be largely "back to normal" in 2017 after a year of "marginal new committed capex."

Statoil

With most of its procurement sourced in Norway, streamlining subsea logistics has been a tempting but elusive target for

Big BOP

Marine Cybernetics, owned by DNV GL, can check the thousands of lines of code in a blowout preventer's control system.

Norway's stately deep-water operator. Lower oil prices, however, may be the impetus needed to get suppliers and other operators involved in "simplified" equipment supplies. Company clerks in Scotland and Norway are charting and securing equipment supplies via an "x-vendor interface," part of a new "spares" organization that could "lower rig modification costs," an expense Statoil "will map."

"The idea is to put project pricing back into the system," a spokesman says of the commodity-like equipment distribution envisioned for "known" rather than "tailor-made" tech.

A billion kroner have been earmarked to build warehouses, in at least Norway, and $1 billion in ready subsea systems are understood to already be sitting in storage. Statoil has bought and put away equipment while securing from suppliers a measure of interchangeability (notably from Aker Solutions and FMC) in work-over systems, trees and templates. The company says it has enough work-over systems, at least, and, since 2010, has paid deposits on other equipment.

Xvision

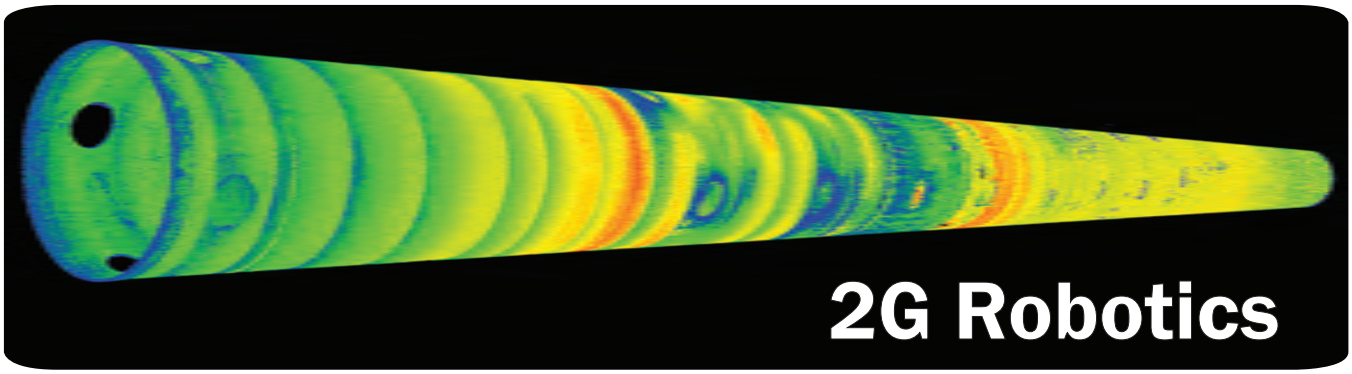
Quietly, Oslo-based graphics outfit Xvision has since 1999 helped engineers design a 3D vision for 300 of the world's more complex offshore projects. In the summer of 2015 they're offering in the 2D field app of "personal" scale what customer's like Aker Solutions have purchased for large-scale design simulations. Other clients include Lundin Norway and GE Oil & Gas, which reportedly cut a bid process down from three weeks to one hour using the app.

Dubbed a "field activity planner." or FieldApp, by CEO Stein Kjartan Vik, the app is a "decision tool" that lets engineers drag, drop and move known oilfield equipment into a childishly easy-to-change field layout.

The software takes not-so-visual planning documents — including spreadsheet schedules in MS Excel, which the app replaces — and breaks them down into visuals. The app is a Web-based cloud solution that's "secure and encrypted" for staff working simultaneously on the same document.

Xvision Desktop

photo: Oyvind Hagen, Statoil



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CEO/President: Jason Gillham
No. of Employees: 18

2G Robotics was founded in 2007. The company designs and develops underwater laser scanners for subsea surveys and inspections. These innovative systems generate real-time 3D models of subsea structures and environments from which submillimeter measurements can be instantaneously and repeatably captured. The high resolution 3D models provide the precision and accuracy needed for detecting and assessing damage, developing design and repair plans, and performing maintenance and installations.

The company has continued to expand since 2007 and has gained international prominence for its advanced subsea imaging and measurement technology. 2G Robotics is nearing a total of 50 systems built and deployed worldwide. The scanners have been used on all seven continents to inspect pipelines, mooring chains, jackets, I-tubes, water-supply tunnels, and coastal retaining walls; to facilitate spool metrology projects; and to provide detailed archaeological records of underwater historical sites.

Earlier this year, 2G Robotics solidified its international presence with the formation of a global sales and distribution partnership with Seatronics, an Acteon company. This partnership facilitates global access to 2G Robotics' high resolution underwater laser scanners and provides the benefit of Seatronics' expertise and global technical support.

2G Robotics is dedicated to using advanced research, development, and engineering for the innovation and production of cutting-edge solutions. The foundation of 2G Robotics is its wealth of engineering expertise in the development of reliable systems, which has led to the success of its underwater laser scanners. The 2G Robotics ULS product line currently consists of three models which operate at varying distances, the ULS-100 (short-range), ULS-200 (mid-range), and ULS-500 (long-range).

2G Robotics has developed an advanced calibration process for its systems. The laser scanner systems are factory calibrated and do not require any calibrations while deployed. To scan from moving platforms such as ROVs, AUVs, and vessels, the ULS-500 can be integrated with positioning systems. Mobile profile scanning is useful for applications with large or long scan areas such as kilometres of pipeline or long coastal retaining walls.

Part II

Teledyne Oil & Gas

By Greg Trauthwein

Mike Read is the President of Teledyne Oil & Gas, a division of Teledyne Technologies and a group he formed six years ago. MTR caught up with Read on the occasion of the MTR100 to discuss his corner of the Teledyne world and how it is faring in the subsea sector.

I know your group well, but in your own words can you give us a description of the group that you lead?

I created this team six years ago on the first of August. I was originally the president of ODI – Ocean Design, Inc. And after the completion of the merger by Teledyne, we decided to put together the harsh environment connector companies, which included ODI, Impulse and DGO. , In 2008 we acquired Cormon which brought us into sensing and monitoring for asset integrity. So then we had a couple hundred million dollars worth of harsh environment sensors and interconnect, and we came up with a very original name called Teledyne Oil & Gas. Subsequently, in 2012, we were given the Cable Solutions business made up of Storm Cable and VariSystems which added a nice harsh environmental cabling solution, land-based mainly. And then several months ago Teledyne acquired Bolt and we picked up a nice facility in Houston and another product brand under the name of AG Geophysical Products: primarily side-linked, but it gives us a much stronger position in Houston. So seven product brands, and we go to market globally as Teledyne Oil and Gas.

So the rationale then behind your group is what?

We are innovative but we needed more scale. To get in front of an operator as a small connector company is quite difficult; however, at $300 million with seven brands, you can get an audience with an operator and ask, "What are your technology gaps? We might be able to work together to fulfill them." That was the primary reason, and then that scale gives you cost effectiveness as well.

Can you discuss the markets that you serve – and today when you look at those markets, what do you see?

There are three major markets, and the most dominant is the offshore oil & gas production market. For the subsea distribution system, the linkage of power and optical interconnected systems that provide the power to, and around, the subsea oil field, the FMC trees, the Cameron manifolds, all have to be interconnected. Large modular pieces of equipment are placed across a wide area on the seafloor. We provide harsh environment wet mate and dry mate interconnect solutions that allow electrical power and electro-optical data transmission between these modules, providing the functionality for the subsea oil fields."

That's the primary market we serve. We then move on to land-based fracking sites, where we have harsh environment land, cable and connectors, built by our cable solutions group.

And then finally we have a very strong position on the U.S. Nuclear Fleet, where we provide the pressure barriers and interconnect solutions on the next generation submarine.

And your view of 'the market' today?

When we look at the market today, we are in a fortunate position in subsea as we've won the majority of the large projects, so we have good backlog; however, the industry today is very focused on taking cost out, for obvious reasons.

What data do you monitor and what are those numbers telling you right now?

There's a lot of public information looking at the CapEx dollars that are going to be invested in subsea, and you can drill that down to a well-known metric that is the number of subsea trees, specifically the number of trees that are going to be awarded in the next quarter, the next four quarters, the next three years. That's a dominant factor, but it's not inclusive, because we've experienced growth rates that are higher than industry tree award forecasts, and we've then been able to put together a dozen years of positive growth even though tree awards were forecasted to be down. But it's just as important to consider the subsea field architecture, which is becoming increasingly more complex. That means demand for our equipment is going up faster than the rate of decline for tree awards, for example.

So if you look at the forecast for trees peaking at about 550 two years ago, even though less than 300 were awarded in the last 12 months, this doesn't necessarily mean that our business is going to decline.

We were also able, through acquisitions (Cormon for example) to increase our content per tree. And I would say, conservatively, we have four to five times more content per tree today, than half a dozen years ago, pre-Teledyne Oil & Gas.

How has the continued low oil price impacted your mid-to long-range planning at this point?

Fortunately it has not affected our subsea business in the mid-term. We have won a significant market share and we have a healthy backlog. So short-term, everything is good.

"When companies have a problem, they're most likely to get Teledyne involved early in their program, and that's part of our mantra – 'Get us involved early and we'll help you save time and money and make your project more successful.'"

Mike Read, President, Teledyne Oil & Gas

medium-term, we've been forced to look hard at our cost structure. We had to look at our head count, we had to look at where we manufacture our products, and to do it in the most efficient, optimal way because from operator to engineering company to supplier, everybody is being asked to take out 25 to 30 percent from the cost. We continue to partner with our customers and our supply chain to find ways to reduce costs without sacrificing either quality or reliability.

Every business has its challenges. What are your group's?

Okay, good question. We constantly focus on operational excellence to be the cost leader, to be the company that provides the best value in on-time delivery and service. And we have to make the right investments in new technology.
So we look for funding from our customers to partially fund

medium-term product development, for say, three years, and in this way they show their commitment, and we know that there is really positive demand for the new technology for the products on a three-year horizon. So I would say that one of our significant challenges is, quite honestly, we have too many things to work on.

When you say you have customers 'funding' some new products in development, what specifically do you mean?

Take Shell or Chevron: they have technology gaps in their developments from three to five years out, so they will turn to the industry and they will look for companies like Teledyne who have new technology that can solve high pressure, high temperature, (20K PSI for the Gulf of Mexico), opportunities in three years. And they will then fund, either directly or through an FMC, or through a Cameron, a development program that may last two years. They're really buying the packaging and testing of that solution, so that when it's complete it will meet new industry standards.

What do you consider to be the primary strengths of the Teledyne brand as a whole, and what can or will the company do to better leverage those strengths?

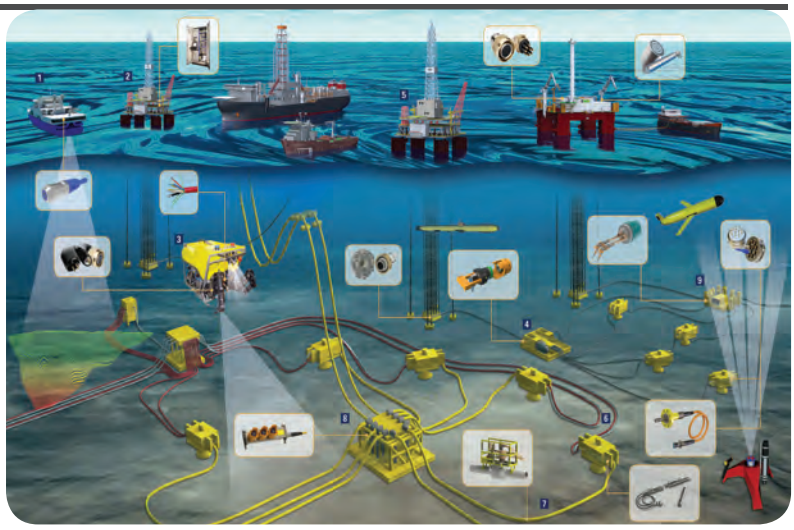
We're working on answering that as we speak, where Earl Childress who I think you are familiar with, has recently been appointed Executive Vice President of Sales and Global Marketing for the entire Teledyne Marine portfolio of Product Brands. He's putting a strategy in place where we are much more visible, we're much more efficient reaching our customers in Asia, reaching our customers in Brazil, in the North Sea, and the Americas. So I think you're going to see a step up in reach, in performance, in brand recognition, and in service that the industry has not seen before. The other opportunity is in sharing technology and technology developments. We recently opened a Technology Development Center in Daytona Beach – 52,000 sq. ft. and 100 people; a big investment in subsea testing and reliability. I think the message to our customers is 'if you really want this product to work for 25 years, come to Teledyne because they have a state-of-the-art, world-class testing facility.' And many of our customers come and test independently here, as well.

What do you see as the defining trends or technologies that will drive your business in the coming generation?

On the seabed there are going to be more sensors detecting flow and pressures; and that's going to drive the need for more bandwidth, to deliver more data, which will create additional requirements for optical and Ethernet communications. Enabling power and data transmission and distributions systems is our sweet spot.

There are going to be more demands for higher pressure and higher temperature capabilities, which again is in our sweet spot with our glass-to-metal sealing and our ceramic technology, which facilitates high power at high pressure in subsea boosting and pumping applications. As I mentioned before, the number of trees is interesting, but in consideration of the number of pieces of equipment that are going to go on the ocean floor with less human intervention, fewer ROVs, smaller ROVs; there is clearly a great opportunity for Teledyne to invest in new materials, new products, and new services.

Teledyne Oil & Gas



Teledyne Oil & Gas, also frequently referred to as **Teledyne Marine Interconnect Solutions**, is focused on strengthening the value proposition by delivering high reliability engineered solutions for subsea and topside pipeline asset integrity monitoring and sensing, power/data network transmission and distribution system applications primarily for Ocean Science, Defense and Oil & Gas exploration and production industries.

Formed in 2009 from a group of market-focused Teledyne Technologies companies, Teledyne Oil & Gas has evolved to become a single integrated organization with seven product line entities: AG Geophysical Products, **Cormon**, DGO, Impulse, ODI, Storm Cable and **VariSystems**, plus a close association with research partner Teledyne Scientific Corporation. Together the teams have participated in hundreds of subsea projects with hundreds of thousands of units deployed.

A global business with company headquarters in Daytona Beach, Florida, USA, Teledyne Oil & Gas has manufacturing sites in Daytona Beach; San Diego, CA; Portsmouth, New Hampshire; Alton and Worthing, UK; Dallas, TX; Houston, TX; and Mexico. Global aftermarket support centers staffed with cross-trained service technicians and engineers are located close to major customer manufacturing locales in Houston, TX, Ellon (Aberdeen), UK, Johor Bahru, Malaysia and two centers in Rio de Janeiro, Brazil. A new Technology Development Center dedicated to advanced engineered technology

development opened October 2013 in Daytona Beach.

Teledyne Oil & Gas excels in new product development and leads with a strong reliability program based on understanding all aspects of our systems' and subsystems' 25 year performance life capability from the materials systems through to the physics of failure of each material in the system and to complex accelerated aging performance qualification using the latest advanced methods of combined stress analysis and materials certification in association with Teledyne Scientific, a leading materials science research center in Thousand Oaks, California.

Teledyne Marine Interconnect Solutions exists as a subset of Teledyne Oil & gas product lines focused entirely on engineered solutions for marine application challenges. These product lines include:

AG Geophysical Products, (AGG) which supplies the world's marine seismic fleet with ruggedized submersible connectors and marine seismic source management systems engineered for reliable performance in the harshest of ocean conditions. Precision machining capabilities with proven production and quality processes deliver ruggedized performance survivability in repetitive high shock and shallow water sealing applications in the toughest deployment and retrieval scenarios that are applicable to demanding ocean science, defense and oil & gas applications as well.

DGO is a leader in providing high-reliability connection and penetrator solutions for high differential pressure challenges in extreme environments. Since 1962, Teledyne DGO has incorporated the unmatched reliability of glass-to-metal seals into optical and electrical solutions for our customers. Of the hundreds of thousands of high pressure glass seals delivered by Teledyne DGO, there are no known incidents where these seals have failed to maintain pressure-tight integrity. Technology solutions include standard and custom engineered dry & wet mate connectors and penetrators for extreme temperature and pressure applications. Recent new product development in High Pressure/High Temperature (HP/HT) down hole electrical feedthrough systems are enabling instrument deployments to gather data in the most extreme environment applications.

Impulse has supplied the underwater industry with the highest quality dry mate submersible connectors and cable assemblies to create engineered solutions since 1978 and is a leader in the design and manufacture of electrical and optical interconnection systems for a wide range of harsh environments. Through creative problem solving, rapid response and competitive pricing, an international reputation for exceptional service and quality has been achieved. Solutions include: Dry Mate Electrical Connectors, Dry Mate Electro-Optical Hybrid Connectors, Wet Pluggable Electrical Connectors, Underwater Mateable Electrical Connectors, Electrical Penetrator Assemblies, Magnetically Operated Proximity Switch and Custom Molded Products. Recent advances in Gigabit Ethernet interconnect solutions for instrument data transmission are enabling more data and faster transmission times.

ODI is a leader in subsea electrical and fiber optic interconnect and distribution systems. ODI's wet-mateable connectors include subsea power and broadband data transmission assemblies using electrical and fiber optic connectors. All are based on patented oil filled, pressure balanced (PBOF) technology. Companion dry-mate submersible connectors and Field Assembled Cable Terminations and PBOF distributions systems complement the wet-mate lines. These rugged components can be used at any ocean depth and in the harshest environments. In addition to standard product lines, ODI provides top quality custom engineered solutions for any subsea networking challenge. Recent new product developments in high power wet mate interconnect systems and advanced broadband communication from "Active" Flying Lead designs are changing the subsea infrastructure profile.

Teledyne Cable Solutions - Storm Cable has provided engineered, custom core, application-specific bulk cable constructions for over 40 years. Storm cables are designed to meet demanding performance specifications of mixed geometry multi-cored cable elements under a single jacket for size, space, and performance efficiencies. Storm produces cables for a broad range of harsh environment applications in the Oil & Gas, mining, heavy equipment, defense and marine markets. Small run prototype quantities for qualification are available with short lead times.

Saab Seaeye

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The Company

Saab Seaeye manufactures electric ROVs, including Saab's range of tethered and hybrid underwater vehicle systems for both the defence and commercial markets. The company has facilities in both the UK and Sweden and employs more than 250 people, with a turnover of around $90 million. Exports stand at more than 80% of sales with the company represented and supported in 25 countries around the world, and has an office in Houston, Texas. Founded in 1986, more than 800 ROV systems have been sold, fitted with a range 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.

The Technology

Technologically, the Saab Seaeye range comes in various sizes, power and tasking options that extend from compact inspection ROVs to work ROVs and AUV/ROV hybrids. **Recently introduced is the Seaeye Technology Toolbox concept that creates a common architecture resulting in the lowest number of parts at the least possible cost for the highest possible performance and quality.** The Seaeye Technology Toolbox is important in the development of breakthrough concepts like the Intelligent Control System, iCONTM, a vital innovation that makes every device within an underwater vehicle aware of its own status, predicts failure and takes action as necessary to keep the vehicle working. iCONTM also lets engineers reach across the world into the heart of a vehicle through an internet gateway that gives them ready access to diagnostics, software upgrades and system inventory.

The Range

- **Falcon** – Portable ROV for easy deployment. Rated 300 and 1000m.
- **Tiger** - Inspection and observation ROV. Five thrusters. Rated 1000m.
- **Lynx** - Larger than the Tiger with additional outlets for survey sensors. Six thrusters. Rated 1500m.
- **Cougar XT** - Powerful observation and light work ROV. Six thrusters. Rated 2000m.
- **Cougar XT Compact** – Low profile version for strong currents. Six thrusters. Rated 300m.
- **Cougar XTi** – iCONTMcontrol system. Six thrusters. Rated 3000m.
- **Panther XT** – Light Work and Survey ROV. Six thrusters. Rated 1500m.
- **Panther XT Plus** – Powerful fast swimming version. Ten thrusters. Rated 1000m
- **Leopard** – Compact, powerful, work class ROV. iCONTM control system. Eleven thrusters. Rated 3000m plus.
- **Jaguar** - Largest work ROV. iCONTM control system. Eight thrusters. Rated 3000m with 6000m option.
- **Sabertooth** – Autonomous, hovering, long range AUV/ROV hybrid for inspection and light work tasks.

Bordelon Marine

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CEO/President: Wes Bordelon
No. of Employees: 300

Bordelon Marine provides Marine Transportation services operating in the Gulf of Mexico and around the world. Founded in 1979, as a provider of offshore vessels supporting a multitude of services to the Oil and Gas Industry. The company owns and operates a fleet of modern offshore supply vessels ranging in size and type from DP1 Mini-supply Vessels to MPSV 260 DP2 vessels. Bordelon Marine offers a full range of services including: construction support, exploration, production, Survey and ROV support, topside mobilization and fabrication management. In 2011, it opened a new state-of-the-art shipyard in Houma, LA to build its deep water DP2 PSV and MPSV series, the Stingray 260 Class. **The Stingray 260 Series includes high spec, cutting edge tech and design in a smaller, more affordable vessel platform.**

The Stingray 260 is a MPSV that can be adapted in a number of different ways, built at the company's shipyard in Houma, LA, allowing for ease of modification to meet a client's needs. The first Stingray vessel was modified to be a light well stimulation vessel for Baker Hughes.

The second and third boats in the series have been modified to support subsea activities, Ultra-Light Intervention Vessels (ULIV).

Greensea

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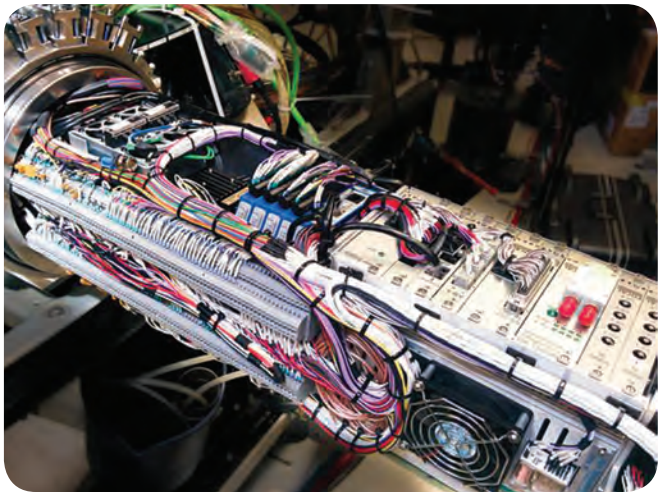
CEO/President: Ben Kinnaman
No. of Employees: 15

Greensea was founded in 2006 to provide the offshore industry with advanced navigation, control, and automation software in an operator-friendly workspace. The company has since installed systems on hundreds of vehicles, and provides software solutions to numerous OEMs, US Government facilities, science and academic institutions, and end users.

Its strength stems from a team of engineers with extensive experience with integrated underwater navigation systems and advanced vehicle control. Backed by this team, Greensea offers commercially available products as well as custom engineering solutions that utilize Greensea's openSEA core technology. Greensea provides integrated inertial navigation systems, mission planning, autopilots, and intelligent automation for Unmanned Underwater Vehicles based on our patent-pending technology, openSEA. openSEA was designed and developed specifically as a modular programming environment for UUVs, and is built on a robust error reporting and communication backbone. It provides proven and tested software modules ranging from optimal control and Kalman filtering, to data management, to native support for thousands of widely-used sensors and devices. The strength of Greensea's technology was first recognized by the scientific community. One of our earliest adopters is the National Oceanic and Atmospheric Administration, who commissioned the company for a complete system upgrade for its Deep Discoverer ROV and Seirios camera platform in 2012. In the spring of 2015 the team successfully integrated technology with the Ventana, the Monterey Bay Aquarium Research Institute's work class ROV, and ROPOS, the Canadian Scientific Submersible Facility's 5,000 meter, 3393 kg vehicle.



Rockland Scientific Inc.

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W: www.rocklandscientific.com
CEO/President: Fabian Wolk
No. of Employees: 15
Annual Sales: $2.75m

Ocean turbulence is a key component in understanding climate change and the challenges of harnessing tidal energy. 2014-15 saw the addition of three more employees and the announcement of the RSI-led UK-Canada Trans-Atlantic funded In-situ turbulence replication evaluation and measurement (In-STREAM project). Rockland Scientific continues growth as the foremost expert, innovator and supplier of turbulence measurement instrumentation.

The Company

Rockland Scientific (RSI) designs and manufacturers high-accuracy instrumentation for oceanographic research. In 2015 RSI was selected to lead one of two projects, selected for funding through a joint research competition managed by UK and Canada not-for-profit research groups and government funded business and innovation accelerators.

In partnership with Dalhousie University, Black Rock Tidal, FloWave TT, European Marine Energy Centre, and Ocean Array Systems, Rockland Scientific will develop a new sensor system to measure the impact of turbulence on tidal devices.

Rockland Scientific offers a wide range of turbulence measurement systems for operation in the upper ocean and down to 6000 m.

The product lineup falls into three major categories: vertical profiling instruments; modular sensor packages for deployments on AUV, gliders and other autonomous platforms; and customized measurement solutions for science, engineering, and security applications.

EvoLogics GmbH

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CEO/President: Dr. Rudolf Bannasch & Dr. Konstantin Kebkal
No. of Employees: 30

EvoLogics GmbH is a German high-tech enterprise, founded in 2000 by a group of leading international scientists and R&D experts. The company's mission is to develop innovative technologies for maritime and offshore industries through interdisciplinary cooperation between engineering and life sciences.

The company 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. Advanced product features have become enabling technologies for deep water exploration and production.

EvoLogics are experts in cutting-edge underwater communication and positioning systems, as well as novel robotic solutions. The company's advanced spread-spectrum technology allows to deliver optimal results for various subsea applications. EvoLogics 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 reliable acoustic telemetry that provides an independent bidirectional 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 to control 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 turn-key solutions ranging from initial deployment up to recovering the equipment.

Seafloor Systems, Inc.

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www.seafloorsystems.com
CEO/President: John Tamplin
No. of Employees: 10
Annual Sales: $3m

Seafloor Systems, Inc. provides a full spectrum of hydrographic survey equipment, software, personnel, training and support—specializing in the geophysical sector—for survey companies worldwide. The company develops and manufactures the HydroLite portable hydrographic survey system, HyDrone-RCV, and EchoBoat remote-controlled survey platforms for remote hydrographic survey applications. Seafloor Systems was formed in 1999 by veteran U.S. Navy Hydrographer John Tamplin, and has built 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 position and orientation systems into a complete, turnkey product. Recent integrated solutions are: the EchoBoat, a remotely controlled multi-purpose vehicle capable of carrying multiple sensors including a multibeam echosounder, side scan sonar, ADCP, singlebeam echosounder, and sound velocimeter. The HyDrone-RCV, a hand-portable, remote control survey boat platform works in conjunction with the HydroLite-TM portable echosounder kit to conduct bathymetric surveys in ponds, lakes, rivers, and streams. The HyDrone has been built with a wide profile to avoid tipping, and watertight construction.

SeaView Systems, Inc.

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W: www.seaviewsystems.com
CEO/President: Matthew Cook
No. of Employees: 7
Annual Sales: $1m

Seaview Systems (SVS) has developed a world-class tunnel inspection solution incorporating inertial navigation into an articulated ROV body. The system merges several new technologies engineered by SVS including a distributed control topology (ROVbus) and an ultra-compact optical fiber multiplexer system.

The ROV is capable of accessing tunnels through tight valves to inspect and geo-locate the tunnels for distances in excess of 20,000 feet. SeaView Systems was founded on experience in maritime electronics and Remotely Operated Vehicles. Since beginning operations in 2003, its has built an extensive portfolio of more than 60 projects working in nine countries catering to various industries including hydro-electric; nuclear; salvage; oil & gas; municipalities (potable water and processed sewerage); pulp mills; mines; and military/police and science (NOAA and NASA).

Multi-Electronique

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CEO: Jacques St-Pierre
No. of Employees: 12

Multi-Electronique (MTE) Inc. offers a large, 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. It is powered by Alkaline "D" cells and available in three lengths for short, medium and long deployment (respectively 16, 64 and 128 batteries).

CM Lab Simulations

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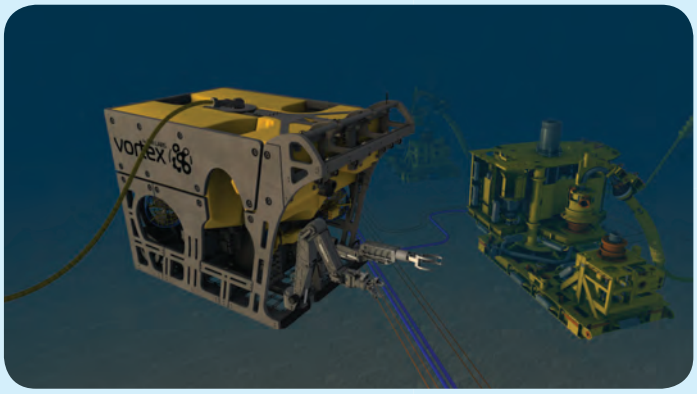
CEO/President: Robert Weldon
No. of Employees: 135
Annual Sales: $7.5m



CM Labs is the developer of Vortex, a simulation platform that simulates the dynamics of virtual cranes, equipment, ROVs, AUVs, vessels, robotics, cable systems, tethers, and sonar. Vortex is found under the hood of many major maritime engineering and training applications today.

For more than 15 years, CM Labs has provided simulation solutions and services to organizations around the world. Through simulation, it helps to augment skills and reduce the risks of complex operations. With experience ranging from deep-sea to space projects, the CM Labs team features experts with decades of experience and wide-ranging backgrounds in training, vehicle dynamics, heavy equipment and robotics.

All CM Labs technologies and services are backed by our multidisciplinary staff, with PhDs and master's degrees in the fields of virtual reality, engineering, computing, physics, and mathematics.

Through Vortex, CM Labs provides capabilities for training simulators, mission rehearsal, serious games, virtual prototyping, and testing. Vortex customers include FMC Technologies, Allseas Group, Subsea7, Oceaneering, Forum Energy, MARIN Institute, and more than 100 other leading organizations.

From Class A DNV ROV pilot simulators to drill deck simulators to crane simulators built to API, NORSOK, and OMHEC training guidelines, Vortex training solutions are used every day to prepare operators for the challenges offshore.

For EPIC projects, Vortex is used to virtually plan operations from the deck to the seabed—from lifting and rigging to tooling systems and asset deployment.

With Vortex, operations can be simulated, not just animated. This provides engineers with a complete understanding of equipment layout, functionality and control. It assures operational predictability, lower risk, and reduced commissioning time.

Operations modeling can be used to optimize existing projects, as well as new projects at the FEED stage. This includes the simulation of critical lifts, SURF installation, material handling, deck layouts, field visualization, and ROV operations.

Vortex provides engineering-quality real-time simulations that can be integrated with controls and systems design software to test and validate your equipment and procedures.

Vortex also simulates subsea hydrodynamics, cable systems, sonar, and other critical systems simulations and visualizations. Simulations run in a real-time environment that allows you to consider the impact of water currents, wind, and visual conditions. It provides a comprehensive simulation of equipment operations in situ and allows you to test in the virtual world what you can't in the real world.

Aanderaa Data Instruments AS, a Xylem brand

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Website: http://www.aanderaa.com
CEO: Patrick Decker
No. of Employees: 90

Aanderaa's roots were formed in the need to make reliable measurements in the earth's most harsh environments. Founded in the early 1960s by Ivar Aanderaa, the Aanderaa name quickly became synonymous for robust and reliable instrument solutions for oceanographic and other environmental measurements. Now as part of Xylem, Inc., the Aanderaa reputation continues to serve the global need to have better, smarter, and more robust sensor and systems solutions. Aanderaa actively collaborates with other companies within the Xylem Analytic family giving it a global access to its customer base and systems integration capabilities in remote parts of the world. Aanderaas' latest innovative environmental products such as the new in-line ZPulse DCS for easy system integration, the Doppler Current Profiler Sensor Sensor as a stand-alone product as well as the SeaGuardII DCP with Dual Head , marks a turning point in distributed instrumentation for underwater measurements of Hydro Acoustic, Electro-Optical, Electro-Chemical, Pressure, Temperature, Meteorological data in observing networks and self-contained instrumentation. At the core of the system is the CANBus based AiCaP protocol, which enables self-detection of connected sensors and dynamic setup of configuration menus. This protocol was developed by Aanderaa in order to achieve the extreme low power requirements of the Underwater Observatories. The master-slave protocol extends the CANBus protocol with extra signaling to efficiently wake up sensors or datalogger to receive data when necessary. Sensors on the bus perform their own measurements at the required intervals and send collected data to the SeaGuard or SmartGuard logger. These dataloggers assemble the datasets and package them to ensure safe communication of data to a receiving station utilizing the Real-Time communication system. Sensors on the AiCaP bus are utilizing Smart Sensor technology and can operate both in the bus configuration and as stand-alone entities. In the latter mode, they can be interfaced to any computer or logger using the RS-232 port and can be programmed to varied modes of operation.

Sensor Technology Ltd.

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CEO/President: Niru Somayajula

Sensor Technology Ltd. (SensorTech) designs and manufactures custom acoustic transducers, hydrophones and piezoelectric materials. The company was founded in 1983 and in the early days had a strong focus on research. It has conducted experiments on the space shuttle, the Mir space station and in ocean depths below 20,000 ft. More than 30+ years in business it has shifted our focus to industrial applications.

SensorTech produces custom acoustic sensors for companies building systems for mine hunting, sonic ranging, sub-bottom imaging, trawl monitoring, fish tagging, marine seismic exploration and more. It also makes acoustic transducers and hydrophones for use outside the marine environment, for applications such as medical imaging, oil well logging and gas flow measurement. Its history of research and development is the key to its ability to design custom devices for such a broad range of applications and industries.

(1.) SensorTech manufactures piezoelectric ceramics, including hard and soft PZT meeting the specifications for Navy Types I, II, III, V and VI.

(2.) It uses its own ceramics to design and manufacture custom acoustic transducers and hydrophones. Volumes range from one-offs and prototypes to high volumes, producing as many as 6,000 hydrophones per week, month after month.

(3.) It designs and manufactures hydrophone preamplifiers and transformers for piezoelectric acoustic transducers. These components provide the first layer of electronics, simplifying the process of integrating our custom sensors into the systems of our customers.

Editor's Choice

Five Stand-Outs

MTR's roving correspondent Kira Coley was tasked to identify and deliver five innovative companies worthy of inclusion in the 10th Annual MTR100.

Deep Trekker Inc.

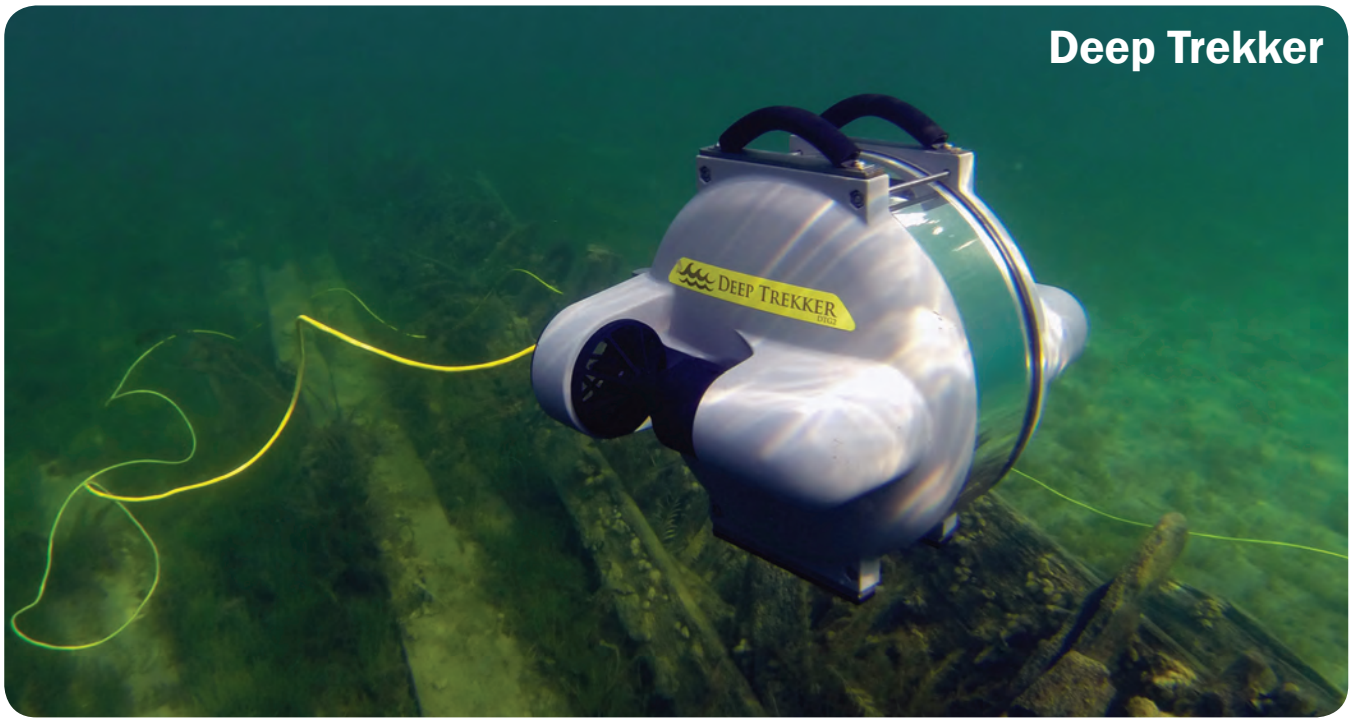
Deep Trekker Inc. was founded in 2010 with a mission to bring a fully capable yet portable and accessible remotely operated vehicle to market. Over the last 5 years, Deep Trekkers ROVs have quickly been adopted around the world as the go to underwater observation tool. Based on clean-sheet, innovative engineering, Deep Trekker offers a new breed of submersibles. Deep Trekker products are used across the world for applications including aquaculture, commercial diving, salvage, military, oil & gas, marine survey, research and recreation.

As the World's first fully Portable Vectored ROV, Deep Trekker's DTX2 patented pitching system is combined with powerful vectored thrusters for unprecedented flexibility and movement in the water. Forward, reverse, up, down, and lateral movements are available in 360 degree vertical and horizontal planes using only 4 thrusters. Vertical movements are accomplished using the main thrusters instead of relying on substandard vertical thrusters, providing unmatched speed & maneuverability. The DTX2 comes with many options for sophisticated add-ons such as single and multi-beam sonar, USBL positioning, Cutter Attachments, Cygnus Thickness Gauge, tether lengths up to 300 M. Intelligent features come as standard with the DTX2 ROV System, allowing users to work in higher currents and maintain stability.

Taking its cues from larger ROVs, the DTX2 brings all of the functionality required for difficult jobs, but without the usual complexity. Building on the proven DTG2 platform, Deep Trekker offers unparalleled ease of use and simplistic sophistication.

Schmidt Ocean Institute

Established in 2009, the Schmidt Ocean Institute strives to advance the frontiers of ocean research and exploration through novel technologies, intelligent observation and analysis. The last year has seen their involvement in many ground-breaking projects, pushing the boundaries of innovation and marine research. Schmidt Ocean Institute approaches oceanographic re-



(Credit: SOI/ Logan Mock Bunting)

search from the technological, operational, and informational perspectives. The institute maintains and operates R/V Falkor as a technologically advanced scientific platform suitable to support multidisciplinary oceanographic research and technology development. Collaborators get free access to R/V Falkor with her on-board research facilities and expert technical support in exchange for a commitment to openly share and communicate the outcomes of their research.

In March 2015, the Schmidt Ocean Institute worked with the University of Sydney, MIT, as well as other institutions on the "Coordinated Robotics" project, which was also featured in June 2015 issue. The goal was to expand techniques for efficiently coordinating deployments of multiple exploratory underwater vehicles by advancing algorithms and their autonomous capabilities. The success of the project has brought engineers even closer to leaving groups of vehicles untended for long periods for a variety of underwater observation and data collection missions.

The "Perth Canyon: First Deep Exploration" was another project based in one of Australia's proposed national reserves. Despite being just 50 kilometers or so from Western Australia's capital of Perth, the canyon's deeper reaches remained poorly known and largely unexplored until 2015, when scientists from the University of Western Australia onboard Schmidt Ocean Institute's Research Vessel Falkor explored the region, along with a deep-diving remotely operated vehicle.

Xeos Technologies

With decades of manufacturing experience, Xeos Technologies have successfully designed market leading wireless telemetry products for use in the world's harshest environments. Products range from deep sea alarm beacons to surface oil spill tracking systems to land based perimeter surveillance systems. Xeos is an Iridium Value Added Reseller and provides contract engineering services in addition to its standard product line. All these qualities have brought them success in their four divisions: Communications, Oceanographic Asset Recovery, Remote Monitoring and Security.

The Apollo is an independently powered, self-contained mooring beacon with the power of an ultra-bright LED Flasher combined with satellite communications. Users receive notification of the Apollo's arrival at the surface from anywhere on earth via the Iridium Low Earth Orbit satellite communication system. This beacon provides unparalleled visibility, even in the worst conditions.

Apollo is fully submersible and has been rated to 11,000 m (36,089 ft) below sea level. In addition, the solid state surface sensor provides a measure of reliability unavailable in mechanical methods. The new APOLLO unit combines all the best features of Iridium communication beacons and LED Flashers, along with up to 10 years deployment on alkaline batteries.

With older style VHF beacons, a handheld "direction finder" would need to be used to locate equipment, sometimes in very


dotOcean's GraviProbe

harsh conditions. The APOLLO can receive a real-time GPS location from virtually anywhere and then relay the beacon's current coordinates, allowing a quick recovery of equipment.

The Xeos APOLLO is a fundamental improvement over older technology and provides a single unit that will meet and exceed any requirements for depth, extended deployments, non-corrosive material construction, as well as the enhanced capabilities of a combination GPS/Iridium/LED flasher.

dotOcean Nautical Innovations

dotOcean develops pioneering measurement instruments for sediment profiling, sensor networks and data acquisition platforms for the maritime and offshore industry. Its unique product range is making its mark in the industry and they are quickly emerging as a market leader in sediment profiling technology. Today dotOcean offers a range of innovative measurement instruments and rapid development services. Their expanding range of products have applications in many areas including dredging, port and offshore construction and subsea pipeline installation.

The GraviProbe is a free fall impact instrument, analyzing the underwater sediment layers during intrusion. Under its own weight it accelerates and penetrates fluid and consolidated mud layers.

The rheological conditions of the soil layers are determining the probe's dynamical behavior. The data acquired from onboard accelerometers, inclinometers and pressure sensors is feeding a model which determines the rheological parameters of the intruded medium (depth, undrained shear and viscosity).

As a result the GraviProbe is able to very accurately distinguish the depth of the fluid mud and consolidated mud layers, even in gaseous environments.

The high sensor data acquisition rates of up to 2kHz in combination with a low drag housing results in the highest quality profiles at drop rates over 7 m/s. Due to its light weight, the probe can be operated manually from a small vessel, platform or quay, limiting operational costs.

Additional products include the GraviProbe Rheology which provides tip resistance and shear strength and the GraviProbe Soil which has a conus extension to penetrate hard, stiff sediment layers.

Teledyne Bowtech

Teledyne Bowtech specializes in the design, manufacture and supply of underwater vision systems, offering the industry an extensive range products including video inspection systems, underwater cameras and underwater LED lights. Teledyne

Bowtechs' products can be deployed at any ocean depth in harsh environments within the ROV AUV, Oil and Gas, defense, oceanographic, nuclear, leisure and marine science industries.

The Tech

The SURVEYOR-HD PRO ultra-wide angle underwater HDTV camera is designed to provide the viewer a greater angle of view, from the standard Surveyor HD, whilst remaining compact and very competitively priced. The camera is ideal for ROV inspection tasks, scientific observation and broadcast applications. Video output is available as HD or HD-SDI over fiber.

This camera sits at the top of their product range and has recently been used by Curtin University in partnership with the Western Australian Museum on an expedition to survey the wrecks of the HMAS Sydney and the HSK Kormoran.

The camera is available in a variety of control formats, including the Bowtech Products GUI, which facilitates the control of all features including white balance, auto tracking and back light compensation, which can be switched on or off using the GUI.

Excellent images are obtained, through the fused quartz hemisphere window and the camera is ideal for overall scenes and close-up inspection while using a remote control setup. The optics are also fully corrected for radial lens distortion and chromatic aberration. The camera is housed within a 4,000m rated titanium housing, as well as a 6,000m option with a fused quartz hemisphere window.

Teledyne Bowtech
Surveyor HD Pro

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AXSUB Inc.

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CEO/President: Mr. Eric Gaudreau
No. of Employees: 5

AXSUB is a manufacturer of diving equipment such as Digital Video Recorders, Low voltage LED Lamps, Underwater Cameras and Electronic Depthmeter. Its flagship product, the AxVIEW 2V-RM, is 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 2nd generation of the company's Diving Data Management System (AxDDM) that is designed for a typical rackmount installation available as a 1, 2, 3 or 4-diver system. AxSub has a portable version: the AxVIEW P available as a 1, 2 or 3-diver system. This system can be deliver with a Panasonic Toughpad and monitors installed in the lid of the Pelican case.

Hyperbaric and Subsea Environments Data Acquisition Systems: Over the last five years, the AXSUB team has designed several different types of monitoring systems for the Underwater and Hyperbaric Industry. Our systems are used by the key players for video recording and continuous depth monitoring of divers.

Falmouth Scientific, Inc.

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CEO/President: John Baker
No. of Employees: 17

FSI's engineering knowledge and experience have enabled the company to offer instruments, systems, and solutions that help our customers collect and relay data in real time. Core competencies include system and design engineering; on-site volume production, rapid prototyping, encapsulation, and assembly; and electrical, acoustic, and system testing. Innovative development efforts have led to several new product and system introductions over the past year, with more planned for the months to come. FSI operates from a state-of-the-art manufacturing facility located in the marine technology corridor on Cape Cod, MA.
"Falmouth Scientific offers a full spectrum of systems to cover sub-bottom and seismic survey needs:

The Bubble Gun family of low-frequency, portable seismic systems offer performance that exceeds that of competing systems but with a much smaller footprint and required infrastructure. Other key Bubble Gun features include its low frequency, wide band signature, and its extremely high shot-to-shot wavelet correlation (greater than .96 without timing controllers). The recently announced CHIRPceiver is a true 24-bit CHIRP sub-bottom profiling transceiver. It is available in dual and single frequency configurations, and supports multiple frequency bands. FSI also offers hull mounted low and high frequency arrays, as well as other specialized low frequency transducer systems.

Sensor-based products include the PLUS Family of current, wave, and tide meters; rugged and portable side scan sonar imaging systems; solutions for drilling and vortex induced vibration monitoring; and other acoustics-based underwater instrumentation. Service areas include custom design, development, integration, and production of marine systems and acoustic transducers; and value-added services such as prototyping, product assembly, encapsulation, calibration, and pressure testing.

Blue Robotics Inc.

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CEO/President: Rustom Jehangir
No. of Employees: 4
Annual Sales: $360,000

The T100 Thruster won the "Cool Idea Award" from Proto Labs in April 2014

Blue Robotics – operating out of a garage but planning to move into a new 1500-sq. ft. space – was founded in 2014 by Rustom "Rusty" Jehangir, Joe Spadola, and Josh Villbrant – young engineers who, when working on a marine robotics project, had trouble finding affordable thrusters. Searching for solutions, they found the need for affordable thrusters was prevalent across the industry.

The trio came up with what it calls a unique and capable design, a design which won the Cool Idea Award from Proto Labs in April 2014, covering the cost of its injection molding tooling. The company launched the T100 Thruster through a Kickstarter crowdfunding campaign in August 2014, raising $102,000 over a 30 day period.

By November 2014, it had shipped its first batch of thrusters, and since then, the company reports it has shipped more than 800 thrusters and sold more than 1200 thrusters, serving a broad range of customers, from middle school MATE teams to researchers at Woods Hole Oceanographic Institution, in 25 counties.

It released new products, including the T200 Thruster and the BlueESC, in April 2015, and there are a number of other products in development for 2015.

The Big Picture

The team's long term goal is to become the definitive source for marine robotics parts, components, and supplies to the student, hobbyist, and low-end commercial market, spurring innovation and new technologies. The technology is based around a three-phase brushless motor like you'd find on a model aircraft or drone. The motor was designed from the ground up for use in water. The motor windings themselves are designed for low-speed operation suited to a propeller in water. The windings are protected from corrosion with a multi-layer protective coating. The typical steel bearings were replaced with high-performance plastic bushings designed for use underwater. This eliminates the need for lubrication and leaves the thruster with a single moving part.

The structure of the motor is built entirely of injection molded plastic that is UV resistant. Because the motor is completely immersed in water, there are no enclosed air or oil cavities, eliminating traditional pressure limitations. To date it has tested the thrusters to maximum depth of 3000m with no damage. The expectation is to operate at even greater depths with no issues.

It also developed an electronic speed controller that is waterproof, water-cooled, and designed to mount directly to the T100 and T200 thrusters. An electronic speed controller (ESC) is required to operate the brushless motors. It is highly compact and offers a digital communication interface to minimize the number of wires that must pass through the vehicle hull.

Kraken Sonar System

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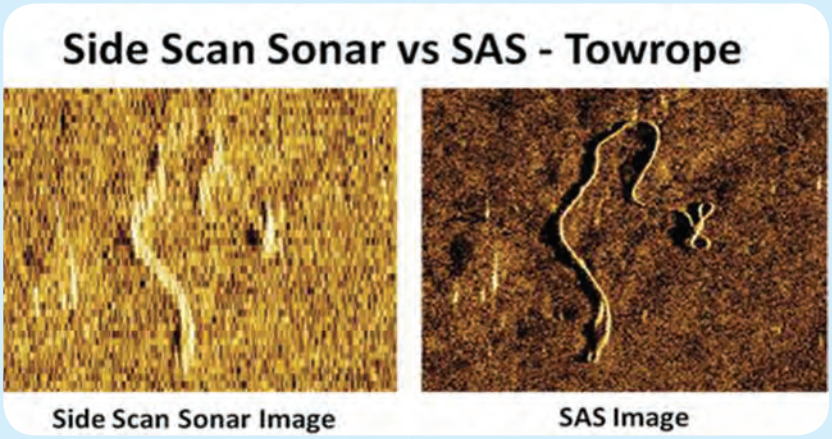
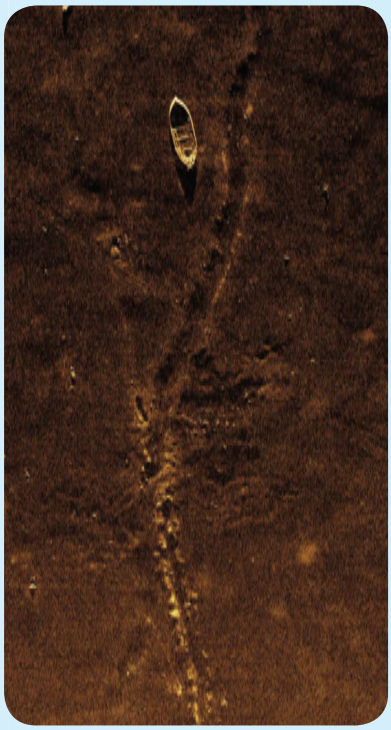
CEO/President: Karl Kenny
No. of Employees: 20





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. It is recognized as an innovator of Synthetic Aperture Sonar (SAS) – an underwater imaging technology designed to dramatically improve seabed surveys by providing ultra-high resolution imagery at superior coverage rates.

Kraken's series of SAS products called AquaPix leverages nearly two decades of R&D conducted by NATO's Undersea Research Center and millions of dollars in funding support from NATO government sponsors.

Kraken is currently engaged in various stages of technology validation and teaming agreements with leading laboratories and strategic industry partners including Defense Research and Development Canada, U.S. Navy's Naval Sea Systems Command (NAVSEA); the UK Ministry of Defense; Northrop Grumman; ECA Robotics and others. Kraken is located in beautiful, Conception Bay South, Newfoundland.

Kraken's AquaPix is an advanced, ultra-high resolution Interferometric SAS (InSAS) with 3D bathymetric capabilities, primarily designed for use onboard UUVs and Tow Bodies. It is capable of providing detailed images with an along-track/across-track resolution better than 3cm out to a range of 300m from each side of an underwater vehicle (600m swath). It can also produce bathymetric data with a resolution better than 25cm out to full range while delivering very high depth accuracy, in compliance with IHO S44 special order requirements.

In parallel with the hardware design, senior sonar scientists at Kraken have developed a complete software package for InSAS imaging called INSIGHT (INterferometric SasImaging Georeferenced High-fidelity Toolbox).

The first system was successfully integrated and deployed onboard DRDC's Arctic Explorer AUV in Halifax, Nova Scotia in August, 2012. All of the InSAS software processing was performed by Kraken's INSIGHT toolbox.

INNOMAR Technologie GmbH

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No. of Employees: 20

For about 20 years Innomar has provided high-resolution parametric sub-bottom profilers. The product line SES-2000 comprises SBPs for extremely shallow (less than 1m) to full ocean depth (11,000m) waters. Combined parametric SBP / dual-frequency sidescan sonar are available for shallow waters. Applications include the detection of fluid mud layers and sediment structures for dredging and geological surveys as well as searching embedded objects like cables, pipelines or archaeological artefacts. All data can be stored in industry standard formats. Optimized and user-friendly online and post-processing software is available. Innomar also develops underwater acoustic systems, electronics and software on customer's request. Renting of equipment is possible, too.

Parametric acoustics provides narrow sound beams and wide acoustic band width as pre-requisite to achieve high-resolution results. It has more than 280 parametric sub-bottom profilers sold worldwide.

SBG Systems

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CEO Thibault Bonnevie
No. of Employees 25

SBG Systems is a supplier of 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 ideal solutions for Aerospace, Land, and especially Marine (surface and subsea) projects such as vessel motion monitoring, ROV & AUV control, Hydrography, and Buoy positioning. SBG Systems designs, manufactures, and calibrates all its products. SBG Systems adds value to its inertial systems by designing specific data fusion algorithms and calibration techniques to enhance sensors' performance. SBG Systems offers compact & cost-effective: - Motion Reference Units, - Inertial Measurement Units, - and Inertial Navigation Systems. The new Ekinox series perfectly fits marine needs. It provides 0.05° Attitude, 5 cm Heave on 4 monitoring points, and 2 cm position (GNSS enhanced). It accepts aiding data from DVL, Dual Antenna GPS, USBL, etc. With additional NMEA protocol and Ethernet communication, Ekinox is appears as a cost-effective alternative solution to FOG technology for Marine applications. With its subsea enclosure, the Ekinox Subsea Series, released in February 2014, is operational up to 6,000m. 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.

Since 2007 SBG Systems delivers high performance and cost-effective MEMS-based Motion Reference Unit (MRU) and Inertial Navigation Systems (INS) to the Marine industry (50% of our turn over). Our products are mainly used in Offhore, Marine, and Underwater applications (Hydrography, USV, AUV & ROV navigation, Motion Monitoring, etc). In February 2015, SBG Systems released the Apogee Series, the most accurate inertial navigation systems based on the robust and cost-effective MEMS technology.

SEACON

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For more than 45 years since the company was established, the newly acquired TE SEACON Group have become a global manufacturer of a wide range of more than 2500 underwater electrical and fiber optic connectors.

Offshore equipment must operate safely and reliably 24/7/365 under harsh conditions. Building on its expertise in designing robust, reliable connector systems to meet the challenging and harsh environments of subsea environments, it works closely with both equipment designers and exploration/production companies to create connectivity solutions to meet the specific demands of an application. Also, with over 45 years' experience, TE's SEACON business has developed one of the widest ranges of underwater electrical and fiber optic connectors available anywhere in the world. TE now offers a complete connector system solutions for harsh offshore environments serving the global oil and gas industry.

Underwater-mateable connectors have enabled underwater industries to build modular components for subsea use. In particular, these wet-mate technologies have allowed subsea systems to be assembled on the seafloor. This has allowed the user to maximize modular system size and weight within the constraints of their installation equipment whilst, once installed subsea, still able to connect these modules to use interconnected and distributed communication, control and monitoring systems. A major consideration in the selection of underwater-mateable connectors is the intended mode of operation of that product with reference to it's specification and hence cost.

Underwater-mateable connectors are used for joining up electrical or optical circuits underwater. They provide a termination of an underwater cable or oil-filled hose, containing electrical conductors or optical fibers or both. This allows divers, Remotely Operated Vehicles (ROV's), Autonomous Underwater Vehicles (AUV's) or automatic connection systems, to facilitate the connection of the two halves underwater. The impact of being able to do this has enabled significant progress in the modularization of underwater systems in the oil and gas, defense and oceanographic industries, allowing the following:

- Modular sub-systems to be installed underwater, one at a time, and then later interconnected together to distribute power and communications, forming larger underwater systems
- Facilities to include ports for diagnostic maintenance activities or for future expansion
- Modular systems designed to suit the constraints of the installation equipment being used

The HYDRALIGHT is a field proven, second generation underwater mateable, high integrity, fiber optic connector. This 8 channel, fully underwater mateable, oil filled pressure balanced and field proven connector is fully qualified to 7,000m, with an average single mode insertion loss of less that .2dB and a average single mode back reflection of -50 dB. With a design life of 30 years and a life cycle of a minimum of 100 mate/de-mates, this connector meets the following specifications:

- Norsk Hydro NHT-152-00073 Rev 04H
- Statoil TR1233
- Elf Exploration AO-32-2-011-LT-00-SN-005 Rev C
- Total GSEPSPS021
- BP GP78-21

GeoGarage

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GeoGarage is a web and mobile nautical charts platform.

GeoGarage was founded by two people involved in marine electronics innovation for more than 20 years each, previously responsible with professional experiences in launching innovative, including MaxSea, which was one of the first software designed for marine navigation, to the first 3D 'flythrough' seafloor mapping integrated in Olex software. This now extends as it has pioneered nautical web and mobile mapping, it claims. The GeoGarage proposes an API – compatible with all the online technologies – to third-parties allowing them to embed the charts layers in their own applications.

The web and mobile platform proposes online subscriptions to third-parties in order to use the nautical charts directly issued from international Hydrographic Offices and regularly updated in the GeoGarage Cloud solution in their own applications.

SCHOTTEL HYDRO GmbH

SCHOTTEL formed a new subsidiary - SCHOTTEL HYDRO GmbH incorporating the company's hydrokinetic energy business. SCHOTTEL HYDRO comprises activities in three segments: hydrokinetic turbines, semi-submerged platforms and components, such as turbine hubs and drives. The new subsidiary is located in Spay, Germany, while around 100 SCHOTTEL sales and service locations ensure customer proximity worldwide.

"Since a few years we have been working on the development of highly efficient, reliable and cost-effective solutions for gaining in stream energy," explained Prof. Dr. Gerhard Jensen, CEO of SCHOTTEL. "SCHOTTEL HYDRO allows us to dedicate even more to hydrokinetic energy solutions. By now we are involved in projects around the world and aim at a full penetration of the emerging hydrokinetic energy market with our solutions and products."

SCHOTTEL described its hydrokinetic turbines as lightweight, yet robust instream generators, with a rotor diameter between three and five meters. Depending on the current velocity, one turbine produces between 54 and 70 kW rated, grid-ready electric power. Higher power demands are met by combining several turbines in one installation. Each of the turbines is connected to a frequency converter feeding into a common DC bus installed on the tidal platform. The turbines can be implemented in rivers, sea straits and tidal races offshore in jetty, semi-submerged or submerged platforms in varying numbers.

Together with the subsidiary TidalStream Ltd. SCHOTTEL HYDRO offers the semi-submerged floating platform TRITON. TRITON platforms can be adapted to host turbines of different designs and sizes. Effective use of tidal energy in water depth up to 90 meters and a generating power of up to 10 MW in a single installation are feasible.

The platform is attached to a gravity-base, drilled pile or pinned frame anchor point. A universal joint allows

the platform to align to the direction of the flow. Buoyancy is provided by two spar buoys which hold a variable number of cross arms. The turbines are mounted on the cross arms. The platform is especially maintenance friendly: The electronic system is accessible in the spar buoys and by emptying or filling of ballast tanks the platform switches between operating and maintenance position. This platform will be installed in 2016 in the Bay of Fundy, Canada.

Titanium Industries T.I.

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CEO/President: Brett Paddock
No. of Employees: 190

T.I. provides performance metal solutions for the marine, industrial, oil & gas, aerospace and medical markets. T.I. delivers supply chain solutions at all levels of sophistication and complexity. T.I. is ISO 9001:2008 & AS 9100 Rev. C registered. Its inventory is multi specification certified across industry standards and customer requirements. Its diversified inventory is certified to industry standards such as ASTM, AMS, API, Norsok & Nace standards.

Allspeeds Ltd.

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CEO/ President: Colin Schroder
No. of employees: 40

For more than 30 years Allspeeds' Webtool range of cutting tools has been standard equipment in ROV fleets around the world. Recently Webtool guillotine cutting technology has been developed for both maritime and subsea emergency disconnect systems, ensuring vessel / equipment integrity and crew safety.

Webtool is an Allspeeds brand and offers a broad range of cutting tools for ROVs and maritime and subsea emergency disconnection systems. In addition to a range of standard cutting tools,

Webtool is able to provide custom cutting equipment for use at any water depth. All work is carried out under the Quality System ISO 9001, guaranteeing quality of design, manufacturing, supply and after sales service.

Webtool is a technology leader in hydraulic guillotine cutting and gripping tools for use subsea, on deck and for deployment in emergency disconnect systems.

Suitable for cutting wire rope, guide wire, cables, hoses, umbilicals and fibre 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. This requires less of the available cutting force capacity compared to the standard blade-on-anvil, increasing efficiency. However, the main benefit is the reduction in deformation of wire rope after the cut. By spreading the load, the wire is cut on both sides rather than cut and squashed. Maintaining the roundness of the steel wire section makes it much easier to re-use cut ropes during drilling operations.

A further recent development in Webtool cutting technology is the emergency disconnection tool for tugs and offshore support vessels, and subsea well intervention systems.

BioSonics, Inc.

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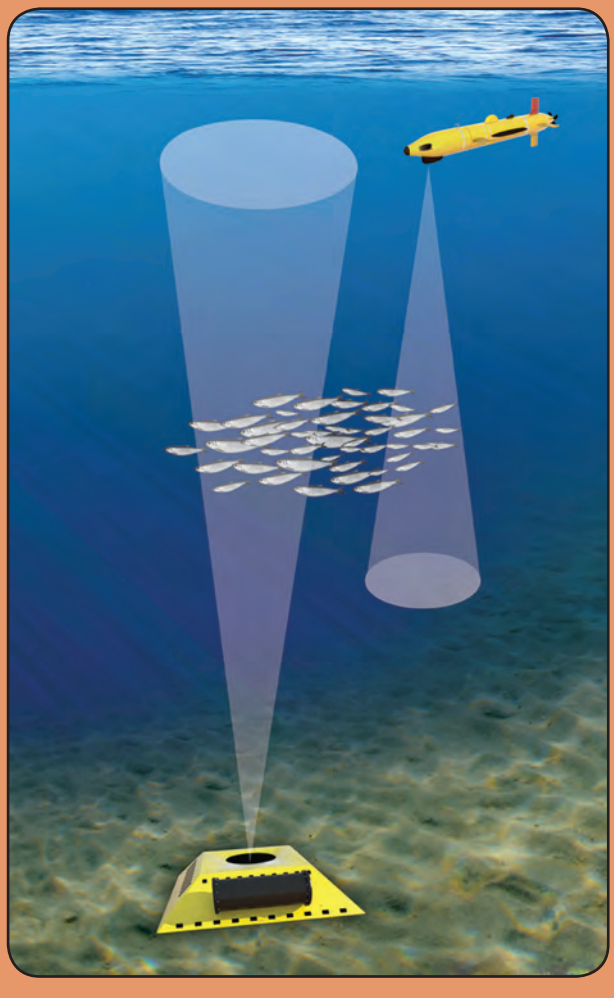
CEO/President: Tim Acker
No. of Employees: 15

BioSonics has manufactured scientific echosounders for over 35 years. BioSonics first introduced fixed-location hydroacoustic fish monitoring in 1980. BioSonics introduced the mobile scientific echosounder in the mid-80's 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' rich combination of products and technical services provides unique monitoring solutions for researchers, regulatory agencies, and private industry. ITs clients include hundreds of federal, state, and provincial agencies, research institutions, and private sector entities worldwide. BioSonics technology centers around 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.

Recent innovations include:

- Fixed-station monitoring system for debris monitoring at cooling water intakes. Several systems now in use at nuclear power facilities used for early warning and reducing risk of clogged intake screens.
- 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.
- ROV mounted echosounders for aquatic habitat and fisheries surveys conducted by remote control using wireless Ethernet communication. This technology allows for data collection in environmentally sensitive and/or hazardous areas inaccessible by manned vessels.
- Pioneering of fully autonomous submersible echosounders used for seafloor observatories, AUV deployments, and deep-towed surveys using uplooking transducers for assessing surface oriented targets.
- Development of the Wave Glider DT-X SUB.



Valeport

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CEO/President: Matt Quartley
No. of Employees: 81
Annual Sales: $12.5m

Valeport is a U.K. manufacturer of underwater measuring equipment that reinvests in R&D to develop new products for Hydrographic & Oceanographic markets.

Valeport was established in 1969, in the small port town of Dartmouth in the South West of England, with a simple product range based around the Braystoke Impeller Flow Meter. Sold to Oceanics plc in 1982, a strategy change saw Valeport put up for sale in 1985, and it was acquired in a management buy out by Charles Quartley, Technical Director of Oceonics. Since then, Valeport has expanded its product range, and developed a strong reputation within the industry for high quality, reliable instrumentation. In 2003, the company outgrew the factory in which it had been based since 1969, and acquired a site a few miles up the river Dart in the historic town of Totnes. The new site met all requirements, and contains all the facilities necessary for the development, production, calibration and testing of all its products.

In 2005, Charles stood aside as Managing Director to be replaced by his son Matthew, who has been with Valeport since graduating in 1994. A new investment of $3.6m in a 3.5 story facility was added in 2013 to more than double the workspace to 28,000 sq. ft. and houses the entire production facility with a fully equipped CNC workshop, state of the art calibration laboratory and two floors of ESD protected assembly workshop. The business now employs around 81 staff, and continues to invest heavily both in new product development, and also in all the facilities necessary to manufacture and supply the quality products for which Valeport is known.

Products include: Sound Velocity Probes / Sensors, Altimeters, Bathypacks, Depth and Pressure sensors, Radar Level Sensor, Current Meters, Tide Gauges, Wave Recorders, CTD's, Multi-Parameter CTD's, new Fluorometer and optical sensor range, plus a GPS Echo Sounder.

Forum Energy Technologies

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Web: www.f-e-t.com
CEO & Chairman of the Board: C. Christopher Gaut

Forum Energy Technologies (FET) is a $1.4B company, formed in the summer of 2010 in a five-way merger among Forum Oilfield Technologies, Triton Group, Subsea Services International, Global Flow Technologies and Allied Technology. Since then it has grown through acquisition and organically.

FET is a global oilfield products company, serving the subsea, drilling, completion, production and infrastructure sectors of the oil and natural gas industry. Its 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, Texas with manufacturing and distribution facilities globally.

Its legacy brands represent some of the best known in the business. The most recognizable include Perry and Sub-Atlantic (ROVs); Blohm + Voss Oil Tools, P-Quip, Pipe Wranglers and Vanoil (tubular handling); Dynacon (LARS and winches); and Davis-Lynch, Cannon and Merrimac (downhole products).

MacArtney Underwater Technology Group

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Group MD/CEO Niels Erik Hedeager

The MacArtney Group is a supplier of underwater technology specializing in design, manufacture, sales and service of a wide range of systems to offshore oil & 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.

MacArtney has been supplying products and engineering solutions for more than 35 years and is a privately owned corporation with group headquarters in Esbjerg on the west coast of Denmark. From its head office, it 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 also represents manufacturers of underwater products. MacArtney supply includes underwater connector (SubConn, OptoLink and MacAPI), cable and termination systems, advanced NEXUS fibre optic telemetry systems, electric CORMAC and M ERMAC 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, TRIAXUS and FLEXUS vehicles. Moreover, MacArtney supplies a versatile range of LUXUS underwater cameras, lights, media controllers 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 offer turnkey solutions designed specifically for requirements and installed ready for use wherever needed.

Earlier this year. MacArtney introduced its new range of advanced in-house developed hydrostatic pressure vessels. While the company has long offered worldwide access to cutting-edge hydrostatic test facilities and services, the company also designs and supplies its own range of pressure vessel to clients who require to set up their own facility capable of putting almost any type of underwater equipment to the test.

Based on this concept and technology, MacArtney now offers a range of four capable and versatile standard pressure vessels. Furthermore, MacArtney is able to supply customized or bespoke vessels featuring alternative dimensions and pressure rating. If required, the company can even quote and supply a complete test environment including all equipment, systems and ancillaries.

With a pressure capacity up to 690 bar, MacArtney standard pressure vessels can simulate the hydrostatic operating conditions at 7000 meters of ocean depth. In further support of simulating realistic subsea operation and getting accurate results, the entire testing process is computer controlled - with real time electric and optical measurements. Moreover, in-house developed control software enables plug-and-play testing, bespoke test programs and repeated pressure cycling. Other pressure vessel benefits include lid integrated penetrators and the user friendly ‘clamp-lock’ system which allows for swift test mobilization and turnaround. Optional features include live video monitoring and in-vessel temperature control.

Loggerhead Instruments

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CEO/President: David A. Mann
No. of Employees: 4

Loggerhead Instruments creates long-term underwater acoustic recordings for noise and animal sound monitoring and study. The company's products have been deployed from New Zealand to Greenland, Hawaii to South Africa, French Guiana to Sweden, and many ocean waters in between. The DSG-ST Ocean, available in economical PVC (rated to 250 m) or robust aluminum (rated to 3,000 m), is used worldwide by publishing scientists and consulting environmental engineers interested in long-term, low-power recording. OpenTag is a rechargeable, reusable, reprogrammable and reasonably priced, open source motion datalogger available with gyroscope, accelerometer, magnetometer, pressure and/or temperature sensors. Sold as a naked board or embedded in watertight epoxy, the open source software allows customers to use the OpenTag for a wide variety of applications. The new Remora is an entirely self-contained, stand alone acoustic recorder which is easily adapted for any autonomous underwater vehicle. Its flexible sampling schedule and rechargeable lithium polymer battery allows it to operate for extended periods of time at depths up to 1,000m.

Birns, Inc.

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Marketing Director: Amy Brown
Production Manager: Keith Gear
Engineering Manager: Jeff Kirby
Facility: Engineering and Manufacturing
Square Footage: 11,400 sq. ft.

Since its early days as a pioneer in the subsea lighting industry serving the U.S. Navy, BIRNS' precision-engineered lighting lines have illuminated the depths. From the 33,000 lumen, 3km-rated BIRNS Snooper and the 16,000 lumen 1kW BIRNS Sirius to the BIRNS Doubly Safe Chamber Light, BIRNS lighting systems provide enhanced safety and effectiveness in working at depth.

BIRNS' connector division was launched in 1990, and subsequent deep submergence, high density connector series' like the 6km-rated BIRNS Millennium and BIRNS Primum lines resulted in global success. Both have configurable inserts, and can handle high and low voltage, with both high (≤ 3.6 kV) and low (≤ 600V) contact combinations. The BIRNS Millennium series also features coax, fiber-optic, and hybrids of electro-coax, electro-optical and electro-opto-mechanical configurations. The BIRNS Primum series is engineered for the heaviest power and electro-mechanical applications demands with exceptional resistance to physical abuse. BIRNS' Electro-Opto-Mechanical (EOM) cable assemblies provide immense performance capabilities and are developed with precision to preserve the integrity of the delicate optical fibers. They deliver huge levels of power, signal and data and withstand extreme environments, providing load strengths of > 50,000 lbs.

BIRNS continues to blaze new technological trails, with quality certifications and manufacturing capabilities that meet or exceed the most exacting requirements. Its Quality System is certified to ISO 9001:2008 by DNV and complies with 10CFR50 App. B (NQA-1). The company's world-class cable facility is SUBMEPP-certified to NAVSEA S9320-AM-PRO-020, only one of seven such commercial organizations in the U.S. All BIRNS QA personnel and production technicians are certified to both J-STD-001 and WHMA-A-620-A Class 3. BIRNS holds ABS Product Design Assessment Certification for all of its man-rated submarine and SAT-system penetrators.

Its team of dedicated engineers has deep in-field experience and uses the latest 3D parametric solid modeling software to deliver outstanding solutions with precision and speed. All designs are performed in model space. Whether it's determining the correct pin configuration for a complex electro-optical hybrid connector cable assembly, developing a deep submergence underwater vehicle lighting system, BIRNS engineers enhance the quality and efficiency of every project from inception to delivery.

BIRNS utilizes advanced digital inspection equipment, including a Mitutoyo DCC CMM (Coordinate Measuring Machine) as well as a Video Measuring system, new technology that combines the power of an optical comparator with digital video, hi-res cameras, telecentric optics and LED illumination.

Caley Ocean Systems Ltd.

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W: http://www.caley.co.uk
CEO/ President: David Cooper
# of employees: 55

In 2015, Caley successfully developed a compact, self-contained IWOCS Deployment System that is safer and more operationally efficient than a conventional IWOCS. The Caley bespoke, high redundancy cable tensioner system, developed for Prysmian Group, accommodates both cable and outsized bodies, allowing uninterrupted tensioning of the cable during installation.

The Company

Based in Glasgow, Scotland, and established in 1968, Caley Ocean Systems Ltd. has a strong international reputation as a center of excellence in offshore handling systems for the Oil and Gas industry; Oceanographic, Marine Science and Naval Emergency vessels, and Offshore Cabling. Caley Ocean Systems is a business within the Seanamic Group, which also includes leading designed and manufacturer of dynamic thermoplastic subsea umbilicals and cable, Umbilicals International. Together they offer packaged surface to seabed solutions that combine in-depth engineering and manufacture with industry leading innovation and systems performance.

With an experienced engineering team and dedicated manufacturing facilities, Caley Ocean Systems' services include innovative 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. The company has agents and representatives worldwide in South Korea, Australia, US, China, Japan, India, Germany and South Africa.

The Tech

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 comprehensive systems design facilities including 3D modelling (Autodesk Inventor & Solidworks) and Finite Element Analysis (ANSYS Professional), Caley has a large manufacturing facility. Covering over 25,000 sq ft (2,323 m2), the high bay, multi-function workshops include two 2 x 40 tonne overhead cranes. Offshore handling system design, build and logistics are in compliance with HSE/QA (ISO14001:2004 and OHAS 18001:2007).

Caley offers a range of dive handling solutions, fully certified by leading certifying authorities and compliant with IMCA guidelines. It also supplies bespoke handling systems for ROV and AUV for water depths over 4000m, and fully certified by leading classification societies.

The award wining, Caley Davit is recommended around the world as the premier solution for safe deployment of rescue and workboats. With over 250 systems in operation, the Davit is guaranteed for Sea State 6.

ASV

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CEO/President: Dan Hook
No. of Employees: 60
Annual Sales: $6m

In the rapidly growing maritime autonomy market, ASV has established itself as the leading designer, manufacturer and operator of Autonomous Surface Vehicles (ASVs) across the defense, oil and gas and science and survey industries. With a team of 60, ASV has supplied more than 70 unmanned systems in five years.

As the market for Maritime Autonomous Surface Systems continues to grow, ASV remains at its forefront as one of the world's leading Autonomous Surface Vehicle (ASV) suppliers. With specialist expertise and experience in ASV concept design, build and commissioning, operation and maintenance, the company provides solutions to commercial, defense and scientific applications in the UK and across the globe.

ASV's team of naval architects, mechanical, electrical and software engineers and robotics specialists have delivered solutions such as mine countermeasures (MCM) ASVs, marine target drones, long endurance survey catamarans, oil field services vehicles and station keeping buoys as well as sophisticated control systems.

The company culture of innovation and achievement leads ASV to participate in a range of unmanned maritime systems experiments and is involved in a variety of advanced autonomy development programs where the company provides both technology and demonstrator platforms.

ASV continuously works to develop autonomous technology through both internal R&D projects and external partnerships. In March 2015 it was announced that ASV, along with nine commercial and research partners, was awarded funding from government body Innovate UK to undertake in excess of £3million worth of R&D for Maritime Autonomous Systems.

ASV has continued its expansion into the market for science and research with the delivery of two further C-Enduro vehicles following the prototype build in 2014. Operations with the C-Enduro have so far included the integration of Passive Acoustic Monitoring (PAM) systems and ADCP.

Investigative work looking at using an ASV for oil and gas applications is continuing with the C-Worker 6. The first of its kind, this vehicle is designed to work offshore in oil field operations and has already completed subsea positioning, ADCP, acoustic modem and multi-beam survey operations. ASV continues to develop ASVs for Mine Countermeasures (MCM), this includes the ongoing operation and maintenance of the Halcyon ASV for Thales UK.

Aquabotix

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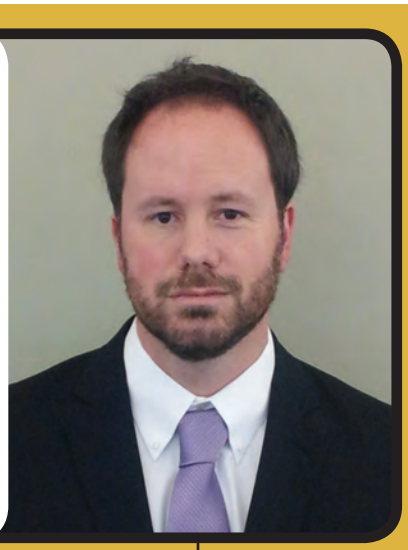
CEO/President: Durval Tavares
No. of Employees: 15

Aquabotix Technology Corporation develops smart technology for ROVs, helping to create a new breed of ROVs - the ROV/AUV hybrid. The HydroView and HydroView Professional are remotely controlled via a tether with the added functionality of autopilot commands.

Its iPad and laptop applications are intuitive driving systems for underwater ROVs. From case to water in three minutes; from inexperienced to accomplished pilot in three hours; no formal training, lengthy instruction or special degrees are needed to profit from Aquabotix technology.

RBR



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CEO/President: Greg Johnson
No. of Employees: 26

Since 1976, RBR Ltd. has been manufacturing high precision instruments for oceanographic, freshwater, groundwater and cryospheric research. Founded by Richard Brancker, the company is now run by a team of enthusiastic engineers and oceanographers and produces instruments calibrated to WOCE standards. deploy

RBR develops and markets submersible data loggers (sondes, recorders) for CTD, conductivity, temperature, depth (pressure), turbidity, fluorescence, dissolved oxygen, pH, ORP (RedOx), PAR measurements. RBR provides other sensors, thermistor chains (strings), tide gauges, and wave gauges to meet all your measurement requirements. Our instruments are all built on a modular platform to permit rapid custom configuration. All of our new generation single,dual and multi-channel loggers are based on a new architecture that incorporates more memory, more battery power, and faster data download.

Calibration equipment at RBR permits traceable calibration for oceanographic instruments including temperature to +/- 0.002 degrees, conductivity to +/- 0.003 mS/cm and pressure to +/- 0.01%. In house calibration of DO, pH, ORP (RedOx) and turbidity complement those for the fundamental physical measurements.

RBR also manufactures custom electronic instrumentation. This equipment ranges from adding customer-specified sensors to our precision data loggers, to remodeling research-specific equipment, to making completely new instruments.

Part III

Teledyne Marine Acoustic Imaging Group

Kim Lehmann, President of the Teledyne Marine Acoustic Imaging Group and the Teledyne RESON Group, discusses with Marine Technology Reporter the driving trends in the subsea business and the impact on his specific group of companies.

By Greg Trauthwein

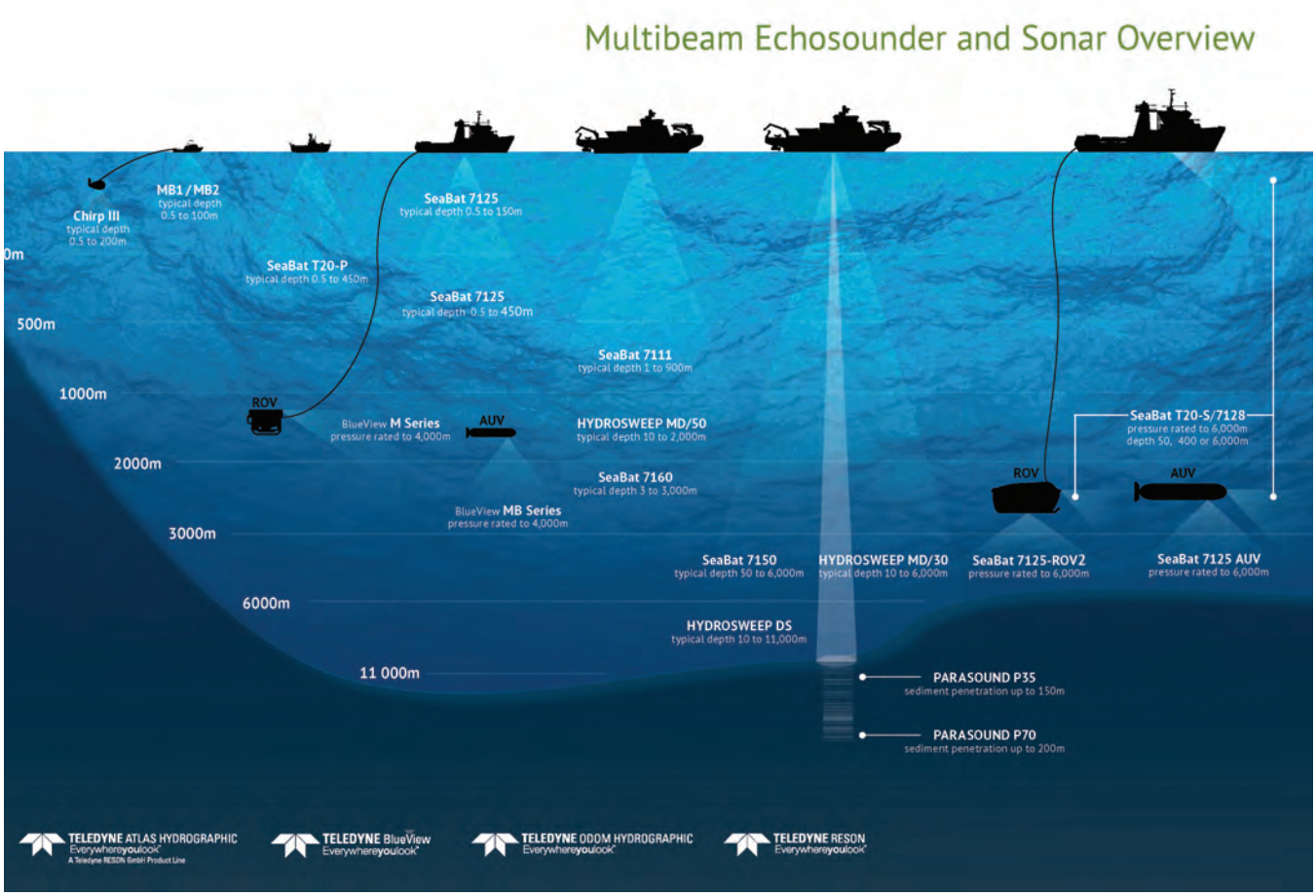
Advancing the business of working underwater is dependent on a number of interconnected technologies that must work together with ease and efficiency. Imaging, or the ability to more clearly 'see' underwater, is one area that has expanded leaps and bounds in quantity and quality in recent years, driven by organizations such as the Teledyne Marine Acoustic Imaging Group.

Meet the Group

"Inside the Teledyne Marine Acoustic Imaging Group we have Teledyne RESON, Teledyne BlueView, Teledyne Odom and the recently acquired Teledyne ATLAS Hydrographic," said Lehmann. "We do imagery and echosounding underwater," looking and measuring with a sonar. "That's the key principle of what we do; and then we have many other smaller niches in there, but when you look at our main deliverables, that's what we do."

The most recent addition to the group was ATLAS Hydrographic, an acquisition that adds breadth to the entire product line-up, as Lehmann explains.

Teledyne Marine Acoustic Imaging multibeam echsounder and sonar range overview



“In August 2014 we acquired all the assets out of ATLAS Hydrographic, renaming it Teledyne ATLAS Hydrographic,” said Lehmann. “(With this acquisition) we strengthened our deep water capability and that means we can actually measure and map the sea floor from a surface vessel to the full ocean at 11,000 meter water depth.”

According to Lehmann full ocean depth capability is a necessity in today’s subsea market, particularly in the realm of marine and oceanographic research, as well as increased government investment in deep sea capabilities, used for example in the identification and extraction of natural resources and minerals and mapping of territorial waters.

Bremen based Teledyne ATLAS Hydrographic was a true industry pioneer. From the early 1920s, the forerunners of the company contributed sonar know-how to the service of marine science and the hydrographic mission supporting safety of navigation. Many key inventions are rooted on patents held by the company, such as the first dual-channel singlebeam echosounder installed on-board a seagoing vessel, the DESO, and the utilization of the parametric effect for sub-bottom profilers, the PARASOUND.

In recent years, Teledyne ATLAS Hydrographic has invested in implementing state-of-the-art features into its HYDROSWEEP and PARASOUND deepwater systems. Besides being used by international users from marine science, it is operated on all four German oceangoing research vessels including the brand new RV SONNE. Using the hull-mounted sub-bottom profiler it is possible to penetrate the seabed more than 200 meters in waters as deep as 11,000 meters; at the same time, the full water column can be imaged and recorded and sediment structures can be resolved down to 15 cm layers.

“The capability here is very strong,” said Lehmann. “That is a unique capability we are able to do with the Deepwater Echsounder and the sub-bottom parametric profiler, and you can (go to) full ocean depth, so you’re sampling the water column, you’re looking at the seafloor, and you are able to penetrate the sea floor up to 200 meters of depth to get an image of the seismic structures of what’s down there. That is truly very advances high-tech precision marine solutions.”

Tech Drivers

While the technology which allows users to see better in the underwater environment, Lehmann reckons that it is the integration of technologies with a variety of sensor inputs that is a driver today, and ultimately his group is working toward delivering not only raw data but actionable information based on customer need and demand.

“When we look at what’s driving our group, I would say it is technologies where we integrate solutions intelligently,” said Lehmann. “And all of that input is then turned into measureable information, which might be a fully computed map; it might be information on where you are able to find minerals; it might be how to navigate or how (and where) to dredge; it might be simulation of the most optimal port entry of your vessel.”

“When we integrate all of this information, then we are able to calibrate and optimize a workflow, so that you can optimize your operations.”

One of Teledyne Marine Acoustic Imaging Group main markets is the offshore market, and while offshore overall continues to struggle with low oil prices, Lehmann said it is a good market for the company as it’s not just about oil and gas.”

"When we look at the offshore market, it's not just oil and gas, it's also minerals, it's renewable energy, it's construction and subsea construction," said Lehmann. In the case of Teledyne Marine Acoustic Imaging Group, the business proposition generally runs from project inception to completion, as they are there:

- supporting them at the early stages, helping operators find out where to drill, build and construct at the seabed;
- when companies construct subsea, helping them to understand exactly how to place equipment, pipelines and other constructions;
- throughout the life of the system, helping them to own and operate equipment, helping them navigate the ROVs or AUVs and helping to ensure subsea facilities are maintained well;
- when it comes to decommissioning, to understand exactly how you then take it apart and remove subsea assets in an environmental-friendly way.

But that's really only one part of his business.

"Then there is hydrography, our key segment and the biggest part of our business, which really has a lot of different businesses (within)," said Lehmann. From surveys of the sea floor to create maps to navigation, to port and harbor infrastructure to environmental protection, the possibilities are nearly endless. Just as important is the size of Lehmann's hydrography toolbox, a set of capabilities that has a multitude of tools, "from the low end of the market where you might need a single beam or smaller multibeam system to the high-end market were you need very high precision multibeam systems and sub-bottom profilers. Sea floor mapping, route surveys, ports and harbors, marine research, are some of the main elements inside hydrography. We service our customers with the complete solution; the multibeam echosounder and other needed underwater sensors, positioning and motion sensors, data acquisition and processing software and the engineered integration fitting your vessel." The construction, civil engineering and dredge business are strong growth areas for Teledyne Marine Acoustic Imaging Group. On the dredge side, we offer comprehensive full solutions, from the positioning of critical equipment to exact monitoring of progress to ensure that the proper amount of material is dredged the first time. On the civil engineering front "we have a software solution called "Teledyne PDS", and in PDS you can make an infrastructure modification or update of a harbor or a bridge, for example. "You can inspect it first to get precision data on the infrastruc-

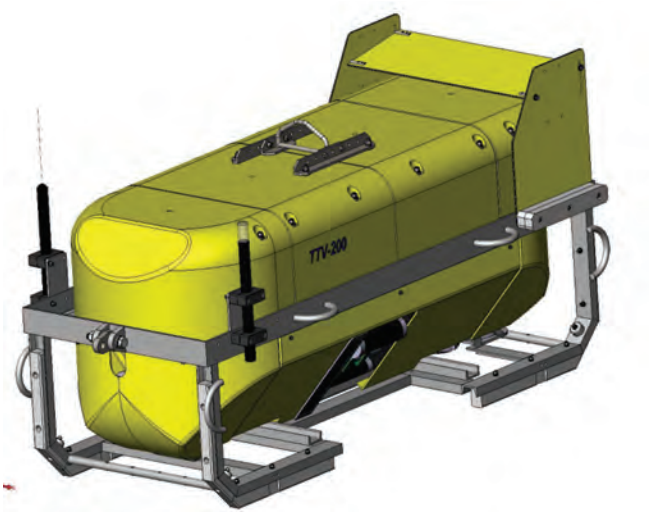
Teledyne Marine Acoustic Imaging Group

Teledyne Marine Acoustic Imaging Group is a provider of advanced multibeam echosounder and other sonar solutions servicing a variety of markets and applications. This group is comprised of the following Teledyne companies, all focused on providing leading-edge imaging solutions:

- **Teledyne ATLAS Hydrographic** has contributed to marine science and safe navigation for nearly 100 years. With its HYDROSWEEP multibeam echosounders and PARASOUND sub-bottom profilers, the company covers the core technologies of hydrographic instrumentation for deep water applications.

- **Teledyne BlueView** is a leader in 2D imaging and 3D scanning sonar technology. The company's advanced sonar systems are currently deployed on AUVs, ROVs, surface vessels, fixed positions, portable platforms, and have been adopted by leading manufacturers and service providers to support mission-critical operations.

- **Teledyne Odom Hydrographic** has over 30 years' experience manufacturing high performance sonar systems with a hard earned reputation for durability, precision and custom-



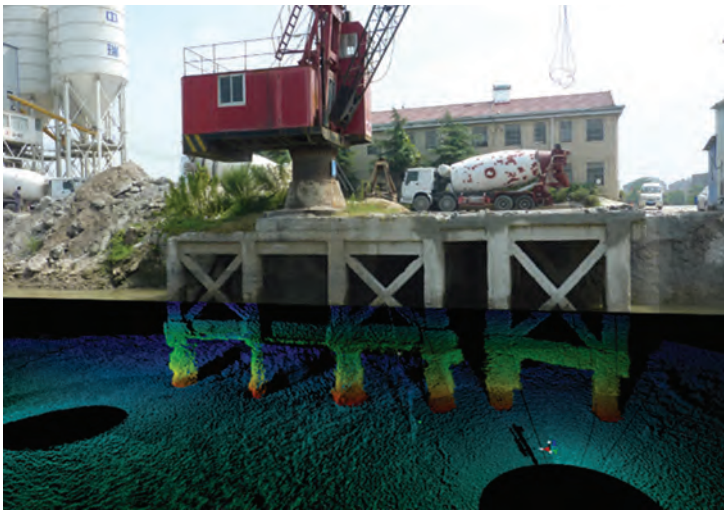
The tow vehicle is co-developed by Teledyne Benthos and RESON.

er service. From portable dual frequency single beam echo sounders to fully integrated multibeam systems, Teledyne Odom Hydrographic has equipment to meet the most challenging demands.

- **Teledyne RESON** is a leading provider of high-quality

ture. We offer solutions including LIDAR for the above water and multibeam echosounders for below the surface and merge real-time the data in highly accurate maps and construction images. This allows you to plan where you want to go and what you want to do. You can also use that for inspection, so you can inspect bridges and dams for example." Perhaps the biggest advantage is the ability to 'maximize the efficiency of the diver's time in the water,' meaning the use of advanced technology products can decrease the likelihood of dangerous situations. The diver can then be guided towards the spots underwater where the detailed inspection need to take place saving a tremendous amount of time and making the quality of the inspection much higher.

The last part of the Teledyne Marine Acoustic Imaging Group business is defense and security, where it offers a multitude of solutions with a variety of ranges aimed at a variety of vehicle platforms and capabilities. "This is an area where we see quite a lot of growth, as well; significant growth," said Lehmann. We are very proud to be working with the top defense and security integrators as well as with the leading navies around the world.

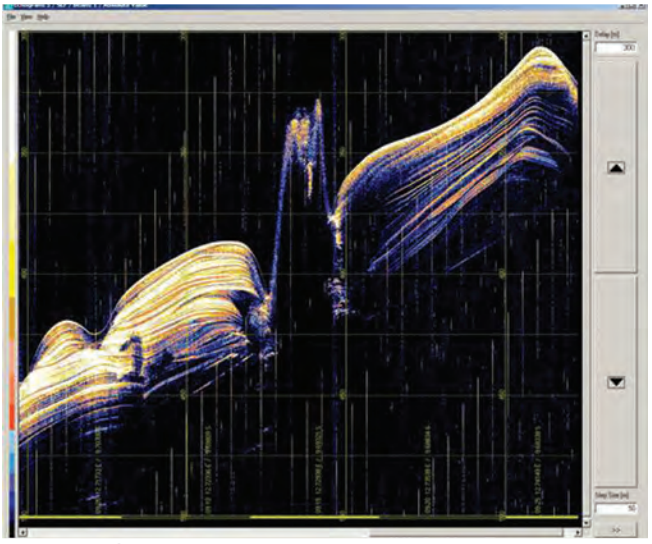


BlueView construction monitoring data image.

underwater acoustic solutions. With global presence and service-facilities, they specialise in the design, development, manufacture and commissioning of advanced multibeam sonar-systems, sensors, transducers, hydrophones and survey software. They operate in the hydrographic, offshore, dredging, defense & security and marine-research business areas.

Teledyne Marine Acoustic Imaging has locations focused on multibeam echosounder and sonar technology including research & development, manufacturing, sales and after sales support at the sites in Denmark, USA, Holland, Germany, U.K and Shanghai. Furthermore it supports customers through a truly global sales network of distribution partners in more than 47 countries.

The group includes over 40 engineers and hydrographic surveyors dedicated to its Engineering Services team focused on providing close support to our multibeam echosounder and sonar customers, wherever they are and whatever the circumstances. The Engineering Services team operates out of service centers at six locations worldwide and it has extended the proximity to customers through a global network of local service partners.



More than 50m penetration along a slope at approx. 400m water depth. Courtesy of University of Bremen, recorded onboard research vessel Meteor.

The Teledyne Marine companies are deeply integrated and work closely to develop cutting edge solutions, such as Teledyne Benthos and Teledyne RESON collaborating to develop a deep tow system including a SeaBat 7125 Dual Head multibeam echosounder and a Teledyne RDI Doppler Velocity Log for Odyssey Marine Exploration. This vehicle, to be used for search missions down to 6,000m, is currently undergoing final sea trials.

develogic GmbH

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CEO/President: Markus Motz
No. of Employees: 17

develogic subsea systems is a German-based company with a focus on developing and manufacturing turn-key customized data-acquisition and telemetry solutions for marine monitoring applications. To be able to deliver cost-effective systems with short turnaround times 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. Available technology ranges from modular pressure housings, data loggers and acoustic telemetry solutions to seafloor landers, large sensors- and telemetry buoys.

The end-to-end design and manufacturing process integrates electronic and 3D mechanical design, multi-physics and structural simulation, 3D CAM and computer-aided inspection in order to provide consistent high quality to our customers.

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 3 years and RAFOS sound sources for underwater navigation are part of the standard product portfolio.

Customers are well-known international research institutes, navies and companies in the renewable energy, construction and offshore oil and gas sector.

develogics' team of engineers as well as production experts enables us developing, manufacturing and supporting sophisticated systems for demanding subsea applications.

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 6000m and deeper.

Its extensive in-house manufacturing capabilities for both mechanical and electronic systems support the creation of highly integrated, unique solutions. In 2013, develogic invested more than EUR 1M in state of the art CNC machining centers as part of the extension of its mechanical workshop. Pick-and-place machines, a vapor phase soldering oven and related inspection, test and measurement equipment allow prototyping of highly integrated customised PCBs with shortest turnaround times. With its up-to-date facility we can offer the full range of specification, development and production of short and high quantities in the fields of mechanics, electronics and software, as well as quality assurance and in-house trials.

Linden Photonics

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CEO/President: Amareh Mahapatra
No. of Employees: 6

Linden Photonics Inc. was founded in 2002 by Dr. Amaresh Mahapatra and Robert Mansfield. Since its inception, Linden's design specialists have developed a range of miniature, high strength optical fiber cables, cable coatings and specialized optoelectronic packaging for environments where high strength and compact size are required.

On the forefront of polymeric design Linden has worked with the Navy, it's prime contractors and many local manufacturing and plastics experts to develop a proprietary, low cost manufacturing process for the production of high strength, small diameter cables with single or multiple optical fibers. We offer a range of standard cable products and custom design options to fit the specific needs of our customers.

Most high strength cables require the addition of longitudinal strength members such as Kevlar. By using LCP buffer over any fiber or wire a maximum alignment of polymer chains yields a high tensile strength. Linden has developed proprietary processes such that thin, extruded strands of LCP have a tensile modulus comparable to Kevlar.

Hydroid Inc.

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W: http://www.hydroid.com
CEO/President: Duane Fotheringham

Facility: 40,000-sq. ft. state-of-the-art facility – opened October 2014
Square Footage: 40,000-sq. ft.
Testing Capabilities: The new facility features a testing tank and pressurized water chamber. The tanks are used for ballasting vehicles and ensuring that the systems are ready for at-sea testing. Hydroid also utilizes two boats for testing. The larger boat is equipped with a launch system.
No. of Employees: 148

Part of Kongsberg Maritime's AUV Group, Hydroid is the world's most trusted manufacturer of advanced Autonomous Underwater Vehicles (AUVs). REMUS AUVs provide innovative and reliable full-picture systems for the marine research, defense, hydrographic and commercial offshore/energy markets. REMUS vehicles are the most advanced, diversified and field-proven AUVs in the world. REMUS AUVs are combat-proven AUVs in operation with the U.S. Navy.

The Company

Historically, the sheer magnitude of the ocean has made comprehensive exploration unfeasible. Hydroid is helping to change that with its full-picture REMUS AUVs. These unmanned underwater robots offer a flexible alternative to surface vessels. They 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. As leader of the team that originally developed the REMUS AUV at Woods Hole Oceanographic Institution (WHOI), 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. In 2008 Hydroid was acquired by the Norwegian technology conglomerate Kongsberg Gruppen. Now, a subsidiary of Kongsberg Maritime, Hydroid is recognized as a leader in the maritime industry.

The Tech

The REMUS AUV is the culmination of 16 years of leading-edge R&D and boasts a proven track record for highly reliable and consistent field operations. 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 1500m); and the REMUS 6000 (depth rated to 6000M), a deep-water workhorse. All REMUS AUVs are built on a common technology base incorporating the intuitive vehicle interface program (VIP); this keeps vehicle maintenance, mission planning, check-out, data analysis and cross-vehicle training seamless across the model line. The vehicles differ by size, endurance and payload sensor configurations. The vehicles can be equipped with many different instruments, depending on the model and the intended use. This includes advanced GPS-aided inertial navigation; Doppler velocity log; acoustic fish trackers; varying sensors; nitrate and nutrient analyzers; conductivity and temperature monitors; radiometers; side scan sonar; bathymetry; bottom-mapping, echo sounder, forward-looking sonar; video camera module; turbidity sensors; and electronic still camera with strobe and magnetometers.

All vehicles incorporate embedded software. Hydroid's R&D efforts have focused on enabling AUVs to operate multiple payload sensors simultaneously, enabling the real advantage AUVs offer over traditional survey methods.

JW Fishers Mfg. Inc.

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CEO/President: Karen Fisher
No. of Employees: 20

In 1971 JW Fishers began manufacturing underwater metal detectors for recreational scuba divers. Demand for its products grew and commercial diving companies and police departments began asking for other types of underwater search equipment. In the late 70's Fishers expanded its product line to include boat-towed detectors, video systems and ROVs. As computers became smaller and more capable the company expanded into sonar; developing powerful, low cost side scan systems. Today Fishers offers three side scans using the most commonly requested frequencies, 100K, 600K, and 1200K.

The newest addition to Fishers product line is a sub bottom profiler. This sonar's low frequency sound waves are capable of penetrating through the ocean floor and producing images of objects buried in the bottom strata layers. Fishers scanning sonar systems are popular with many public safety dive teams because of their economy.

Fishers designs and manufactures all of its underwater search systems at its factory in East Taunton, Mass. Its line of equipment includes hand-held and boat-towed metal detectors, hand-held and boat-towed magnetometers, underwater video systems, ROVs, side scan sonars, scanning sonars, acoustic pingers and receivers, and pipe and cable locators.

iXBlue

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W: http://www.ixblue.com
CEO/President: Philippe Debaillon Vesque
No. of Employees: 500

iXBlue is a provider of solutions and services for navigation, positioning, and imaging, recognized for its work on the development of ultimate performance fiber-optic gyroscopes (FOG), acoustic and sonar signal processing and inertial-acoustic sensor data fusion.

iXBlue's offerings encompass inertial navigation systems, acoustic positioning, sonar solutions and imaging systems. Its solutions are used in challenging applications, including offshore construction and dredging, geophysics and hydrography, ocean science, maritime vessels, fishing, and naval defense.

At the heart of an iXBlue INS lies a fiber-optic gyroscope (FOG). A FOG uses optical waves propagating in a fiber optic coil to accurately measure a rotational rate.

As a FOG is a completely passive device with no mechanical dithering, sealed cavity or high-voltage discharge, it is designed for longevity, reliability as well as very low power consumption.

iXBlue FOGs are the result of more than 30 years of research and development, and they address the most demanding navigation applications and performance requirements from 0.1°/h to 0.001°/h. iXBlue FOGs are insensitive to temperature changes and magnetic perturbations, as well as resistant to extreme shocks and vibrations.

As of the end of 2014, iXBlue has delivered more than 10,000 FOGs (commercial subsea technology: PHINS series, OCTANS series, ROVINS and naval defense: MARINS series). iXBlue has also developed its own acoustic technology, from transducers to power amplifiers, thanks to its expertise in engineering and signal processing. iXBlue delivers the full spectrum of underwater acoustic solutions in order to meet all the challenges of underwater operations: medium and long-range acoustic positioning systems (GAPS), high-resolution acoustic imagery and mapping (FLS product line), synthetic LBL positioning systems (RAMSES) and acoustic transponders (OCEANO).

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L-3 Communications Klein Associates, Inc.

Founded by Marty Klein in 1968, in a small factory in Salem, NH, Klein Associates became the first commercial manufacturer of side scan sonar in the world.

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Salem, New Hampshire 03079
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E: klein.mail@l-3com.com
W: www.L-3Klein.com
CEO/President: Frank Cobis
No. of Employees: 50

Founded by Marty Klein in 1968, in a small factory in Salem, New Hampshire, USA, Klein Associates became the first commercial manufacturer of side scan sonar in the world. Since then, L-3 Klein Associates has become the leading supplier of side scan sonar equipment, and waterside security and surveillance systems to navies, shipbuilders, secure installations, researchers, oil & gas explorers, and hydrographers all over the globe.

L-3 Klein is a leading sensor technology provider that manufactures and designs high-resolution side scan and multi-beam sonar equipment, and radar-based security and surveillance systems. The System 5900 Multi-Beam Side Scan Sonar represents Klein's advanced multi-function 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 unprecedented benefit of an advanced bathymetry payload for the growing Autonomous Underwater Vehicle (AUV), Remotely Operated Underwater Vehicle (ROV) and UUV markets.

The L-3 Klein 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 Klein System 4900 is a versatile Side Scan Sonar that can be used for many different survey and recovery applications. The high-fidelity, high-definition imaging abilities and the portability of the System 4900 make it an ideal tool for Search & Recovery (SAR) missions while its rugged construction, selectable frequencies and 300 m operational depth rating provide superb capabilities for the coastal survey and security communities.

nke Instrumentation

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T: +33 297 36 41 31 / E: info.instrumentation@nke.fr / W: www.nke-instrumentation.com
CEO/President: Jean Claude Le Bleis
No. of Employees: 30
Annual Sales: $7.4 million

nke Instrumentation designs, manufactures and sells instruments and systems for water measurements and environmental monitoring. Its fields of application are ocean, deep sea, coastal, rivers and lakes, and its range of products includes: data loggers, autonomous buoys, deep floats, sediment sensors and profilers.

nke Instrumentation is involved in several research projects, both nationally and internationally, and works in partnership with scientific institutions such as Ifremer and CNRS.

The French company launched its Brazilian subsidiary in July 2013 : nke Instrumentaçao, located in Rio de Janeiro (Serviços e Equipamentos Ambientais e Oceanogràficos)

Autonomous Data Loggers:

- for parameters monitoring (Pressure, Temperature, Salinity, Dissolved Oxygen, Turbidity)
- for environment monitoring (Silting, Heat Flow, Atmospheric Corrosion)
- behaviour analysis of immersed systems (Force, Acceleration, Slope, Corrosion)
- fishing control (fishing time, ship position, immersion time of trawl)

Southwest Electronic Energy Corp.

823 Buffalo Run, Missouri City, Texas 77489
T: +1-281-240-4000 / E: info@swe.com / W: www.swe.com
CEO/President: Len Benckenstein
No. of Employees: 65

Since 1964, Southwest Electronic Energy (SWE) has been a pioneer in innovative energy solutions serving the specific needs of original equipment manufacturers. SWE has changed the game in subsea and oceanographic applications with SWE SeaSafe, a lithium-ion battery solution which powers subsea vehicles, control systems and oceanographic equipment safer and longer with 4X the energy of a sealed lead acid battery. Pressure tolerant to 6000m, SeaSafe batteries include SWE's patented battery management system, POW-R BMS. The BMS has the brainpower to assure safe operation, protect the module's cells from damage, allow reliable distributed battery system architecture, and prolong battery life. Rechargeable with a standard power supply, SeaSafe Smart modules are easy to use battery building blocks for customers to integrate in their own oil filled pressure equalization enclosures. Modules can be connected in series or parallel to meet voltage and capacity (Ah) needs. The SWE SeaSafe pressure equalizing battery case holds four smart battery modules with systems configured-to-order based on V/Ah requirements.

Each smart module is autonomous with its own BMS containing advanced algorithms for automatic and continuous safety protection, charge control and balancing. Additional components to support SWE SeaSafe include the Parallel Integrator Isolator (PII) and the SWE SeaSafe Observer Support Software which allows the user to monitor the health of the battery in real time. The Woods Hole Oceanographic Institution has partnered with SWE in the development of SeaSafe, utilizing it in various Nereid AUV and Hybrid ROVs. SWE's most recent subsea battery development is pursuing a version of SeaSafe called SeaSafe-Direct, a battery module the same as SeaSafe, except that it could be used directly in the sea water. Eliminating the cost, size, and weight of the oil filled pressure equalization case would make SeaSafe –Direct even easier to use with higher net energy density. Development is progressing with significant validation tests in process.

Sea-Bird Scientific

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W: http://sea-birdscientific.com
CEO/President: Casey Moore
No. of Employees: 200

Over 40+ years, Sea-Bird Scientific has developed award-winning technologies to solve the most difficult problems in natural water. Its CTDs 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 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. Today Sea-Bird Scientific employs more than 200 people in the U.S., Canada, and Europe in the development, manufacture, calibration, sales, and support of our products. We provide products and services through two commercial businesses:

- **The Ocean Research Business Unit** works with our research and oceanographic customer base and remains the source of most of the core products and services of Sea-Bird Electronics, WET Labs, and Satlantic. It also manages the firms' growing capabilities in autonomous platforms and sensors.
- **The Sea-Bird Coastal Business Unit** addresses the emerging requirements for improved monitoring of the world's coastal margin zones and inland waters.

Our customers include universities and research institutes; ocean observing programs; national, regional, and local government agencies/departments; energy companies; engineering firms; environmental consulting businesses; and navies throughout the world. Our products are used in numerous critical environmental research and monitoring efforts, ranging from determining the ocean's role in, and the associated impact from, climate changes to the monitoring of environmental impacts of major episodic events such as oil spills and tsunamis.

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 our instruments, test and evaluate prototypes, oversee production calibration processes, and answer questions from scientists using our instruments around the world. As a member of Team Durafet, we have been selected as a finalist for the $2M Wendy Schmidt Ocean Health XPRIZE, a global competition to create pH sensor technology that will accurately measure ocean acidification. Team Durafet includes representatives from Honeywell, Monterey Bay Aquarium Research Institute (MBARI), and Scripps Institution of Oceanography (SIO), as well as Sea-Bird Scientific. Other key oceanographic parameters measured by our instruments include temperature, salinity, pressure, oxygen, pH, fluorescence, turbidity, nitrate, phosphate, and irradiance. Its 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.

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