INSIDE Special 32-page *"Atlantic Canada"* Pull-Out Section • "Greening" the Research Fleet

MARINE TECHNOLOGY REPORTER

March 2012 www.seadiscovery.com

AUV Insights with
Dr. Jim Bellingham
Chief Technologist, MBARI

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Autonomy Lights the Way

Tidal Power
Bay of Fundy:
Epicenter for Tough Trials

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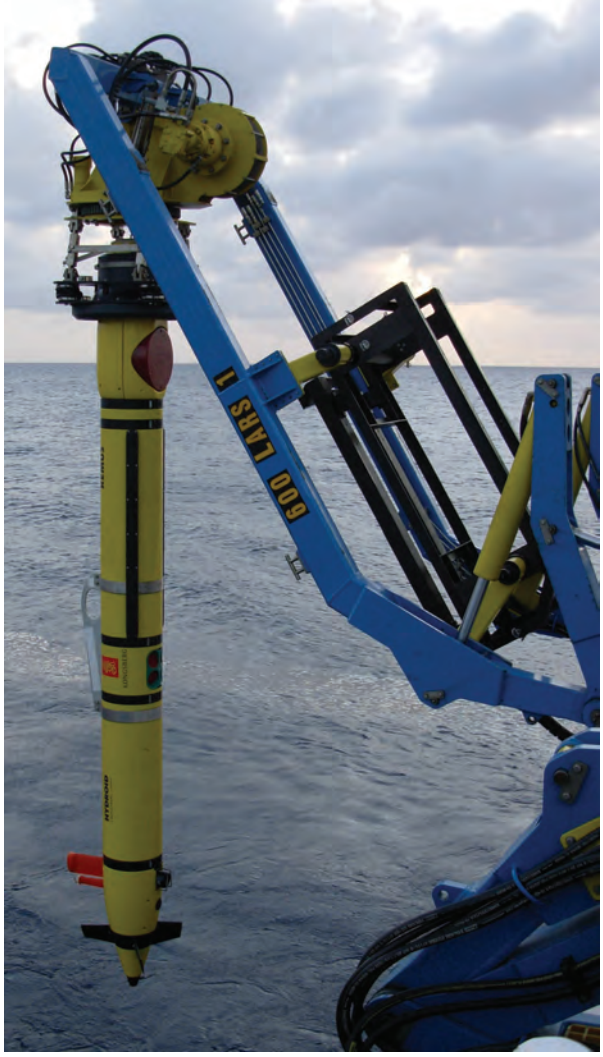

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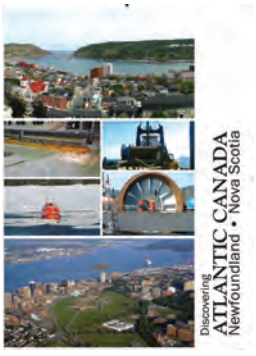

Atlantic Canada

Atlantic Canada, particularly the subsea clusters in and around Halifax, NS and St. Johns, NL, are featured.

See story on page 33

On the Cover

In our Annual Vehicles edition, MTR sought insights from some industry luminaries for perspective on what the future may hold.

(Photo courtesy Bluefin)

See story on page 12

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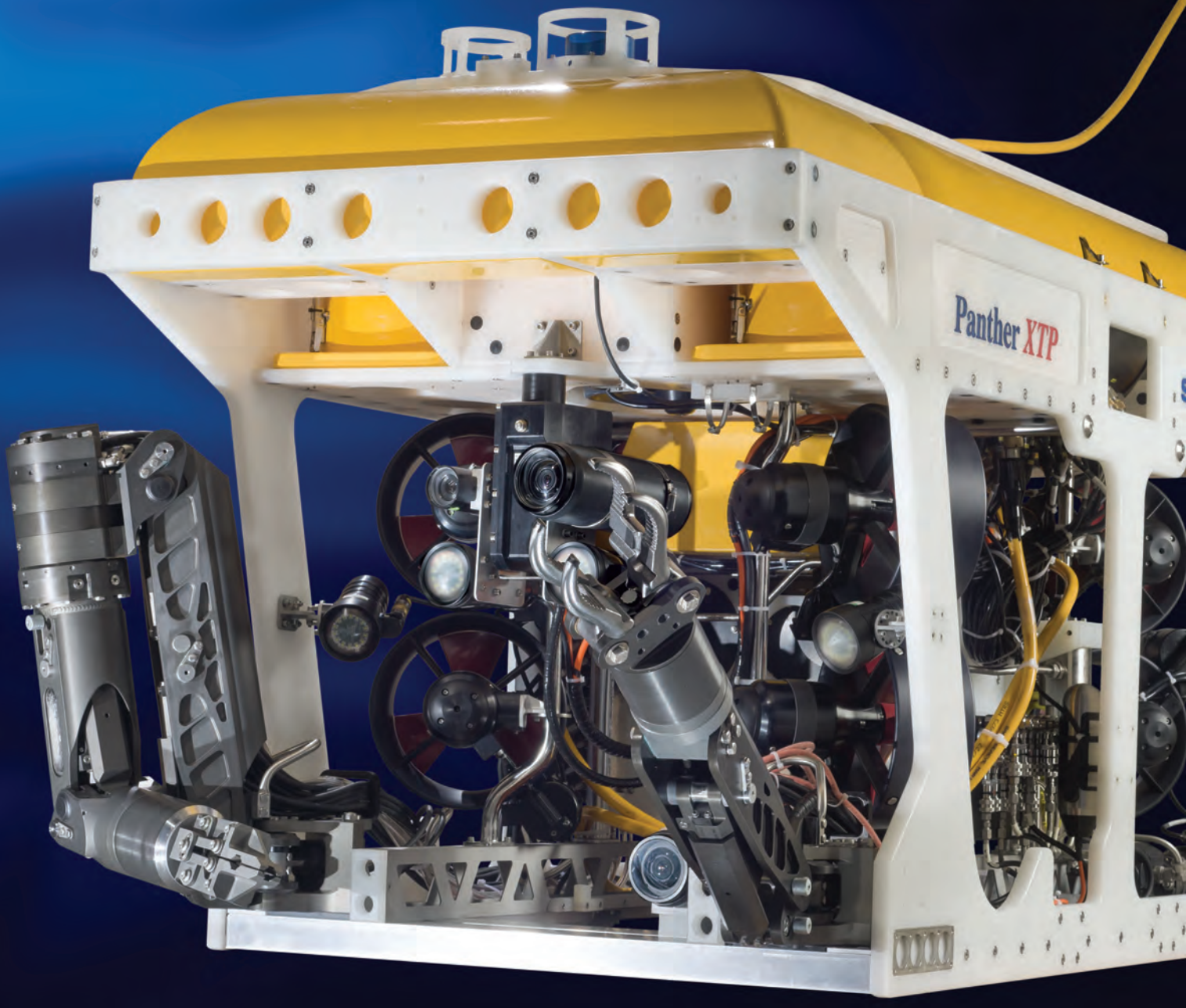

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National Competition Set for April

SeaPerch Challenge

Building on the success of the first-ever **National SeaPerch Challenge** held last year in Philadelphia, this year's expanded challenge will be hosted by the Prince William County Schools on April 12-13, 2012 at the Manassas Park Community Center in Manassas, Va. Nearly 75 teams, consisting of four students and one adult leader each, from school districts and after school club/groups including 4-H, Boy Scouts and Girl Scouts will assemble for the event.

As Susan Nelson, Executive Director of SeaPerch, said, "We are pleased with the increase in the number of teams from 38 last year to nearly 75 teams this year. The growth in the program has been remarkable, and the fact that so many of the local teams are willing to hold regional competitions and send their top teams to the National Challenge is a true win." Including additional student and adult observers, parents, volunteers, judges, VIP's, speakers and committee members, a total attendance of 450 is projected in Manassas Park.

The SeaPerch program was designed for students to learn important principles of science and engineering by assembling, troubleshooting, testing, operating and competing with their own Remotely Operated Vehicle (ROV). The program, now in its sixth year, is sponsored by the Office of Naval Research (ONR) and administered by the Association for Unmanned Vehicle Systems International Foundation (AUVSIF),

What: SeaPerch Challenge
When: April 12-13, 2012
Where: Manassas, VA
Info: www.seaperch.com

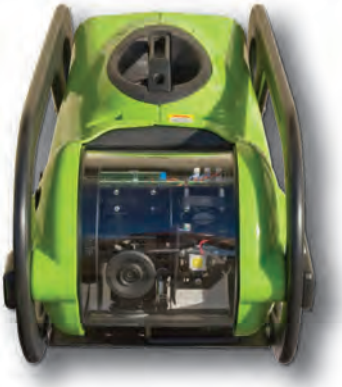
with major support for the National Challenge from the Naval Engineering Education Consortium (NEEC). "The National Challenge was made possible both last year and this because of the grants provided by NEEC, and in these difficult funding times, they came through to help defray the majority of the costs associated with the event and we are grateful for this continuing support," added Nelson. Because of ONR's commitment to SeaPerch, which introduces K-12 students to STEM (Science, Technology, Engineering and Mathematics) through underwater robotics, the program has grown exponentially, reaching over 40,000 students to date. With over 4000 trained teachers and mentors participating as well, students are learning through this hands-on activity by following an established academic curriculum to discover the excitement of STEM as a potential future career path.

The program reaches a diverse population, so participants in the Challenge will be students across the country, from inner city Baltimore to rural Mississippi to Native American reservations in Minnesota to the islands of Hawaii, all students who have been introduced to STEM through SeaPerch.

Competition day, Thursday, April 12, will begin with an opening ceremony, immediately followed by the poster and pool competitions. The SeaPerch ROV technical competition events in the pool will consist of an underwater obstacle course as well as a new salvage operations competition that is different from last year's event, a description of which may be found on the SeaPerch website under "Rules and Events" on the National Challenge page. **Anyone interested in volunteering to judge an event may visit www.mysignup.com/seaperch** to register.

Next year, the National SeaPerch Challenge will be held on the campus of Indiana University-Perdue University Indianapolis (IUPUI). For news and updates about the National Challenge, visit the SeaPerch website, www.seaperch.org, and for questions **contact Phil Kimball, Program Director, at pkimball@seaperch.org.**

SeaBotix



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In September 2011 *Marine Technology Reporter* was invited by three levels of Canadian government to "tag along" on a European trade mission which was visiting primarily the areas in and around Halifax, NS and St. Johns, NL. The purpose of *MTR's* participation was to extend our knowledge and contacts for information in this region, which is rich with maritime and subsea history. The week was an enlightening one indeed, and through a collaborative effort of myself and St. Johns-based correspondent Andrew Safer, we present to you in this edition a full 32-page section dedicated to exploring the myriad of fibers that strongly connect the commercial, scientific, education and government communities to produce what is arguably one of the more prolific and focused subsea technology clusters in the world.

For those of you who have not had the opportunity to explore the region yourself, perhaps use this as a launching point to discover how the region and it private companies and public institutions may be of use to your own endeavors. St. Johns is a tightly knit community that I've had the pleasure to visit on several occasions; the common bond being the evolution of technology, system and process to support a community that makes its livelihood from the sea, one of the most unique and harsh ocean locales on the planet.

The Halifax region was energized late last year with a $25B, 30-year Canadian Navy contract awarded to its Irving Shipbuilding, a contract which will have long, deep ramifications for generations to come. The visit to Halifax was a particular pleasure, and while the list of incredible contacts was too long to mention here, there are two that truly stand out.

Dr. Kenneth Lee is an acknowledged global expert on the use of chemical dispersants in the treatment of oil spills, and our story "**The Spill Stopper**" starting on page 58 explores his team's endeavors to help Mother Nature heal itself in the event of disaster.

It would seem foolhardy to have a conversation about Nova Scotia without discussing the unique Bay of Fundy, and the **Fundy Ocean Research Energy Center for Energy — FORCE** — serves as a hub to bring government, scientific and commercial forces to bear in the quest to prove ocean renewable energy concepts and systems on what could be called the world's toughest proving ground. Our interview with Doug Keefe, Executive Director, FORCE, starts on page 47.

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MARINE TECHNOLOGY REPORTER
www.seadiscovery.com
Vol. 55 No. 2
ISSN 1559-7415
USPS# 023-276

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

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

POSTMASTER: Send address changes to MARINE TECHNOLOGY REPORTER, 118 E. 25th St., New York, NY 10010-2915. Postmaster send notification (Form 3579) regarding undeliverable magazines to Marine Technology Reporter, 118 East 25th Street, New York, NY 10010.

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

Greening the Research Fleet

Industry and Scientists chart the way forward during two days of substantive discussions at Duke University in Durham, NC. Solutions, strategies and emerging technologies all on the table as oceanographic research vessel operators look for ways to minimize their environmental footprint while enhancing their financial position to continue important missions. A rare partnership begins to yield fruit.

by Joseph Keefe

Bruce Corliss of Duke University. Bruce is UNOLS Chair and coordinator of the workshop. It was Bruce's vision that sparked this UNOLS initiative to green the research fleet.

At one of the more productive and interesting workshops attended by this writer in recent memory, the full breadth of the ocean research community came together to hear from industry experts who laid out possible ways for research vessels to economically and effectively keep their vessels not only in environmental and regulatory compliance, but also, to exceed that benchmark. Along the way, the different issues faced by research vessel operators became obvious. Likewise, emerging solutions got just a little bit closer.

The Nicholas School of the Environment at Duke University provided the ideal setting for the University-National Oceanographic Laboratory System (UNOLS) workshop – entitled Greening the Research Fleet – which advanced the effort to develop sustainability guidelines for oceanographic research vessels. Indeed, the 1.5-day workshop featured presentations from marine architects, designers, builders, related private businesses, and representatives of the federal government and foreign research vessel operators. The exchange of information was well received by the gathered throng of ship operators, scientists, technicians, builders, and marine architects, all with the ultimate goal of greening the academic fleet.

The World's Oceanographic Research Fleet Evolves

At stake for workshop participants was the future of the combined collection of UNOLS research assets, including 33 ships, 17 laboratories, and as many as 61 research institutions. UNOLS, originally created in 1971, lists as one of its primary purposes as the promotion of access to research fleets and facilities. As regulatory and environmental pressures increasingly impinge on their collective scientific missions, a similarly important goal is the "greening" of the research fleets in a cost-effective manner, extending in some respects beyond that required by the authorities. As it turns out, it's no small task.

Industry and academics alike discussed and defined various aspects of vessels and their scientific missions, along with the impact of each on the environment. Discussions ranged from port facility considerations all the way to lube oils, emissions, trash and a myriad of other considerations. And, the question was asked, "If scientists were driving boat design, what would their hot-button 'wish-lists' include?" The answers might just surprise you.

Baseline: Time to Catch Up

Arguably, the world's research vessels lag behind their commercial counterparts in terms of environmental correctness, but if so, the gap appears to be largely a function of finance. Whereas shipping companies can reinvest profits (and more plentiful human resources) in smart renewal and audit processes, the funds to merely continue operations are sometimes hard to come by for scientists, especially in this economic environment. That said, where the funding disconnect between the commercial world and the research community remains very real, industry experts

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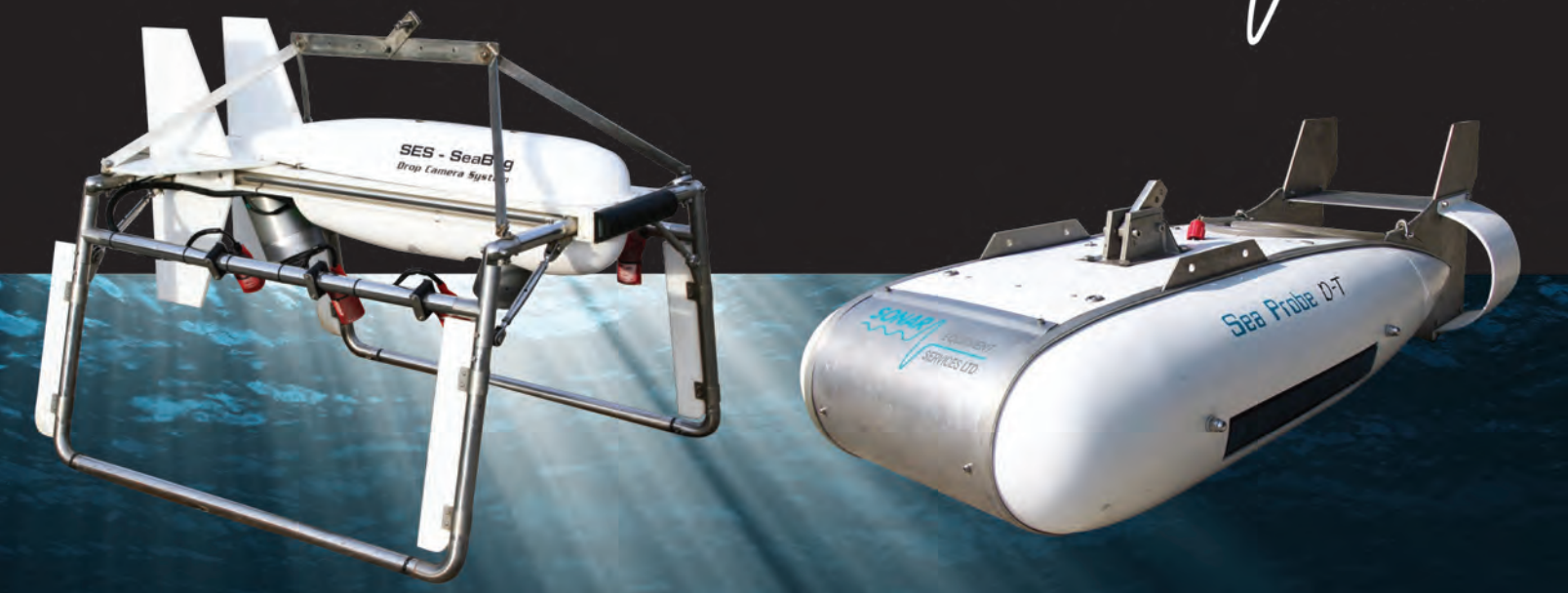

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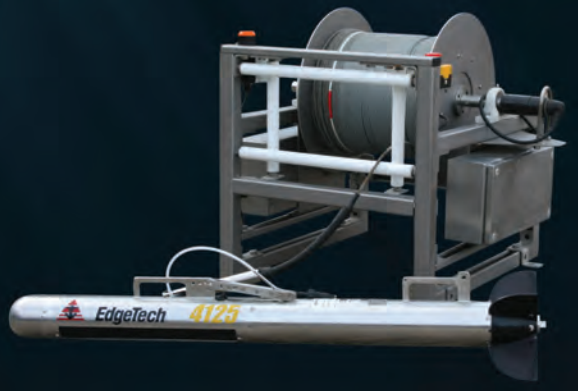

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nevertheless showed their UNOLS counterparts creative ways to get to the promised land. In exchange, the scientists themselves explained some real progress on their own in way of reducing their environmental footprint.

Specific Areas of Concern

Workshop presentations, each followed by robust question and answer sessions, included:

- Oceanography Under Sail: What can be Learned from the Tara Ocean, Lee Karp-Boss (on behalf of the Tara Oceans consortium), University of Maine;
- Foss Hybrid Tugs, Susan Hayman and Paul Jamer, Foss Maritime Company and AKA Group
- Engineering Challenges for a Green Ship Conversion, Matthias Teichrieb, Tactical Marine Solutions Ltd.;
- Vessel Energy Management, What It Is and Common Areas for Energy Improvement, Michael Gaffney, Alaris Companies;
- Developing an Environmentally Compliant Vessel Lubrication Plan, Ben Bryant, Kluber Lubrication North America;
- The Benefits and Challenges of Bio-fuels and Bio-lubricants in Marine Applications, Dennis Donahue, NOAA-GLERL;
- Sustainability and Building a "Green Culture" in the Marine Transportation Industry, Deborah Franco, Harley Marine Services;
- Commercial Shipping Initiatives in Energy Efficiency And Environmental Compliance. Robert Bowers, Maersk Line, Limited;
- Lessons Learned from Greening the Cruise Vessels, Jaime Sweeting, Royal Caribbean Cruises Ltd.;
- SNAME Marine Vessel Environmental Performance Method, Timothy S. Leach, The Glosten Associates, SNAME;
- SuPort: Integrating Sustainability into Ports, Craig Covil, Arup;
- Radiated Noise of Research Vessels, Christopher Barber, ARL Penn State;
- Next Generation Research Vessel: Balancing Performance with Zero Footprint Objectives, Timothy S. Leach, The Glosten Associates;
- Greening the European Research Vessel Fleet, Cattrijsse, A & Rogers, R., Flanders Marine Institute & National Oceanography Centre; and
- Emerging Sustainability & Life Cycle Initiatives-Implications for Fleets & Ports, Jay Golden, Duke University.

Breakout sessions highlighted the second day, during which moderators summarized the session findings, after which the formulation of preliminary workshop findings were assembled by participants. All of the presentations will soon be available on-line for those not fortunate enough to make it to Durham.

"Going Green": No End Game

Perhaps what became most obvious was that the greening of the fleet goes well beyond simple vessel design issues. And, while integrating things like bio-fuels and eco-friendly lube oils into your operations presents enough challenges, workshop participants were also told that the effort must include an environmental management plan that benchmarks as many as 34 environmental impacts. A clear consensus was reached that all operators – whether commercial or scientific – must (a.) exceed minimum regulatory requirements, (b.) have as a goal "zero impact," (c.) define best practice, and (d.) devise some sort of quantitative metric to measure progress. By Wednesday afternoon, they were well on their way to starting that process.

For a collective fleet of 31 dissimilar vessels with often differing scientific missions, the road to better environmental performance and economic sustainability will probably not be short one. In fact, according to the gathered experts, it never ends. None of it will be possible, however, without a change of culture within each organization. Providing ownership to the entire team on any "green" initiative is key, as is the involvement of everyone in the organization, top-to-bottom.

Scientists engaged in oceanographic missions are typically some of the most environmentally conscious folks you will ever meet. Certainly, I found that to be the case this week in Durham.

The genuine desire to manifest that attitude in the hulls and platforms that allow them to do their work was also easy to see. And, while this sort of effort often involves measuring progress in painfully slow increments, the mood of the workshop was one that promised concrete, immediate action.

That's not often the case on the waterfront. For that reason alone, the action at Duke was a refreshing change of course.

"OK guys, *this* is new..."

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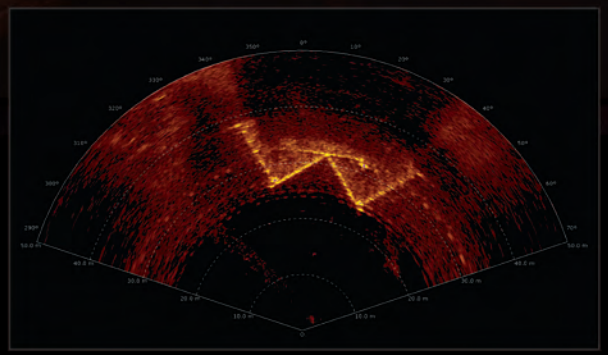

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Subsea Vehicle Technology

From the Drawing Board to the Field

The bid to build and use Autonomous Underwater Vehicle (AUVs) began more than 50 years ago, and by the 1970's this infant technology lead to the creation of unmanned vessels such as SEA SPOOK, SPURV and SKAT: all early examples of a technology that were costly and inefficient. Time and related technological development – specifically in the areas of computing power and power generation – have conspired to deliver today what is fast-becoming an indispensible tool in the hands of the world's navies, the world's offshore energy companies and the world's scientists. Marine Technology Reporter gained an exclusive 'sneak peek under the hood' at some of the world's leading developers, manufactures and users of autonomous technologies, to gain some insight how the trends of today will help to develop the subsea solutions of tomorrow.

By Rhonda Moniz

In the Field

Professor Henrik Schmidt

Professor of Mechanical and Ocean Engineering, MIT

Dr. Henrik Schmidt is a Professor of Mechanical and Ocean Engineering at MIT. He got into the AUV side of things via sensors, when he started working with underwater acoustics and modeling sound propagation in the ocean, as according to Dr. Schmidt, "acoustics is the only serious way we have of communicating underwater and it plays a big role in sensing underwater when it comes to sonar systems." In the mid 1990s there was a group at MIT's Sea Grant college program run by Jim Bellingham who later became Director of Engineering at MBARI

"In those days we were doing a lot of underwater acoustics up in the arctic. This was just after the end of the cold war in the 80's and we needed some information about how the ice would look underneath. So I got together with Jim in the early 90's and these vehicles were just starting to be developed and we got together and got our sponsors to agree to work together on getting underwater vehicles under the Arctic ice." It was in 1993 that he and Bellingham started looking at how they could use AUV's to measure things in the ocean, specifically acoustics. "Then in the late 90's I was on sabbatical at a laboratory in Italy where I used to work before MIT and I was working on locating sea bed objects, mines specifically, and we started looking at the acoustic field produced by these scattering objects when personified by sound," Dr. Schmidt said. "We made a couple of experiments where we actually had an MIT underwater vehicle brought over to Italy and we collected acoustic data with it over this target field." Since then Dr. Schmidt has been focused on the synergy of the robotics and the acoustic sensors.

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 Subsea Vehicle Technology

How are AUV's being used in your current work?

Dr. Schmidt: One of the things we are looking at is communicating underwater acoustically. In shallow water particularly where it is an issue. In 100-m water depths we are operating an AUV and have a modem hanging over the side. We could communicate with the vehicle for a certain distance, say less than 500 m away, and then when it moved beyond that there was no communication whatsoever. So we realized we had to program the behavior system of the vehicle so that it could move to places in the underwater environment where it could communicate or better sense. Now we are using that sensing for instance for tracking acoustic sources. We are looking at where we need to place ourselves in the water column to be able to track these targets over longer time periods. Because of the fact that acoustic communication is extremely limited, we really have to put al ot of that behavior into the autonomy system on board the vehicle. An example of that would be the predator vehicles that are used over in Iraq and Afghanistan. They are basically remotely operated vehicles and have a very high communication capacity. The communication capacity we have underwater is roughly eight to nine orders of magnitude lower. The number we are dealing with when communicating between two points underwater today is, in spite of all the progress that has been made, about an order of magnitude of about one hundred bytes per minute. So that is one hundred characters per minute. There is no way we can control these vehicles as if they were remotely operated vehicles using acoustic modems, it's impossible. In contrast to the predators we have to put allot of intelligence down in these vehicles. The basic paradigm we are dealing with is that each underwater vehicle has to be able to complete the mission without being in any kind of communication with the operators.

We always have the same problem when using any of the manufacturers: it is a pain in the neck when dealing with controlling the vehicles.

Dr. Schmidt, MIT

That sounds like a challenging problem and very mission specific.

Dr. Schmidt: Yes it is. We work with several vehicles from three manufacturers. A very important part of this from the scientific point of view is the need for mission specific control. We always have the same problem when using any of the manufacturers: it is a pain in the neck when dealing with controlling the vehicles. All the manufacturers have a standard control system on board. So what we are doing is taking all this decision-making, the sensing, the modeling, and the higher-level control of choosing speed, heading and depth, and we have moved that into the payload. What that means is we have a closed loop between the sensing and the control. What that further means is that we can take the same payload and put that into any vehicle. So we have our identical software in our autonomy system running on all of the three manufacturers vehicles that we have. We call that payload autonomy. This new autonomy paradigm is going to be on all vehicles operating in the Ocean Observatory Initiative (OOI), funded by the National Science Foundation (NSF). We are part of the NSF team that is providing the cyber infrastructure for the ocean observatory.

Can you tell us about the Ocean Observatory and the role of AUV technology in this initiative?

Dr. Schmidt: Certainly. There is going to be an infrastructure that is being deployed over the next few years. A lot of the hardware is built by Woods Hole. The software is under development by the University of California in San Diego, and Scripps, and we are also a part of that team. There is going to be a cabled observatory on the Fuca plate off the coast of Seattle, and there is going to be a couple of coastal observatories that will have moorings as well as underwater vehicles. There is going to be one on the East Coast, which is in an area on the west coast of the Mid Atlantic Bight down by the Carolinas. Then there is a global component with moorings that will be in the Pacific and one in the South Atlantic. All of this hardware infra structure, the cable observatory and these underwater vehicles will all be connected by a common software infrastructure. This payload autonomy that we have devel-

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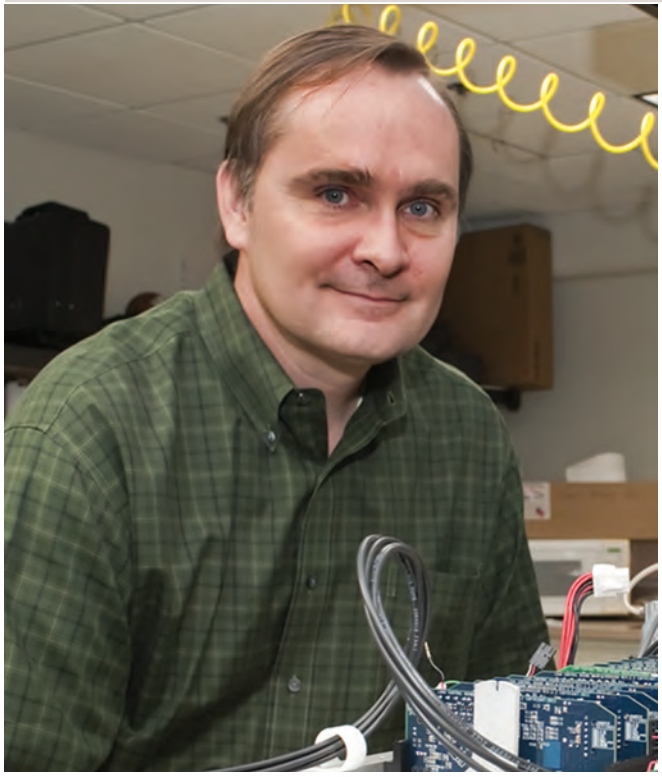
oped will be running on all of these vehicles.

How will it all work?

Dr. Schmidt: The way that it will work is if you as a scientist want to use the Ocean Observatory infrastructure and you want to bring your own AUV for instance, then the ocean observatory management is basically going to give you a time slot. That is if you win your proposal through NSF of course. They are going to give you a time slot and a certain part of the infrastructure and they are going to basically hand you something that looks like a computer chip on something similar to a USB stick. You will have to plug that into the vehicle.

They will only be able to use their vehicles or the moorings if they go through this infrastructure. They will be controlling their systems with our software. The way you can think about it is if you have a scientist using an area of the system to listen to whales for instance, you cannot have someone come with an AUV and run in that area using a sonar.

Of course that would affect the measurements the whale observers would be getting. That whole side of the infrastructure will be taken care of to avoid those kinds of conflicts. The other thing that is a very new concept with this observatory is that any data collected within it is going to be made available on the world wide web two seconds after the data is collected. It is a $400m program funded by NSF.



Dr. Jim Bellingham, Chief Technologist at the Monterey Bay Aquarium Research Institute (MBARI) is a a physicist by training and he sees AUVs as a way to conduct experiments in the ocean. He views them as an instrument platform, and as a consequence, views them as being coupled with the science. "One of the things that I do is to work with a team of scientists that have an enormous observational problem," said Dr. Bellingham. "Currently I am working with marine microbiologists, and we work on this set of vehicle capabilities that will let them make the kinds of observations they want to make."

In the Field

Dr. Jim Bellingham

Chief Technologist, Monterey Bay Aquarium Research Institute

So you are essentially designing the tool to fit the experiment.

Dr. Bellingham: Exactly. In this particular case the problem we are working on is in a class you would call ecogenomics. The question revolves around understanding the marine microbial ecology. These organisms in the ocean play a vital role in the biogeochemical cycles. In the carbon cycle, in the nitrogen cycle, and yet they are poorly understood. It has only been in the last decade and a half that the tools have been available by virtue of advances in the genomic world to begin to sort of probe these organisms. There are a whole set of problems, one of the problems is these organisms don't culture in the lab environment. The classic tool of microbiology is you take a Petri dish and grow your organisms in a Petri dish so you have a monoculture. Well it turns out that most of these things don't seem to like to grow in a monoculture. They seem to need other organisms around to survive and they exist in very dynamic environments.

A colleague of mine, Ken Johnson, is fond of saying that half of the oxygen we breath comes from the ocean and the other half comes from terrestrial plant ecology. This is true, yet where it takes decades and sometimes centuries to establish forests on land, in the ocean environment plankton forests come and go in days or weeks. It is this unbelievable boom and bust and understanding the

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dynamics of that environment that is key to having an understanding of the changes in a larger global environment. These changes will affect the productivity of the ocean as well it's ability to be able to take up our carbon dioxide, and dictate where the carbon dioxide will go. Of course we know it will make the ocean more acidic, but how will that affect this microbial ecosystem? These are really fundamental questions, in some senses they are some of the great questions of the day. They are the things that we absolutely have to know because we are changing the ocean. We are going to continue to change the ocean for some time and it is really important for us to be able to understand how those changes are going to impact us.

These are very exciting days, as a whole new way of looking at the oceans are dawning. AUV technology can lead us to a better understanding of that.

Dr. Bellingham, MBARI

How does the technology fit in?

Dr. Bellingham: What we are trying to do is observe these organisms for long periods of time. Long periods of time in the life of a microorganism who might live for anywhere from days to weeks, months or a year. I used to look at our vehicles in terms of economics, which was driven by our ship economics. If it made sense to run the vehicle very fast and get all your data in a day then that's what you did. That's how most vehicles today are designed for sea floor mapping or even our water column sampling, but in the case of these microbial communities the real key is to have the right instruments on board and to have the staying power.

So you need the right instruments to fit the AUV platform. What type of instruments are you working with?

Dr. Bellingham: A lot of the instruments for this type of work today tend to be lab instruments. The flow cytometer is a key instrument. They are big bench top instruments, they take allot of power and they have a trained operator running them all the time. We want to put those on our little AUV's and have them in the ocean. The key is to be able to observe these organisms and see how a community structure changes and how the organisms respond as the environment around them changes. In order to do that you need to be able to take repeated measurements on the same organisms, and so as a consequence we have come up with this concept of what I like to call organism relative observing systems. So rather than stay at one spot on earth and observe the ocean waters as it drifts by you or race through the ocean making repeated measurements of ocean water like we do today with most of our AUV's, what we want to do is find an aggregation of organisms, and follow them.

It sounds like the duration on site is a major requirement?

Dr. Bellingham: The idea is, like many of these ideas, you have many different platforms and in our case we have these robots and the robot's job is to follow and characterize this collection of organisms and characterize the ocean around them. It is really a mobile observatory concept and we are starting out with it in coastal waters. We run it for one to two weeks, but ultimately we would like to do it in places like the Central Pacific, where we can go out and actually populate an eddy with our vehicle and see how the ecosystem trapped in the eddy changes.

When dealing with a greater distance why not conduct some of these experiments from a ship?

Dr. Bellingham: Ships are expensive. So what happens is when you are doing science with a ship you have to make sure you really need the ship for that.

You must have seen a lot of growth with the tech.

Dr. Bellingham: When I first started building vehicles in the 80s everything in the vehicle was from scratch. As a consequence by the way, because you are building it from scratch there is only going to be so much complexity and reliability you are going to have. We were spending most of our time convincing ourselves our vehicle worked so our sensor systems were not the main focus. What happened as we got into the 90s the vehicle started actually working, we were taking them out to sea and the vehicles were doing what we actually asked them to do, and by the late 90s the focus turned to the science instrumentation.

The science instrumentation we were putting on was really being used for towed platforms where power was no object. As we started building more vehicles and commercialized it the other suppliers started adapting things they made for towed platforms and started putting them on AUV's. On one hand that was great, because it was a thousand times better than anything we could build ourselves, but on the other hand it was still not optimized for power. I took as a case study a number of years ago with this one particular system that consumed over 200 watts, and I went to a colleague and asked him if he designed it how much power would he actually need to solve that problem. He came back with an answer that was more than a factor of 10 lower. If you really design instrumentation for an AUV, and you make it energy efficient, then you fundamentally change how you design the AUV.

What do you see for the future of the technology?

Dr. Bellingham: These are very exciting days, as a whole new way of looking at the oceans are dawning. We looked at the ocean as salt water, it was a certain temperature, it had a certain amount of salt in it, it was going a certain direction, and fish swam in it. That was sort of the popular view of it. **And now we realize the ocean is a giant chemical factory and a chemical factory with tens of thousands of microorganisms in every drop of ocean water, and they fundamentally are part of the chemical cycle that allows us to live, that allows us to survive on the planet. AUV technology can lead us to a better understanding of that.**

From the Drawing Board

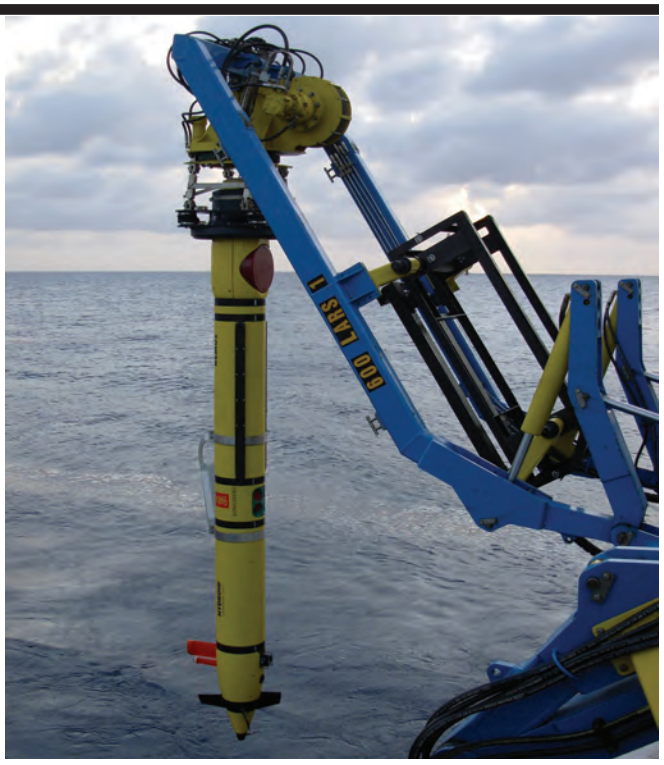
Graham Lester

Director, Hydroid Europe

Hydroid emerged from Woods Hole Oceanographic Institution (WHOI), at the Ocean Systems Lab (OSL) by Chris von Alt, who is the current president, and his team. von Alt originally came out of the Deep Submergence Lab (DSL) at WHOI, and set up the Ocean Systems Lab. The technology developed was REMUS, which stands for Remote Environmental Measuring UnitS, and was designed for environmental monitoring. It became apparent early on from the U.S. Office of Naval Research (ONR), that this had potential military applications to save human lives by getting the diver out of the minefield. ONR helped to accelerate the technology by funding the group and progressing its development and evaluation with the U.S. Navy. And so early military applications began with the Navy Seals and it grew in strength, but this was being done in a WHOI lab so the decision was to form a company under license from WHOI that could manufacture this technology and take it forward, so the lab continues to develop AUV and REMUS technology. **von Alt transitioned over sometime later into Hydroid and the company has basically gone from starting out with three people in East Falmouth to 22 employees in 2005, and in 2011 it is 85 employees … and currently looking to add another 20.**

Kongsberg is now your parent company as well?

Lester: In 2007 the board of directors and owners of the company thought the time was right for Hydroid to continue flourishing, and in order to continue to grow it needed a strong parent company to take that development forward. So we went out and looked for potential parent companies and the company that came through as the strongest was Kongsberg who already had their own AUV technology.



Yes, Kongsberg has the HUGIN.

Lester: Yes, which they had been developing on a parallel track while Hydroid and WHOI had been going along the military and marine research markets primarily U.S. based, Kongsberg had been going in the offshore oil

industry internationally based, and so it made sense to bring that all together and strengthen all the technologies. Since that time in 2008 we have been working closer together and transitioning technology that includes navigation systems, sensors, peripherals and our launch and recovery systems making things interoperable so you can launch a REMUS from a HUGIN ramp system, you can launch a HUGIN from our launch and recovery system (LARS), making things interoperable. We are now moving forward in our software systems to give a common look and feel to the whole family so the whole family is getting stronger and stronger and it has leveraged the benefits of all the research that was done over there and the research done over here.

With HUGIN and REMUS, was it easy to dovetail them together and to make the technology work?

Lester: Yes and no. HUGIN was designed for the offshore market so its method of construction is much different. Its design for carrying sensors was designed for geophysical offshore customers with higher resolution sonar. It is really a Rolls-Royce vehicle, incredibly engineered. But one of the great things we have been able to do is to transition some of the technologies that have been developed on HUGIN back all the way down to the REMUS 100. So with the REMUS 100 now we are just delivering systems that have the same navigation systems as our most expensive vehicles. We are now being able to bring this technology down into smaller systems. They now have much more capabilities. Where it may look on the outside that these vehicles have not changed much they have on the inside. We really are moving at quite a pace. The technology inside these vehicles is progressing quite rapidly.

What trends are you seeing with regard to applications and what is the largest market segment for this tech?

Lester: The largest historically is still the military. Military applications, particularly mine warfare, but we have seen significant growth in the hydrographic market and that is because previously these vehicles did not have the performance level hydrographic surveyors needed to meet the IHO standards, but with the new systems we can essentially gather data sets with the same quality if not better quality than we could from a vessel to do a hydrographic survey.

With regard to hydrographic surveys, have you seen a rise in the deepwater mineral mapping application?

Lester: Yes, there are deposits of rare earth metals so there is a growing industry to get this material from the ocean floor. There are a number of companies out there that need to map and do very high-resolution maps. If they want to suction this material from the ocean floors it tends to be in certain areas, very specific areas. In order to make that mineral deposit study they need very detailed survey information, which you can't get from a vessel mounted system. So this technology is being used to collect data sets that they could not otherwise get. Other areas we see, the offshore industry continues to look for new areas to work. **The vehicles are being used more and more for pipeline inspections autonomously instead of an ROV. Having an AUV follow the pipeline by looking at sonar data and by detecting it and following it.** The oil industry is also going under the ice in the coming decades and they need this technology to understand the environment in which they are working. Understanding how the environment is changing while they are working in these areas by using these remote technologies.

What are some of the challenges you are seeing now?

Lester: Some challenges have been getting the sensor manufacturers to produce. When you are in an industry that is in its infancy and you are not producing high volumes and you need sensors that are powerful but smaller in size that is a challenge because you can't promise the demand so they are reluctant to produce something they do not yet have a market for. That is why it is so great being part of Kongsberg because we have within house so many technologies and we can make that decision that we can make that technology AUV compatible and we are going to make it smaller and we are going to make it so it is able to go into deep water and drive that forward ourselves to some extent. These sensors also drive allot of the cost of the platform. We have so many vehicles out there in so many different environments, and in so many different situations. All that information comes back into those vehicles and in how those vehicles perform in the water. We are doing very advanced stuff, dynamic docking sonar docking, navigation systems, bathymetry, under ice obstacle avoidance. There are many things we are doing that are very advanced. The vehicle looks the same, but it's the inner working, the know-how, and the technology

From the Drawing Board

Bob Anderson & Jon Crowell

President & Director of Engineering, Ocean Server

Bob Anderson, current President, and Jon Crowell, Director of Engineering, co-founded the privately held Fall River, Mass.-based Ocean Server eight years ago. Anderson brought operations, sales and marketing to the table, and Cromwell his engineering expertise. Together the two – who had previously been in business together in the high-end commercial computer business – have sought to revolutionize the small AUV segment with a focus on small, well-engineered systems that are cost effective to acquire and reliable to operation. "We took a computer system design, the way it is designed, the way it is documented, and the way the cabling and reliability is designed, so it is really a computer system in a tube," Crowell said.

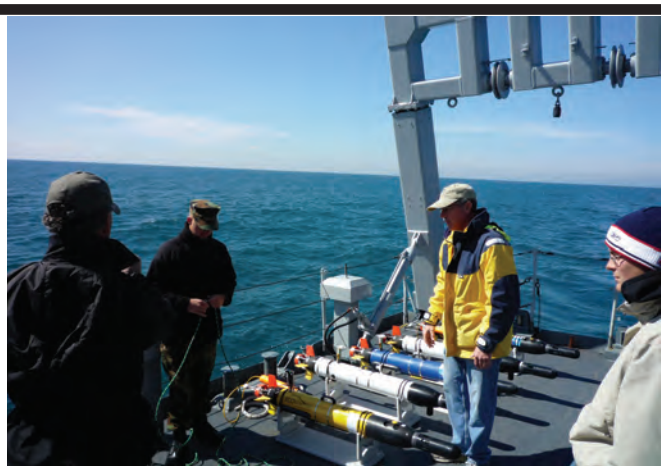
Because you are not held to certain parameters you would be more likely to think outside of the box?

Crowell: Yes, we are thinking outside the box because we don't have that history.

Anderson: The other issue was the consumer off the shelf (COTS) technology that was available to us. In the commercial world you take for granted there are certain applications that drive high volume movement like discs, drives, communications, all standards driven stuff. Then you flip over into the marine side and they really had not been adopting these technologies that were perceived as being less robust, when in reality just because of the sheer volume of them they were far more functional and dependable and less expensive than what was available in these niche environments.

So what are the market segments your company is aiming for and what are the strengths of your technology?

Crowell: We can build an AUV that operates differently and needs no infrastructure. One person can take it to the field and throw it in. Our price point originally was under fifty thousand dollars for an AUV. We got a lot of "yeah everybody says that," but we deliver it. Today on our website it is forty nine thousand dollars, U.S. price. So we stuck to that, and our goal is to make it less expensive.



Anderson: The two keys to making that happen are to organically develop the expensive components. When you buy something there are all these overhead costs associated with it especially if you buy it from a high cost supplier, but if you build it yourself and provide your own IP, then you can capture the margin and lower the cost and it's under your control. The second thing is a lot of our engineering efforts have been focused on taking all these components that are independently functional, but doing all the systems engineering to make them work, to prove them out, and to assure the firmware works and all the systems aspects are understood.

Crowell: In the beginning, for example, a compass we looked at was $800, and the board it had $30 worth of parts. So we started designing and producing our own, and we now have several thousand customers for compasses.

So you have been able to provide this technology to work within tighter budgets?

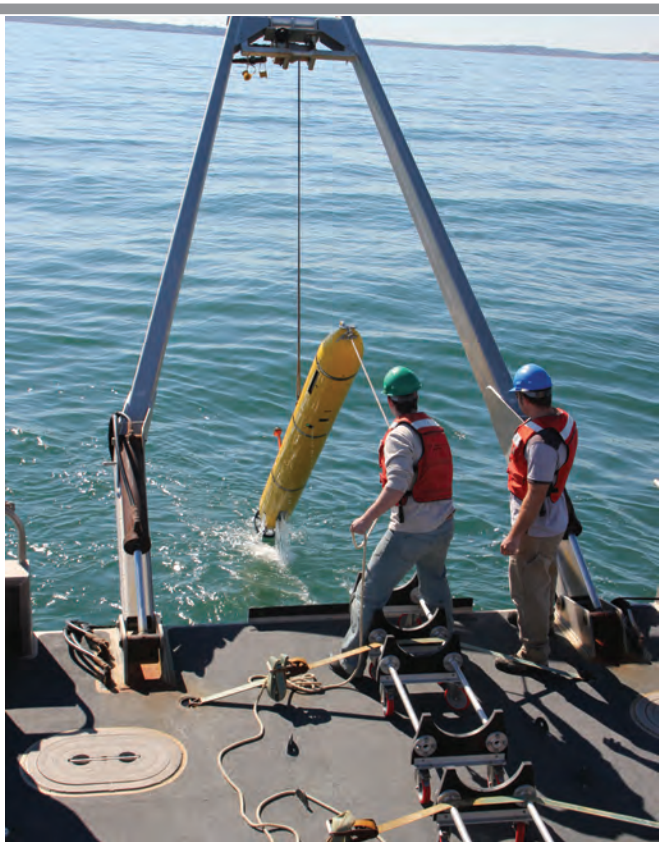
Anderson: The simple operations and cost are enabling companies that would have never before considered buying an AUV. **The big guys used to look at it as a toy because it didn't carry this particular sensor or that one. They thought we wanted to compete in a particular market, but in reality we wanted to create a different market.** Now people are taking our vehicles and using them where they used to use a towed array, for example.

Crowell: Take hydrographic surveys for example. Let's say they have to do a sounding in Boston Harbor. NOAA sends the white ship, and this multi-million dollar ship comes, and it's costly. We, on the other hand, can send an AUV in a van and sound Boston Harbor in a few days and get perfect modern, accurate, and timely data.

From the Drawing Board

David P. Kelly

President & CEO, Bluefin Robotics



Could you talk about some of the origins of Bluefin?

Kelly: It started in the MIT Lab under Dr. Jim Bellingham who was actually working on autonomy and subsea platforms. He was unsatisfied with the platforms that were available, so they started getting into designing and building low cost AUVs. At the time, many of the platforms were full pressure vessels. So they got into the idea of minimizing the pressure vessel space and using a free-flooded architecture which lowered the cost point and weight of the platforms … they did that inside of the lab for a good chunk of the 1990s. Then in about 1997 they started to receive ONR contracts and they spun out a company—Bluefin Robotics. Bluefin used those contracts to build up the technology and capability through the early 2000s. Then just before 2005 they got a contract where they had to build multiple vehicles.

That must have changed the game a bit?

Kelly: Yes, they got to a point with the company where they had to decide whether Bluefin was going to be a design house or a full service AUV company. That led to the sale of Bluefin to Battelle. So now we are a wholly-owned subsidiary of Battelle and a full service AUV company serving all market sectors and all lifecycles. We do internally and externally funded R&D, design, manufacturing, testing as well as training in marine operations. We think offering the full lifecycle enables us to see the lessons learned because we are working with the vehicles in the real world. We feed back to the design process, to identify the operational challenges and improve capabilities.

What are some of homeland security applications?

Kelly: The single largest market for AUVs is defense and the single largest client is the US Navy. On the defense side, AUVs are primarily used for mine countermeasures, but also rapid environmental assessment which provides information about the ocean environment they are operating in. They are also used for intelligence, surveillance and reconnaissance and somewhat for anti-submarine warfare. In the commercial sector, we carve the market into the oil and gas industry which is mostly subsea

survey, pre- and post-construction and monitoring, the environmental monitoring portion and archaeology and salvage. There is also the research side of the market, where universities and institutions around the globe that are doing oceanographic research and subsea platform and sensor development. Those are the three markets that we see and serve. Defense is by far the largest.

Work in the Arctic seems to be an area of application because of the extreme environment.

Kelly: It is definitely applicable. Our vehicles have participated in some arctic and under ice experiments, but the routine, day-to-day application has not been demonstrated. We expected to see our vehicles operating in very high latitudes in the upcoming year.

What are some of the other areas of growth?

Kelly: I think AUV technology is moving out of the earlier proof-of-concept phase and into a generalized acceptance phase. We are starting to see the Navy actually doing operational procurements and are seeing greater interest from various foreign militaries that are starting their experimentation or are starting to look at procuring capabilities themselves. Mine countermeasures is the foremost application for the Navies where they are either retrofitting or replacing their mine countermeasure ships with AUV capabilities. In the commercial market, the technology has been proven now and there has been a couple of leading firms that have dominated the use of AUVs in that space. We are starting to see a broader look from the second tier adopters.

The company seems to be expanding.

Kelly: We moved to the new facility, first because we wanted to co-locate all our activities especially the engineering and marine operations groups in one space. Secondly, to have the capability and flexibility to support the growing market, especially as it matures to higher levels of production and use. Our focus has been to better support those markets we serve. We are seeing operational capabilities coming out of the Navy and the defense market, and greater use and greater growth out of the commercial market. We also acquired the assets of an ROV manufacturer. Hawkes Remotes.

They are working on a prototype vehicle targeted to the commercial markets with a little different architecture and more of an IRM class ROV. It would enable us to be able to play across the spectrum of autonomy from a fully

man-in-the loop system to a fully autonomous vehicle, but still have some reliable robust communications to the surface. Our view is that for certain applications the fully autonomous vehicle isn't going to penetrate the market given the industries predilections. So if we developed a tethered vehicle where you had a man in the loop for some time frame coupled with some elements of autonomy then Bluefin could offer a more readily accepted technology and penetrate that market at a better rate.

What are some of the challenges that may be impeding the progress to fully autonomous vehicles?

Kelly: Well, if you look at which markets have seen success, they have been in the applications where legacy technology really didn't work that well so there has been pressure to adopt it. I think what you are seeing now is our industry is breaking down the barriers and applying the technology in other arenas where the competing technologies aren't as capable, but there has been some historic predisposition to using those because it is known. We have had several conversations on the commercial side where the current technologies really don't give the ultimate end user what they want and so we are looking at what AUV technology can bring to the game, and how it could solve a problem or get deliver the data people want.

I would say on the commercial side you have gone from those early adopters and proof-of-concept users to today, where AUVs are accepted for surveys. And now that they are accepted with track records for proof, and people are asking "where else can they be applied?" We are holding discussions with some of the forward thinkers in the commercial space answers to that very question. Things are moving forward.

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In the Field

Amy L. Kukulya

Senior Engineering Asst. at Applied Ocean Physics & Engineering Lab, WHOI

Amy L. Kukulya wanted to use vehicles to conduct scientific research. But she quickly found the importance of the vehicles to military applications, something that was tough to digest at the outset. "When I first started in this, I had a tough time understanding the importance of using the technology and working with the military to develop our technology, but found it is important to do that in order to apply it to the science community." Today she reports that about 50% of their time is spent working on the military projects.

What are some areas of advancement you have seen?

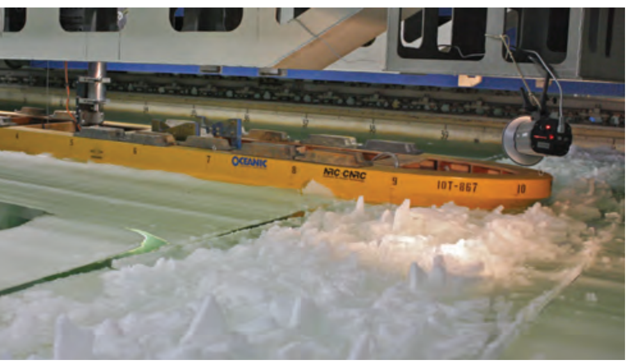
Kukulya: There have been a lot of developments in AUV technology, but there are always applications where we need to go faster or slower, or deeper, or we need to navigate more accurately. We all have the same focus that every AUV developer is trying to achieve, but I think the largest limitation is coming up with new applications and having the support and funding to do the R&D. Currently we have a small fleet in house with ONR as a main partner and they decide where the vehicles are going. What comes after that is for us to acquire vehicles in the lab so that we can take the R&D that has developed from those ONR vehicles and transition that technology onto other platforms that then could be used for science.

You are working on the scientific applications as well?

Kukulya: Yes, we are working on getting the word out. AUV's are so cutting edge, and today are bigger and hotter than they have ever been. Much (of our work) is dictated by the military's interest, and right now that happens to be under the ice work; so there is no surprise that science is very interested in under ice work.

What are some other applications you're working on?

Kukulya: Now we are being asked to continually redesign and to think about being able to have something that is easier, and to simplify the packages. For example, I don't need a 600-m vehicle if I am going to look at the continental shelf, which has an average depth of 250 m. I think what is also driven by the applications is the need to go greater distances.



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From the early days of harvesting fish and building boats to the new economies of renewable ocean energy and oil and gas activity, members of Atlantic Canada's ocean technology sector have had great success in responding to the challenges presented by this harsh environment. Increasingly, they are taking those homegrown lessons and using them to solve challenges the world over.

The Government of Canada clearly has a role to play in supporting the constant evolution of the ocean technology sector and the contribution it makes to our economic development.

We are a country that borders on three oceans. We have the longest coastline in the world. It is obvious then why ocean technology is important to the development of our nation's identity and our economy. And so our Government invests in oceans excellence. We foster a climate that supports R&D and innovation; we invest directly in universities and research institutions; we invest directly in private sector-led R&D; and we encourage international collaboration.

We invest in our public and private sector capacity to continue Canadian leadership in areas such as cold ocean research, marine simulation, the fishing and aquaculture industries, defence and security, and maritime surveillance and transportation.

In September 2011, Atlantic Canada showcased its ocean industries expertise and capability to experts from Italy, Spain and the United Kingdom. The focus of that initiative, funded by the Government of Canada, was to strengthen research and commercial co-operation, and to demonstrate the dynamism of Atlantic Canada's ocean technology sector.

As we connect and collaborate through missions such as this and other business development initiatives, opportunities for international partnership and economic growth will only continue to grow.

Atlantic Canada is home to a dynamic and expanding ocean technology sector. As a national government, we will continue to pursue policies and deliver programs designed to promote a national culture of innovation and of continuous investment in research and development. It is this commitment to innovation that powers the growth and success of our ocean technology industry, and that is absolutely essential to the productivity and competitiveness of the Canadian economy.

Today, we are applying the lessons we have learned and the innovative solutions we've developed in our Atlantic waters to global opportunities, and reaffirming Canada's place among the world leaders in the ocean technology field.

Bernard Valcourt

Minister of State for the Atlantic Canada Opportunities Agency (ACOA) and La Francophonie

Strong Growth, Private-Sector Leadership Characterize the

Newfoundland and Labrador Ocean Technology Cluster

By Andrew Safer

The Newfoundland and Labrador ocean technology cluster is focused in St. John's, the City of Ocean Excellence—with a metropolitan area population of 196,000—which is served by 15 research and educational institutions in its surrounding area. The primary driver for ocean technology development in this province has been the requirement to overcome the challenges of developing offshore oil resources in the presence of sea ice, icebergs, and fog. In addition to overcoming the harsh-environment challenges to oil exploration and development, fish-catching and processing and weather forecasting has spurred further technology development.

OceansAdvance, the organization that represents the cluster, has identified a $1 billion private-sector revenue target by 2015 in this province of just 510,000 people, more than a four-fold increase since 2006. According to the Government of Newfoundland and Labrador's Department of Innovation, Business and Rural Development's report, Surging Ahead: A Profile of the Ocean Technology Sector in Newfoundland and Labrador – 2010, between 2006 and 2010, sales revenues of 50 ocean technology companies rose by 126 per cent to $509 million. "The major differentiator for our cluster," says Les O'Reilly, executive director of OceansAdvance, the organization that represents the ocean technology cluster, "is that it's an inverse-pyramid, industry-led model." He adds that most clusters are pyramidal and are led by research and educational institutions, agencies or governments.

"The private sector is the muscle," says OceansAdvance Chair Anthony Patterson, "that takes the creativity and innovation coming out of the academic milieu and converts it into something that can be used in the real world. It's the flip-side of academic-led curiosity that says, 'If you build it they will come.'"

He adds that Memorial University, the National Research Council's Institute for Ocean Technology (NRC-IOT), Fisheries and Marine Institute of Memorial University (Marine Institute), and College of the North Atlantic are the heart of this private sector-academia-government cluster. Memorial offers the only undergraduate program in Ocean and Naval Architectural Engineering in Canada. Its Ocean Engineering Research Centre carries out applied research and consulting activities in ocean engineering related to the offshore, marine transportation, and fishing industries, operating a 58-metre-long towing tank with wave-making capabilities. Memorial has research chairs in disciplines ranging from ocean technology and Arctic and cold region engineering to reservoir engineering and reservoir characterization, and petroleum engineering. The Marine Institute's seven applied research centers support applied research and development, education and training in areas ranging from marine simulation, safety and survival in the offshore, and sustainable aquatic resources, to ocean mapping and ocean observing systems.

The School of Ocean Technology provides education and training for the next generation of maritime professionals, including the only ROV technician diploma course in Canada. The National Research Council's Institute for Ocean Technology supports the cluster by providing access to knowledge, experience, and facilities—including the longest ice tank in the world— that are unique in Canada, fostering innovation, and helping businesses commercialize science and technology innovations.

OutwardBound 2015, a Strategic Agenda for Accelerating Growth of the Ocean Technology Sector in Newfoundland and Labrador, released by OceansAdvance in 2009, identified three major market thrusts for the cluster to focus on: Arctic/Remote Energy, Next Generation Intelligent Ship, and Ocean Intelligence. Key technological areas that need to be strengthened include: autonomous systems, intelligent systems, robotics; microsystems; information systems; vessel/platform engineering; risk management/ loss control; environmental science; remote power supply; and 'convertible' energy systems. While academia is the heart and the private sector is the muscle of the ocean technology cluster, government is the third key element.

Federal and provincial government departments and agencies have identified ocean technology as one of the fastest-growing sectors of the economy. They provide an integrated network of programs to support activities ranging from collaborative research and innovation, to business development and marketing. Established three years ago, the Research and Development Corporation of Newfoundland and Labrador focuses on increasing R&D investment through both business-led and academic-led programs.

The Government of Newfoundland and Labrador's Department of Innovation, Business and Rural Development supports the sector through its Oceans of Opportunity strategy and the Global Travel, OceanTech SmartGrowth, and OceanTech Intelligence programs. The Atlantic Canada Opportunities Agency supports innovation through the Atlantic Innovation Fund, and business development and marketing through the Business Development Program. Other federal government departments support the sector through activities ranging from hosting trade missions to supporting science and technology innovation projects.

"There are things happening here, quite frankly, that are not happening anywhere else in the country," says Derek Scott, Vice President, Provincial Aerospace, who joined the OceansAdvance board in November. "What is getting known is that there is a surge of activity in the technology sector in this province that brings with it not only direct business activity, but a lot of R&D activity. Over the last five years, this activity has increased dramatically." According to Surging Ahead, between 2006 and 2010, private-sector research and development expenditures increased 57 per cent to more than $23 million. Institutional spending on ocean technology research added in excess of $20 million, totalling more than $43 million in research and development spending across the sector. Leveraging technology products into global sales is the modus operandi of cluster companies. In 2010, nearly 50 per cent of ocean technology-related sales revenues were from exports, a 301 per cent increase from 2006.

Networking and collaboration are key accelerants to cluster activity. Recognizing there was a need to raise the competitive intelligence of the cluster, foster collaborative actions that support the cluster overall, and help support OceansAdvance's OutwardBound 2015 strategic agenda, the Atlantic Canada Opportunities Agency (ACOA), OceansAdvance, and Memorial University partnered to launch the Ocean Technology Commercialization Initiative (OTCI) in 2010. The Newfoundland Association of Technology Industries (NATI) administers the program.

"Strategic collaboration levers results, so we are encouraging companies to collaborate on initiatives and engage in activities that benefit the cluster as a whole," says (NATI) Business Development Coordinator Natasha Hudson. When PanGeo Subsea's Vice President of Technology Development Gary Dinn, past Chair of Oceans Advance, attended the World Oceans Council's Smart Ocean/Smart Industries Workshop on Ocean and Climate Observation in Paris in November, OTCI provided OceansAdvance funding to cover his expenses. "The WOC meeting with scientists provided two strategic pieces of intelligence for the cluster," Dinn reports. "One was understanding from a science point of view how industry will be interacting with leading oceanographic scientists to support data collection from existing platforms, and from a corporate point of view, it may open up opportunities for participation from cluster members in providing solutions to allow that data collection to occur."

NATI CEO Ron Taylor explains the longstanding partnership between NATI and OceansAdvance: "The vision and the strategy of the sector is through OceansAdvance. When it becomes a business-to-business initiative or an international opportunity, it's usually through NATI." Through its export development program, NATI assists OceansAdvance and NATI member companies by supporting exporting opportunities

in global markets. "The benefit of OceansAdvance and NATI working together collaboratively to assist the sector is huge," says Taylor.

When C-CORE wanted to apprise cluster members of their latest initiatives related to resource development in the Arctic and Canada's Northern regions—LOOKNorth and the Centre for Arctic Resource Development (CARD)—the Ocean Technology Speaker Series, co-sponsored by the City of St. John's and OceansAdvance, invited them to present in the meeting room at NRC-IOT where. the series meets six times a year. "The roundtable venue creates a mechanism for feedback and discussion," says C-CORE CEO Charles Randell, "which is a great way to generate and gather new ideas,"

Even though it seems that the cluster is firing on all cylinders, a glance under the hood points to some challenges ahead. "We're maxing out the capabilities of our academic partners," says Anthony Patterson, who adds that more infrastructure for both academia and the private sector is needed to step up the rate of innovation. "What we have now is not sufficient to meet the needs of the opportunities we are uncovering. We need more facilities and HQP." O'Reilly suggests how these requirements can be met. "What has helped us get to this stage is a foundational piece that we need to build on aggressively," he says. "Imperatives for growth are new intellectual property, new products and services that can be commercialized, an increase in HQP and, of course, an abundance of new start-up SMEs." He adds that to achieve these objectives, both increased institutional research output and industry commercialization, as well as new models, will be required. "We need innovative platforms where industry-led directed research can be developed, matured and sustained in partnership with universities and research organizations," he says. "We are currently conceptualizing the development of industry-led consortia where companies partner on a shared pre-competitive research agenda."

O'Reilly adds that this would provide the potential to (1) achieve new intellectual property, (2) create an environment where new graduate students can flourish, and (3) stimulate new company growth. He is quick to admit that there are challenges that need to be overcome, but he also sees "fantastic opportunities" as the cluster's collaborative culture matures, continuing to demonstrate that 'the whole is greater than the sum of its parts'. He sees the existing alignment and cooperation providing the foundation for the development and sustainability of the new models. Patterson points out there are groups actively exploring O'Reilly's idea, and concurs

that it's achievable. Putting this aside, he sees the cluster surpassing the $1 billion revenue target by 2015. "The companies that are bringing products to market from Newfoundland and Labrador are very innovative," he says. "They're becoming larger and they're establishing more sophisticated distribution networks. Innovation matched with companies with established market presence is what's giving us our growth rates. In my view, the billion dollars is a milestone we will hit and then surpass, and then we'll set another milestone." In the meantime, there are companies that are waiting to make breakthroughs, Patterson says.

"Connecting university collaboration with market opportunity," he adds, "works extremely well." He cites Provincial Aerospace, with 900 employees, and Rutter, Inc., with 100 employees, who became large companies headquartered in Newfoundland and Labrador with employees in other countries. "When you get a breakthrough," Patterson says, "you've got to have a global presence. That's what we're all dreaming for."

World-Class Facilities Boost Ocean Technology Companies' Research & Development

By Andrew Safer

Oceanic Consulting Corporation research on ice loads on an FPSO from a first-year ice ridge, in the ice tank at NRC-IOT

Whether they're helping oil companies engineer solutions to the challenges posed by deepwater exploration and production, finding new ways to increase efficiency and reduce fuel consumption for inshore fishermen, or developing a system for harnessing wave power, ocean technology companies, as in the examples below, are making use of the extensive network of specialized facilities located in and around St. John's. Following are examples of how some of these facilities are being used by local ocean technology companies.

In conducting applied research and technology validation experiments in hydrodynamics and Arctic engineering, Oceanic Consulting Corporation provides national and international industry clients access to a range of facilities at the NRC Institute for Ocean Technology (NRC-IOT), the Ocean Engineering Research Centre at Memorial University, and the Fisheries and Marine Institute of Memorial University.

Thirteen of Oceanic's 45-member team work out of offices in NRC-IOT where they conduct maneuvering, seakeeping, resistance, propulsion, mooring analysis, icebreaking, ice-ship and ice-structure interaction, Vortex-Induced-Motion (VIM), and Vortex-Induced-Vibration (VIV) research on behalf of international clients. The VIM and VIV projects are focused on mitigating the wobble effect of ocean currents on the vertical cylinders that make up the risers and spars used on offshore oil and gas projects.

"Oceanic takes the unique capabilities that are here in this building and resident in the people in their company, and they sell that to the world," says Noel Murphy, NRC-IOT's business manager. "They're traveling around the world, fairly aggressively seeking out new markets and new clients, and bringing them back here." Oceanic subcontracts NRC-IOT to both run the facilities and assist with a portion of that work, typically in the areas of control systems and dynamic positioning systems for ships and offshore structures. Oceanic's team also uses the Ocean Engineering Research Centre's 58-meter wave/towing tank, housed in the Faculty of Engineering and Applied Science on Memorial University's main campus, for projects involving small craft (vessels up to 150 feet; the models are up to 7.5 feet) and small-scale VIV work.

They use the NRC-IOT's 200-meter wave/towing tank for projects involving large vessels, and its 90-meter ice/towing tank for Arctic and cold-ocean research projects.

Early on, Oceanic discovered that the 22-meter flume tank at the Marine Institute is ideal for conducting experiments that need to run longer than the 200-meter length of the towing tank allows. They investigate hydrodynamics by keeping the model stationary as the currents are generated in the tank. "If it weren't for the flume tank," says Dan Walker, Oceanic's founder who is currently Executive Director, Business Development and Marketing, "we wouldn't have gotten into the VIV or VIM work we do today."

Having access to this suite of facilities remains a prime competitive advantage, says Walker, who adds that today it's also Oceanic's substantial years of experience and the numerical capability they have developed using both commercially available software and the codes their engineers have developed in house. He points out that most other major research centers don't have ice tank facilities. Increased interest in the Arctic has translated to more frequent use of NRC-IOT's tank, he says, as well as more physical research and numerical simulation for Oceanic in recent years.

In mid-2011, Fleetway, Inc., a member of the J.D. Irving, Limited Group of companies, acquired Oceanic Consulting Corporation. The acquisition brought Oceanic full-circle, considering that its first commercial contract 16 years ago was an icebreaker study for Saint John Shipbuilding, an Irving-owned company.

Marine Robotics Inc. (MRI), a subsidiary of Marport Deep Sea Technologies Inc., used the NRC-IOT facilities extensively to develop the twin-hulled SQX-500 autonomous underwater vehicle (AUV). The SQX-500's unique propulsion and control system provides high maneuverability and the ability to both hover and turn 360 degrees around its vertical axis.

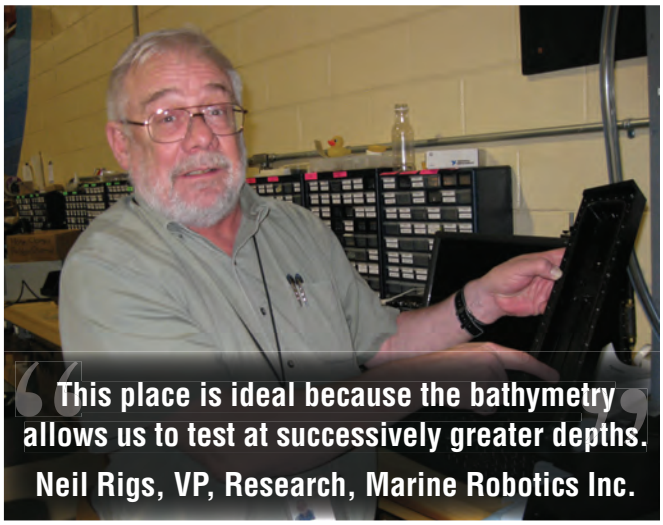
MRI's 9-person staff works in a prototype-development laboratory and in offices within NRC-IOT where they have used the 200-meter towing tank, the 75-meter Offshore Engineering Basin, and the cavitation tunnel for component development and to measure various characteristics of the AUV. At the Marine Institute, they used the pressure chamber and the flume tank for various tests and to validate measurements. Neil Riggs, MRI's vice president of research and development, says that by adding water currents, the flume tank brings the testing process one step closer to the real world. NRC-IOT's expertise in hydrodynamics, underwater vehicles, computational fluid dynamics, and propeller design assisted in the development of the technology, adds Riggs. He says that being part of IOT's Petri dish culture of innovation has been key role to MRI's development process.

Marine Robotics Inc.'s co-op engineering student Scott Holmes, preparatory to launching the SQX-500 at the Holyrood Marine Base.

When it came time to begin testing the SQX-500 in the ocean, Riggs and his team drove 30 minutes from St. John's to the Holyrood Marine Base, which the Marine Institute opened in August 2010. Holyrood provides ocean frontage, and support services for at-sea ocean technology research, development, training, and education activities. Robert Coombs, the Marine Institute's manager of marine services, identifies the superior water quality and the lack of both significant vessel traffic and incidental sources of noise underwater as the Marine Base's key characteristics.

In the mission control room, MRI's lead engineer and a software engineer are testing and fine-tuning the SQX-500's control systems as it executes a mission in the bay. As a safety measure, two technologists follow behind in a chase boat. "This place is ideal," says Riggs, "because the bathymetry allows us to test at successively greater depths." For the first nautical mile, the water depth is 15 to 18 meters, and then it increases to 30 meters—still within diver territory—and, finally, to 200 meters in the approaches to nearby Bell Island. "This allows us to first conduct our tests in shallow water," Riggs explains, "then we move out further in the bay. It's a way of managing risk in the real-world testing process."

Unlike other locations he investigated on the island's coast, the waves here are rarely high enough to prevent testing. "As long as the ice doesn't come in," Riggs says, "we can keep going. Without Holyrood, we would have achieved ¼ to ½ of what we've achieved to date."



The ability to work on the vehicle in the multi-purpose building has also saved a substantial amount of time and money, Riggs says.

When it comes time to perfect one of their sonar-based fishing trawl monitoring systems, eSonar uses the facilities at the Marine Institute's Centre for Sustainable Aquatic Resources and its Centre for Applied Ocean Technology, both housed within the same building. eSonar's systems incorporate sensors to provide information about the operation of the trawl, distance to the bottom, and other fishing parameters. The development team goes to Holyrood to test the components of their trawl systems in saltwater. "The Holyrood facility is fantastic," says eSonar Marketing Director Don Vokey. "They've given us permission to mount various components in strategic locations as long as it's not interfering with work someone else is doing."

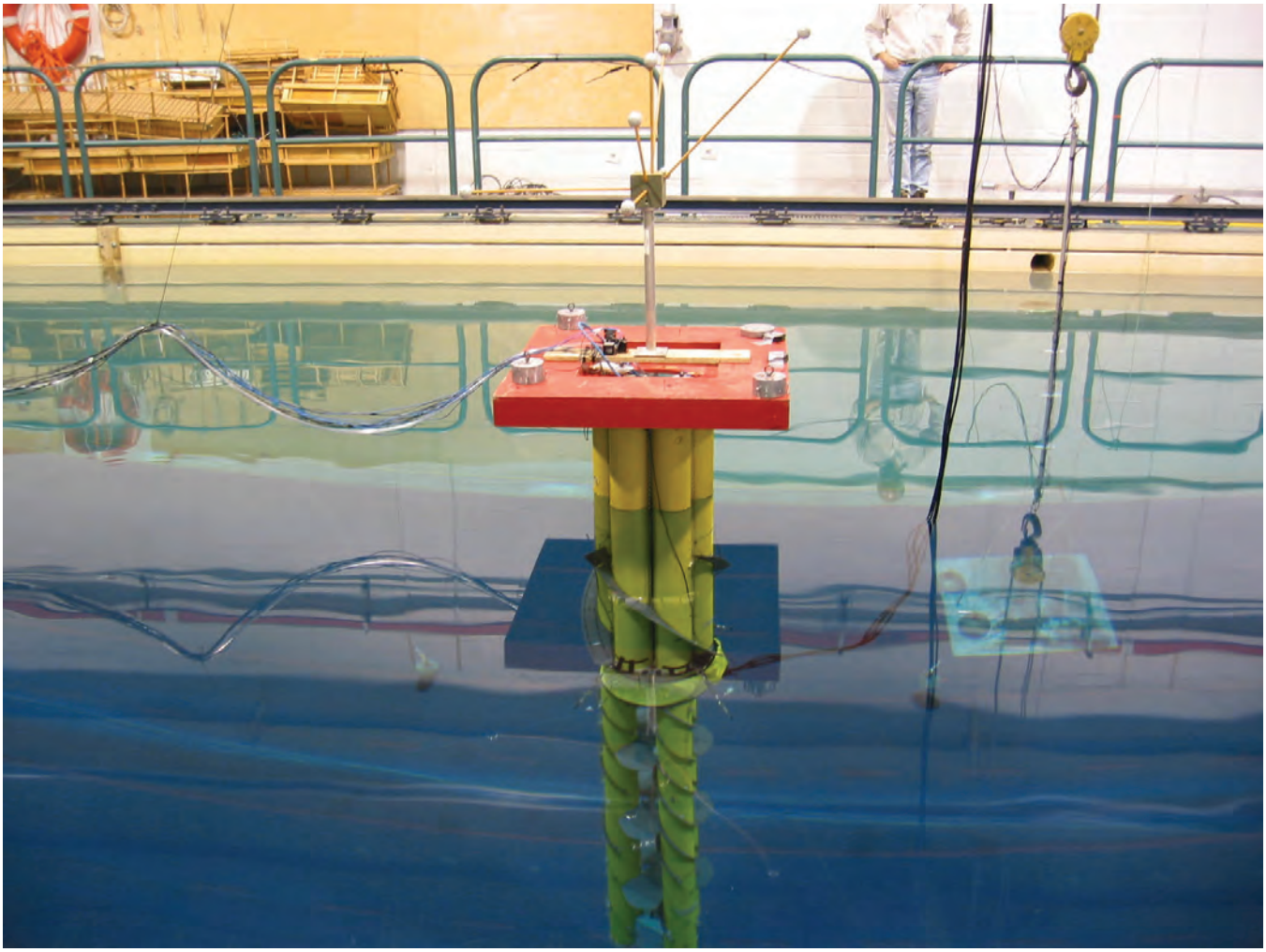
If eSonar had to go out of province to do their testing, that would add "a huge bump to development costs," Vokey says. The economics help the company maintain a low price point on their products. "I think we are perhaps the most affordable system out there," he adds. And their collaboration with the Marine Institute goes beyond product development. "They have been one of our strongest partners from day one," says Vokey, recalling a three-day course the Marine Institute hosted for research groups from the United States about three years ago. When he found out they were fisheries scientists, Vokey asked to meet them, and the Marine Institute provided the introduction. eSonar staff spent a full day with them demonstrating their product "and as a result of that," he says, "we got our first customer."

When SubC Control Limited of Clarenville, NL wanted to locate a satellite office in St. John's, the company moved into the Genesis Centre, Memorial University's incubation centre. SubC develops high-definition video, digital stills, and recording solutions for the professional underwater market. For example, one camera enables an ROV to transmit live standard-definition video topside, while recording high-definition video and digital stills to the camera for later retrieval. Over the last 12 years, the Genesis Centre has assisted both Memorial graduate students and local entrepreneurs in building 50 companies around new technologies—40 of whom have "graduated" and moved on. "Our focus has been trying to develop technology-based companies for this region," says President and CEO Dave King. "Through the Genesis Group we also monitor the research coming out of the university and then try to transfer that over to industry so they can commercialize it, but sometimes a new company is the best vehicle for commercialization." The centre has been instrumental in helping to develop a strong ocean technology sector, having graduated seven companies. The ocean tech focus continues with SubC Control, Grey Island Energy, and EMSAT Corp., three of the companies currently located there.

SubC's Sales and Marketing Director Ron Collier appreciates being co-located with eight other technology companies, "from the guys who are just starting out to the ones who are on their second or third company they've helped launch," he says. "We can leverage their experience and their contacts and take their advice on which road we should take, from product development to marketing and promotion. Some of them have 30 years' experience." Collier says SubC has received valuable advice from their Genesis Centre advisory board regarding matters such as ensuring quality control of products through ISO certification and contacts to enter foreign markets.

Through their Ocean Technology Enterprise Centre (OTEC), NRC-IOT staff assist Genesis Centre companies in further developing their technologies. "We're bringing technical expertise, and they're bringing business, marketing, and finance expertise to the table," says Noel Murphy, NRC-IOT business manager. "You've really got to have the whole package." Grey Island Energy (GIE), developer of the Sea Wave Energy Extraction Device (SeaWEED), has offices in both locations. Genesis Centre CEO Dave King introduced GIE to former Genesis Centre member Brian Lundrigan, CEO of Wyse Design and Development. Since then, Lundrigan, who is now a co-owner of GIE, has provided significant input into the design of the scale prototype the company is currently testing in the NRC-IOT towing tank. Being part of OTEC enables them to avail of the "tremendous expertise in wave energy" at NRC-IOT, says GIE Chief Operating Officer Daniel Hoyles, 24, who graduated from Memorial University with a Bachelor of Commerce (honours) in 2010. IOT staff advise GIE on testing methods, and assist in the testing process. "They help us order the wave regimes to send at the device, which leads to significant savings," Hoyles says, adding, "there aren't many places in the world where you can walk from your office to the ocean wave facility you're going to use for testing." The other key benefit of OTEC, he says, is "talking to people in the offices around us who have experiences with the day-to-day struggles of building a company."

Oceanic Consulting conducted research on the Red Hawk cell spar in the flume tank at the Centre for Sustainable Aquatic Resources, Fisheries and Marine Institute of Memorial University of Newfoundland.



Collaboration in Ocean Technology Development

By Andrew Safer, with Mark Callanan

Dr. Ray Gosine, Associate VP (Research), Memorial University of Newfoundland

> **"We have made use of this place and the challenges that are associated with where we live, and that has helped us develop areas of world-class expertise and the ability to contribute to the development of a pool of knowledge, and now we're seeing this translate to collaborations with industry, which is fulfilling something that's front a center in our mission."**
>
> **Dr. Ray Gosine**

Dr. Ray Gosine, Associate Vice President (Research) at Memorial University of Newfoundland, speaks about Memorial's "special obligation" to Newfoundlanders and Labradorians which dates back to the tragic losses suffered at the Battle of Beaumont Hamel on July 1, 1916. Of the 780 Newfoundlanders who fought there, fewer than 100 survived. "Probably every family in the province was affected," he says, adding that Memorial College was established in 1925 to honor the fallen. "We have a memorial that's more than a cenotaph," he says. "It's a living Memorial."

Referring to a line in Memorial's mission statement ("We recognize our special obligation to the citizens of Newfoundland and Labrador"), he said, "I've never seen that in another university mission statement. I think everyone in the institution understands that where we meet our obligation is not simply in creating knowledge, but in having an impact on the people of this place, and the industry—that's what is important." Reflecting on the province's harsh environment that has spurred innovation, he says, "We have made use of this place and the challenges that are associated with where we live, and that has helped us develop areas of world-class expertise and the ability to contribute to the development of a pool of knowledge, and now we're seeing this translate to collaborations with industry, which is fulfilling something that's front a center in our mission."

Dr. Gosine helped support $97m in externally funded research at Memorial in 2011, approximately one-third of which was oceans-related. Current ocean technology projects in the Faculty of Engineering and Applied Science at Memorial range from a collaboration with Provincial

Photo credit: Provincial Aerospace

Provincial Aerospace and C-CORE collaborate on ice management services on the Grand Banks, offshore Newfoundland, and in Greenland.

Aerospace, the industry representative on the development of remote aerial vehicles for environmental monitoring of the ocean, to a collaboration with Rutter Inc., the industry representative on a seafloor instrumentation project focused on developing geological imaging and earthquake detection capabilities via a network of wireless marine sensors.

Virtual Marine Technology (VMT), a developer of simulators used to train operators of survival and fast-response craft, has collaborated with Memorial on three research projects over the past eight years. Simulation is used to develop competencies and skills that would otherwise be too difficult or dangerous to introduce using on water training. It all started with an informal collaboration in 2003. After heading up research and development efforts for the Coast Guard, Captain Anthony Patterson, now president and CEO of VMT, was working at the Center for Marine Simulation at the Fisheries and Marine Institute of Memorial University (Marine Institute). He figured that with all the engineering capability at the university, they should be building simulators to meet Canada's unique requirements for operating in harsh environments. Dr. Brian Veitch, currently Associate Dean of Research and a professor in Memorial's Faculty of Engineering and Applied Science, was the Terra Nova Project Junior Chair in Ocean Environmental Risk Engineering at the time. He was looking into personnel safety issues in the offshore. He and Antonio Simões Ré, a naval architect and senior research officer at the NRC—Institute for Ocean Technology, had been conducting research on lifeboat performance to identify the performance limitations of lifeboat evacuation systems. Dr. Veitch and Capt. Patterson discussed the issues of lifeboat evacuation and, together with Simões Ré, decided to collaborate on developing a simulator that could be used to safely train people to launch in emergency conditions. They secured project funding from Petroleum Research Atlantic Canada. Randy Billard, Dr. Veitch's student who had just started working on his Master's degree in Ocean and Naval Architectural Engineering, started to work on the project. In 2004, the two of them co-founded Virtual Marine Technology. Capt. Patterson came onboard as CEO three years later.

"Simulation technologies are advanced by Memorial to commercially viable prototypes," Capt. Patterson explains. "At that stage, VMT starts to work with the University to help bring the technologies to fruition." The first project involved modeling and simulation of harsh environments, including rough seas. The second took the early-stage proof of concepts to commercially ready technologies, and the third, currently under way, is expanding VMT's suite of technologies to include emergency health and safety training programs for the offshore. Collaboration with Memorial's School of Human Kinetics and Recreation enables VMT to ensure the simulators are experientially realistic. VMT and Memorial both share the intellectual property, which is developed through a cross-licensing agreement. The licensing arrangement enables the university to use the technology for research. "We get a really strong R&D flywheel moving, and the university gets a partner that's bringing relevant applied research projects to the table," says Capt. Patterson. "Ultimately, the university derives benefits from the commercialization of the technology, but they don't have to take the risks of commercializing it." In May 2010, VMT was the first company to receive international certification for a lifeboat simulator from Det Norske Veritas.

VMT Production Engineer Andrew Edwards explains the procedural hook trainer which teaches how to safely prepare lifeboat hooks for launch.

> **"Having professors and staff from Memorial involved is a huge help. It provides us access to all of the academics, and the research experience they bring with them."**
>
> **Andrew Edwards, VMT Production Engineer**

Memorial University is the proponent of VMT's current research project in which VMT is the industry partner and sponsor, and Dr. Veitch and Dr. Scott MacKinnon, a professor of Human Factors in the School of Human Kinetics and Recreation at Memorial University, are co-leaders. Supported by the Atlantic Canada Opportunities Agency's Atlantic Innovation Fund, the project is focused on expanding the use of virtual environments for training in the offshore. A team of full-time researchers employed by Memorial University—software developers and 3-D modelers—and co-op students in the Faculty of Engineering and Applied Science are collaborating with VMT staff, as well as Dr. Veitch's team of software and hardware developers, and a Human Factors team supervised by Dr. MacKinnon. "Having professors and staff from Memorial involved is a huge help," says VMT Production Engineer Andrew Edwards. "It provides us access to all of the academics, and the research experience they bring with them."

Some of Memorial's development team are located at the University, and some are co-located with VMT's development team. "When we bring the development teams from Memorial and VMT together, they can innovate faster," says Capt. Patterson, adding that the VMT staff who have a lot of experience can help guide the Memorial developers "and help them avoid some of the mistakes we've made." He says if there were two separate groups, the handover from one to the other would be less efficient. "Putting the two teams together," he says, "accelerates innovation." The Atlantic Canada Opportunities Agency (ACOA)'s Atlantic Innovation Fund has supported two simulation research projects in which Memorial and VMT have collaborated. Both the Government of Newfoundland and Labrador's Department of Innovation, Business and Rural Development, and the Government of Canada's ACOA are supporting VMT's efforts to market and sell their technologies globally.

At the National Research Council's Institute for Ocean Technology, Canada's national centre for ocean technology R&D, Antonio Simões Ré has continued to collaborate with VMT since his initial work on the development of numerical models that formed the basis for the lifeboat simulator software. He received the 2010 Federal Partners in Technology Transfer award for his contribution towards VMT's commercialization of the technology. Over the last two years, in a project funded by Transport Canada, Simões Ré and Dr. MacKinnon have compared the effectiveness of simulator-based training and physical training in trials where coxswains navigated rescue craft in ice conditions. In the first year, 18 people were tested using a simulated ice field, and in the second year, the deployments were on real ice. "The simulator-trained people performed better, given the fact that they had never been inside a real lifeboat," Simoes Ré reports. "The simulator-trained novice drivers had a higher pass rate than the others." The final reports have been submitted to Transport Canada. VMT provided its lifeboat simulator and an instructor to conduct the training at the Offshore Safety and Survival Centre on the south side of St.

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St. John's, NL A1C 6K3
Telephone: (709) 576-0634
www.digitalocean.ca
E-mail: sglavin@digitalocean.ca

NavSim Technology
Ocean Technology Enterprise Centre
NRC - Institute for Ocean Technology
1 Arctic Avenue
St. John's, NL A1B 3T5
Telephone: (709) 726-7779
www.navsim.com
E-mail: info@navsim.com / alvin.navsim@gmail.com

Northern Radar
R.P.O. Churchill Square
25 Anderson Avenue
St. John's, NL A1B 4J9
Telephone: (709) 739-4014
Contact: Barry Dawe, President.
E-mail: bjdawe@northernradar.com

Northstar Network
1 Duffy Place, Suite 9
St. John's, NL A1B 4M6
Telephone: (709) 738-6452
www.northstarnetwork.ca
E-mail: howard.nash@nnl.ca

NEWFOUNDLAND DIRECTORY

Northstar Technical
1 Duffy Place, Suite 6
St. John's, NL A1B 4M6
Telephone: (709) 738-6440
www.northstar-technical.com
tmcleod@northstar-technical.com

NOTUS Electronics
91 Empire Ave
St. John's, NL A1E 1W6
Telephone: (709) 753-0652
www.notus.ca
E-mail: notus@notus.ca

Oceaneering Canada
23 Dundee Avenue
Mt. Pearl, NL A1N 4R6
Telephone: (709) 570-7072
www.oceaneering.com
E-mail: mahall@oceaneering.com

Oceanic Consulting
95 Bonaventure, Suite 401
St. John's, NL A1B 2X5
Telephone: (709) 722-9060
www.oceaniccorp.com
oceanic@oceaniccorp.com

Oceans
85 LeMarchant Road
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Telephone: (709) 753-5788
E-mail: oceans@oceansltd.com
www.oceans.nf.net
jbobbitt@oceansltd.com

OceanTouch Instrumentation
2 MacLaren Place
St. John's, NL A1B 5E1
Telephone: (709) 697-5089
www.oceantouch.ca
todd@wildlifecomputers.com

PanGeo Subsea
277 Water Street
St. John's, NL A1C 6L3
Telephone: (709) 739-8032
www.pangeosubsea.com
ckennedy@pangeosubesa.com

PETRA International
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Telephone: (709) 528-4856
E-mail: petra@persona.ca

Poseidon Marine Consultants
391 Stavanger Drive
St. John's, NL A1A 01A
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www.poseidonmarine.nf.ca
bmaybee@poseidonmarine.nf.ca

Pro-Dive Marine Services
17 Sagona Avenue
St. John's, NL A1C 5V3
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www.prodive.ca
E-mail: stjohns@prodive.ca

Provincial Aerospace
St. John's International Airport
St. John's, NL A1A 5B5
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Rutter Technologies
70 Brookfield Road
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Sea-Force Diving
44 Dundee Avenue
Donovans Industrial Park
Mt. Pearl, NL A1N 4R7
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www.seaforcediving.com
barry@seaforcediving.com

Seacom International
Suite 207, Level 2
446 Newfoundland Drive
St. John's, NL A1A 4G7
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paul@seacomcanada.com

Terra Nova Marine
119 Clyde Avenue
Mt. Pearl, NL A1N 4R9
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www.terranovamarine.com
steve@terranovamarine.com

Trans Ocean Gas
Ocean Technology Enterprise Centre
NRC - Institute for Ocean Technology
1 Arctic Avenue
St. John's, NL A1C 5L4
Telephone: (709) 726-7050
www.transoceangas.com
bajzak@transoceangas.com

Tri-Nav Fisheries Consultants
197 Major's Path
St. John's, NL A1A 5B5
Telephone: (709) 754-7060
www.trinav.com
E-mail: tdecker@trinav.com

Virtual Marine Technology
20 Hallett Crescent
St. John's, NL A1B 3N4
Telephone: (709) 738-6306
www.vmtechnology.ca
E-mail: info@vmtechnology.ca

Directory of Ocean Technology Companies and Institutions in NL - 2010

C-CORE
Captain Robert A. Bartlett Building
1 Morrissey Road
St. John's, NL A1B 3X5
Telephone: (709) 737-8354
E-mail info@c-core.ca
www.c-core.ca

Canadian Centre for Fisheries Innovation (CCFI)
Marine Institute of Memorial U.
155 Ridge Road
St. John's, NL A1C 5R3
Telephone: (709) 778-0517
E-mail: ccfi@mi.mun.ca

Centre for Aquaculture and Seafood Development (CASD)
Marine Institute of Memorial U.
155 Ridge Road
St. John's, NL A1C 5R3
Telephone: (709) 778-0532
E-mail: casd@mi.mun.ca
www.mi.mun.ca/casd

Centre for Marine Simulation (CMS)
Marine Institute of Memorial U.
155 Ridge Road
P.O. Box 4920
St. John's, NL A1C 5R3
Telephone: (709) 778-0304
E-mail: cms@mi.mun.ca
www.mi.mun.ca/cms

Centre for Sustainable Aquatic Resources (CSAR)
Marine Institute of Memorial U.
155 Ridge Road
St. John's, NL A1C 5R3
Telephone: (709) 778-0521
E-mail: csar@mi.mun.ca
www.mi.mun.ca/csar

College of the North Atlantic
Prince Philip Drive Campus
St. John's , NL A1C 5P7
Telephone: (709) 758-7473
E-mail: oar@cna.nl.ca
Web address: www.cna.nl.ca/oar
Contact: Mohammad Iqbal, Chair, Office of Applied Research

Marine Institute - School of Ocean Technology
Marine Institute of Memorial U.
155 Ridge Road
St. John's, NL A1C 5R3
Telephone: (709) 778-0460
E-mail: sot@mi.mun.ca
www.mi.mun.ca/sot

Memorial University
(Faculties and Departments)

8.1 Faculty of Engineering and Applied Science
S.J. Carew Building
Memorial University
St. John's, NL A1B 3X5
Telephone: (709) 864-8812
Web address: www.engr.mun.ca

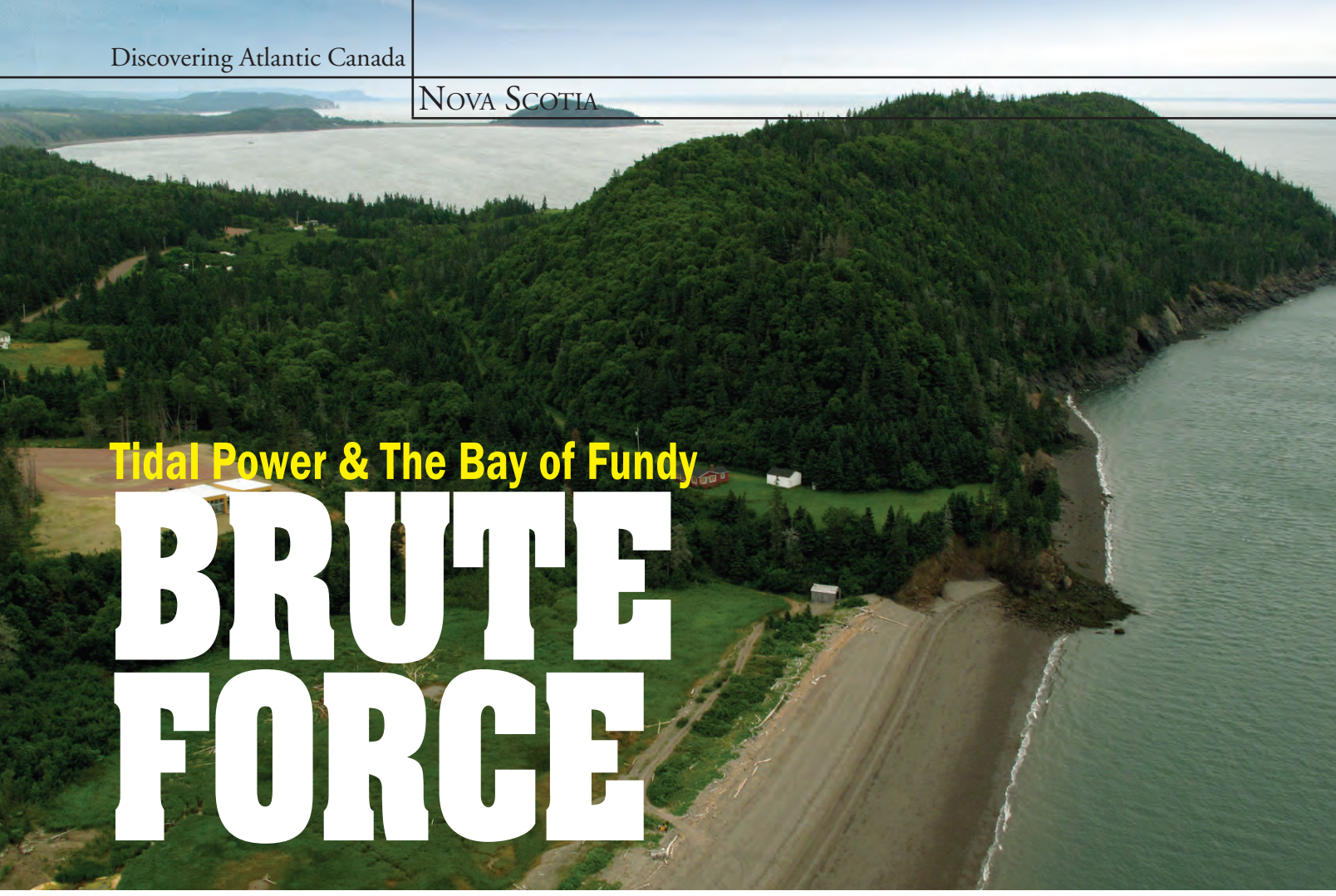
8.2 Department of Physics and Physical Oceanography
Faculty of Science
Chemistry Physics Building
Memorial University
Telephone: (709) 864-8735 or (709) 864-8736
Web address: http://www.mun.ca/physics/main/

8.3 Department of Earth Sciences
Faculty of Science
Alexander Murray Building
Memorial University
Telephone: (709) 737-8142
Web address: http://www.mun.ca/earthsciences/about/

NRC - Institute for Ocean Technology (NRC-IOT)
1 Arctic Avenue
P. O. Box 120936
Telephone: (709) 772-2469
www.nrc-cnrc.gc.ca/iot-ito/index.html

Ocean Sciences Centre (OSC)
Memorial University of Newfoundland
1 Marine Lab Road
Telephone: (709) 864-3708
www.mun.ca/osc/Home/

Offshore Safety and Survival Centre (OSSC)
Marine Institute of Memorial University
Telephone: (709) 834-2076
E-mail: ossc@mi.mun.ca
www.mi.mun.ca/ossc/



Tidal Power & The Bay of Fundy

BRUTE FORCE

Nova Scotia is home to one of the most prolific and interesting tidal sites on the planet courtesy of the Bay of Fundy, which has the world's highest tides and represents a mass of untapped power. The area is the ideal breeding and proving ground for a host of subsea technologies which could help to advance the use and distribution of renewable energy from our tides. Fundy Ocean Research Center for Energy – or FORCE – is Canada's leading test center for in-stream tidal energy technology, an organization that works with developers, regulators, and researchers to study the potential for tidal turbines to operate within the Bay of Fundy environment. Marine Technology Reporter recently caught up with Doug Keefe, Executive Director, FORCE, to discuss his organization's initiatives.

By Greg Trauthwein, Editor & Associate Publisher

Atlantis Deploys at EMC.

Pre-deployment in Halifax harbor.

The Bay of Fundy provides some interesting tidal conditions that are unique to the world. Please give a brief overview of the area and its characteristics?

DK FORCE's test site is in the Minas Passage in the Bay of Fundy. 160 billion tons of water flows through the Bay of Fundy each tide, equal to about four times the estimated flow of all the freshwater rivers in the world combined. We get roughly 14 billion tons of that water squeezing through the Minas Passage on an incoming tide, where we see not only the highest tides in the world, but potentially the most powerful. That's because that huge volume of water has to pinch through the Minas Passage's relatively narrow width of 5 km. Like putting your thumb on a garden hose, as you pinch the water, it speeds up. We have a lot of water, moving very fast. Tidal power output is very sensitive to water speed – the power varies with the cube of the water velocity. So if the water speed doubles, the turbine will provide 8 times more power. And the FORCE test site is very fast – upwards of 5 meters per second. The power here compares with a hurricane force wind.

Another important feature is that by May of this year we will be connected to the provincial transmission system, part of the North American eastern seaboard grid, by a 10km, 138kV transmission line. There are other good sites around the world, but few with the close proximity to power lines and customers…and building new transmission capacity can be very expensive.

In addition, the site is well suited to development, with water depths up to 45m at low tide, a sediment-free bedrock sea floor, and straight flowing – like a piston – currents.

What is FORCE's role in the development of subsea technology/energy for this area?

DK We have three key roles: host, watchdog, and research center.

First is host, acting as a catalyst to industry, lowering their cost of entry. In simplest terms, that means we provide all the infrastructure necessary to deliver electricity from turbines to market. And it is from an approved and permitted site in one of the world's most powerful tidal regimes.

Second is watchdog, providing an independent environmental monitoring program, which we hope will contribute to public confidence in testing and demonstration, and, if warranted, large-scale development.

Finally, is our increasingly significant research program, which ranges from resource assessment to subsea mapping, current profiling, near and far field effects, environmental impacts, and technical barriers. A critical piece of this is site-specific data for developers, who want to understand what kind of tides they are dealing with and what the seabed is like.

FORCE in the winter

Specifically, is the Bay of Fundy area seen strictly as one of the world's harshest testing grounds for subsea equipment, or are there plans on the board to eventually commercialize, to harness the power of the tides for commercial use.

DK FORCE is here to better understand the potential to commercialize, and support informed decisions. Ultimately, the move to large-scale projects will depend on investors, governments, public confidence, and most importantly consumers – they pay for the electricity.
But as the technology matures, the potential is definitely there. Models suggest we can safely extract 2500 megawatts from the Minas Passage during peak flows – and the peak electricity demand for the entire province in only 2300 megawatts.
With this potential in mind, we have built capacity for growth into our electrical infrastructure. We have enough submarine cable capacity for 64 megawatts, which is like putting 64 commercial-scale turbines in the water. This means we have more capacity than any other tidal turbine site in the world.

The province has also supported the idea of commercial growth by creating feed-in tariffs for tidal – an effective way to incent development in the Bay of Fundy. The feed-in tariff has garnered the interest of every major tidal developer on the planet.

What, currently, do you count as your Greatest Technological needs and challenges to help you go about your daily work?

DK For FORCE, one of our greatest needs is access to high quality, site-specific data. Developers, researchers, and regulators all want that data, and acquiring it in a high flow site like ours is challenging.

Specifically, what kinds of companies/technologies/capabilities are the priority to develop in the coming 12 to 24 months?

DK We don't comment on specific companies – our

NS Power Deployment.

role is to enable industry and report the science. However, there are clearly technology opportunities in a number of areas: the turbine design itself, and also the supporting structure, the method of deployment, its cable connection, as well as the sensing equipment need to characterize and monitor the site.

While the challenges of the region are obvious, what do you count as the top three operating challenges for traditional subsea equipment.

DK The fundamental challenge is the extreme conditions at FORCE; this lies at the center of a number of associated challenges: turbine installation and maintenance, vessel access and mobilization time, and electronic equipment reliability and performance.

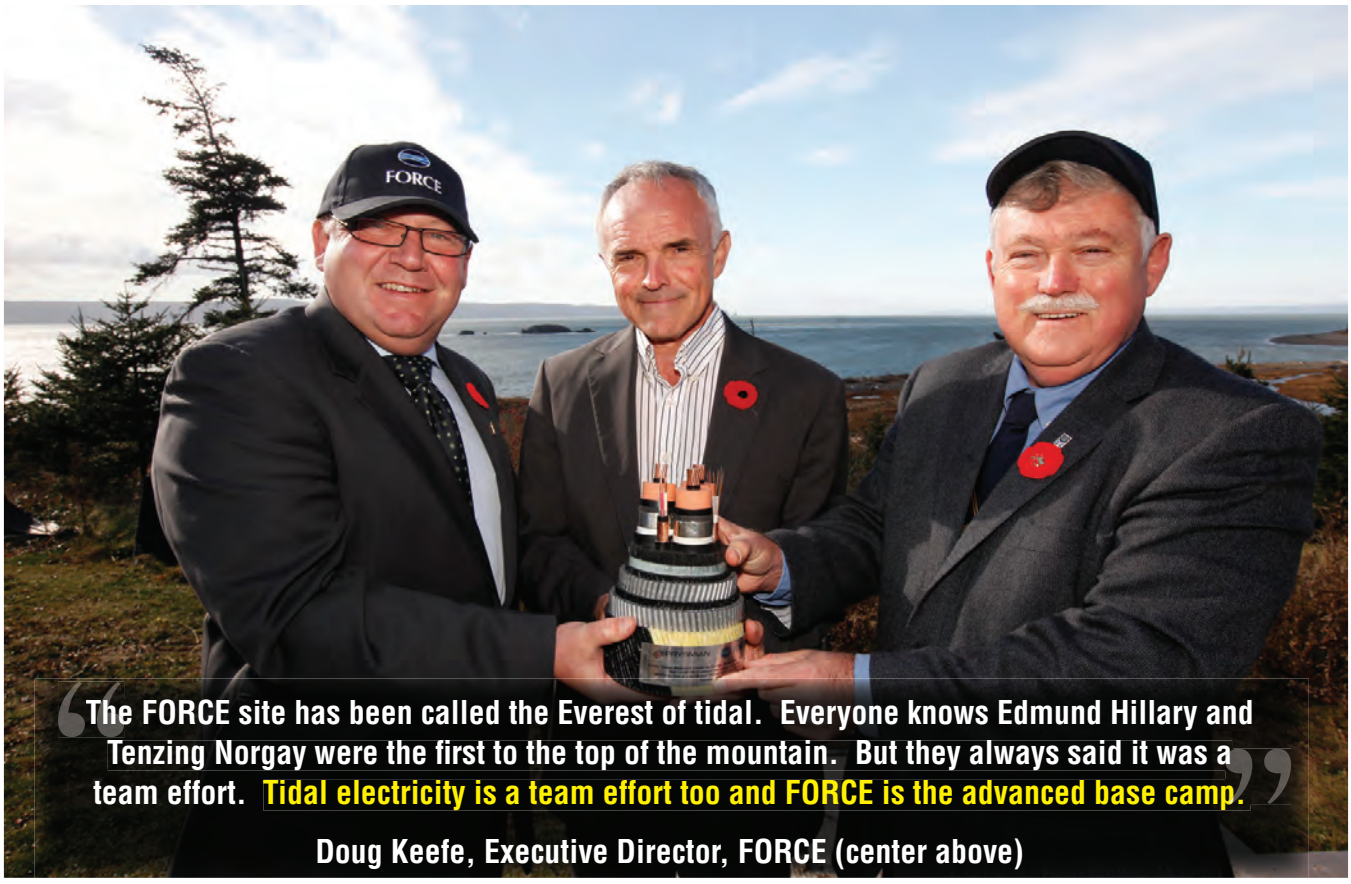
While the challenges are indeed great, what do you see as the ultimate reward of your work?

DK The FORCE site has been called the Everest of tidal. Everyone knows Edmund Hillary and Tenzing Norgay were the first to the top of the mountain. But they always said it was a team effort. Tidal electricity is a team effort too and FORCE is the advanced base camp. When we see technologies succeed here, and over time prove both their safety and economic viability, I believe FORCE will have played an historical role in the emergence of a new and clean energy technology. Better still, this technology has the potential to transform Nova Scotia's electricity supply. This will take time – and there won't be any shortcuts. Developers need time to refine their designs, and we need time to make sure we understand how this technology interacts with both the Bay of Fundy environment, and our electricity market.

For this project, can you explain how government and industry work together for a common end?

DK Everyone sees the enormous opportunity for Nova Scotia and Canada. On the research side, we live in a province with more post-secondary institutions per capita than any other region in North America, and much of that work is centered around ocean-related activity. In terms of

L to R: Premier Dexter, Doug Keefe & Minister Parker.



"The FORCE site has been called the Everest of tidal. Everyone knows Edmund Hillary and Tenzing Norgay were the first to the top of the mountain. But they always said it was a team effort. Tidal electricity is a team effort too and FORCE is the advanced base camp."

Doug Keefe, Executive Director, FORCE (center above)

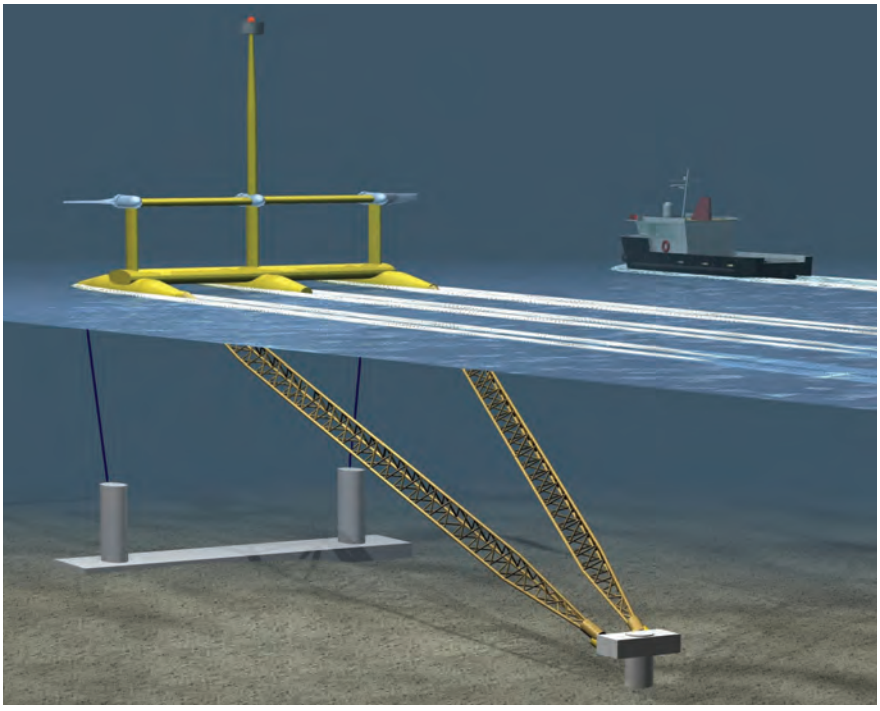
industry, we have over 300 companies with years of experience supplying and servicing Nova Scotia's offshore oil and gas projects: Cohasset, Sable, and more recently Deep Panuke … and many of those companies work in the marine energy environment all over the world.

- Their skills are directly translatable to the tidal industry. And they've already been put to work: identifying the test site, monitoring the environment, towing equipment, building a gravity base, pioneering new research.
- All of the turbine developers have supply chain partners in Nova Scotia and Canada.
- There have been positive signals from all levels of government. The federal government sees a potential supply chain that flows from the Bay of Fundy right across the country, where up to 80,000 megawatts of tidal power lies in wait – they have chipped in the largest grant to the project to date: $20 million.
- The province has been hugely influential by building the right incentives: feed-in tariffs, caps on GHGs, and aggressive renewable targets.
- When FORCE installs the submarine cable this year, we will have a total of 64 megawatts of cable capacity from our test site.
- That moves Canada to the front of the pack in terms of total capacity worldwide … more than any other tidal test site in the world.

So yes, I think it's fair to say we all see the potential. Standing at the window of our visitor center, the potential is obvious to anyone: as the tide moves in and out, the island just offshore forms a bow wave just like a ship steaming through the water.

The water moves fast here.
And there's 14 billion tons of it.

The FORCE site is an idealic breeding ground to ensure maritime renewable energy systems can stand up to the rigors.



Halifax Open for Business to the World

Halifax, Nova Scotia is renowned for its subsea industry cluster of excellence, seamlessly blending business, academia and government to help foster business relationships in and around the province, as well as around the globe. The province received a major boost late last year when the Canadian government awarded a nearly $25 billion, 30-year contract to Irving Shipbuilding for its massive Canadian Navy fleet renewal program, a contract which will have ramification to the region for a generation. Marine Technology Reporter recently spent some time with David Daniels, Nova Scotia Business Inc. (NSBI), Director, Science & Technology to discuss NSBI and its mission to aid the booming business in the region.

By Greg Trauthwein, Editor & Associate Publisher

What, exactly, is the Nova Scotia Business Inc. (NSBI) empowered to do?

We are Nova Scotia, Canada's business development agency. We work to attract new companies to the province and we work directly with local companies to help them meet their growth potential through international business development, financing and venture capital.

Please provide a brief overview of the maritime and subsea sectors in the province.

Our Ocean Technology sector is strong, diversified and growing. We have the highest concentration of companies per capita in North America involved in acoustics, sensors and instrumentation. There is a lot of economic activity around ocean observation, marine defence and marine energy. We have more than 200 companies engaged in this sector and 60 would be considered innovators. These companies play a huge role in adding value by developing and producing technologically innovative products and services.

Currently, Nova Scotia oceans technology sector generates revenues of over $500 million. The oceans technology sector in turn supplies broader oceans-related industries in Nova Scotia which accounts for $5 billion in GDP and 14% of the workforce. The estimated annual global market value for ocean-related goods and services is $3 trillion (US) which has doubled in last six years.

Innovation in this sector has, and still is, widely contributing to its success. Out of all research performed by businesses in Nova Scotia, one-third of it is conducted in the Ocean Technology industry. We have 450 PhDs in ocean-related disciplines, which is the world's highest concentration of researchers in this sector. We have world-renowned ocean-related research institutions including Canada's largest - The Bedford Institute of Oceanography (BIO) which brings together some 700 scientists, engineers, technicians,

contractors and staff working in a range of disciplines.
In addition to BIO, Dalhousie University along with the National Research Council Institute for Marine Biosciences (NRC-IMB), are considered some of the world's most versatile marine research facilities. All this makes Nova Scotia among the top international centers of excellence in oceans science.

We understand that a significant Canadian Navy, multi-year, multi-billion contract was awarded to Halifax' Irving Shipbuilding. Can you please put into perspective the impact that this contract will have on the province, on Halifax, and on the entire cluster of companies serving this subsea and maritime sector?

We are 17 weeks into a 30-year project. Irving Shipbuilding has started the negotiating process for these contracts with the federal government and it is expected that work on the first ship will begin in approximately 2-3 years. It will take time for the impact of this opportunity to be felt across the province. This being said, this is the perfect time for businesses to learn more about how to become prepared to join the supply chain. It is also time for students to think about a career in shipbuilding and workers to think about retraining. This opportunity brings 30 years of sustainable jobs and spin-off opportunities for many more not directly involved in building ships.
This announcement is providing momentum for Nova Scotia's workforce who will now need to access skills, training and learning opportunities that will help them get ready for the direct and indirect jobs the contracts will bring. As part of the bid process, Irving Shipbuilding has demonstrated how it intends to fulfill this contract, and has carefully considered the impact it will have. The company continues to forge important relationships with community colleges and universities to meet the demand for labor, and this on-going process will continue.
A variety of Nova Scotia's oceans technology companies provide for the military, port security, surveillance, and search and rescue activities. Ocean Technology companies operating within the shipbuilding and marine transportation market could see opportunity in developing technology-based, ocean-related products and services for naval architecture, navigation, communications,

HMRI Inside the "Crown Jewel"

Douglas Wallace, **Halifax Marine Research Institute** (HMRI) Science Director, (pictured right) is a leader in developing new technologies to measure changes to the world's oceans. Before becoming Canada Excellence Research Chair in Ocean Science and Technology, Wallace was professor of marine chemistry at the Leibniz Institute of Marine Sciences in Kiel, Germany. There, he also served as deputy director and head of the Marine Biogeochemistry Research Division. He holds a PhD in chemical oceanography from Dalhousie University and a bachelor's degree in environmental science from the University of East Anglia, United Kingdom.

Wallace spent more than a decade working as a scientist at the prestigious Brookhaven National Laboratory in the U.S. He also made significant scientific contributions to his field through the Intergovernmental Panel on Climate Change, and the US Department of Energy, where he developed the first survey to measure the global distribution of fossil-fuel carbon in the oceans.

Wallace is highly skilled at building successful multidisciplinary research teams, including CARBOOCEAN, a five-year study of the ocean carbon cycle, SOLAS, a global project investigating interactions between the atmosphere and the ocean. He also led the development of an ocean and atmosphere observatory on the Cape Verde Islands off the West African coast.

We understand that the Halifax Marine Research Institute – which is touted as a "jewel" for Halifax – is set to open in 2013. What exact activities with the Institute undertake?

Wallace The Halifax Marine Research Institute (HMRI) is the ground-breaking collaborative marine research and innovation vehicle that brings together a number of partners from industry, government and the post-secondary education system regionally, nationally and internationally. With billions of dollars in revenue, thousands of jobs in Atlantic Canada and more than 10 per cent of all researchers in Atlantic Canada focused on the ocean, the Halifax Marine Research Institute (HRMI) will align these assets to benefit the region and the marine science and technology sector. The aim of the organization will be to increase the scale, quality, internationalization and impact of marine research, enhancing both the competitiveness of oceans industries and our knowledge base by taking advantage of synergies and crafting partnerships that build on the region's existing strengths.

Bringing together academics and government researchers, the institute will also serve as a bridge between the marine research community, the private sector and policy-makers, and will provide the best possible tools and scientific information for making informed decisions about our oceans and building the commercialization potential associated with marine industries. As a collaborative activity, it represents the future of marine research and innovation.

Research Themes

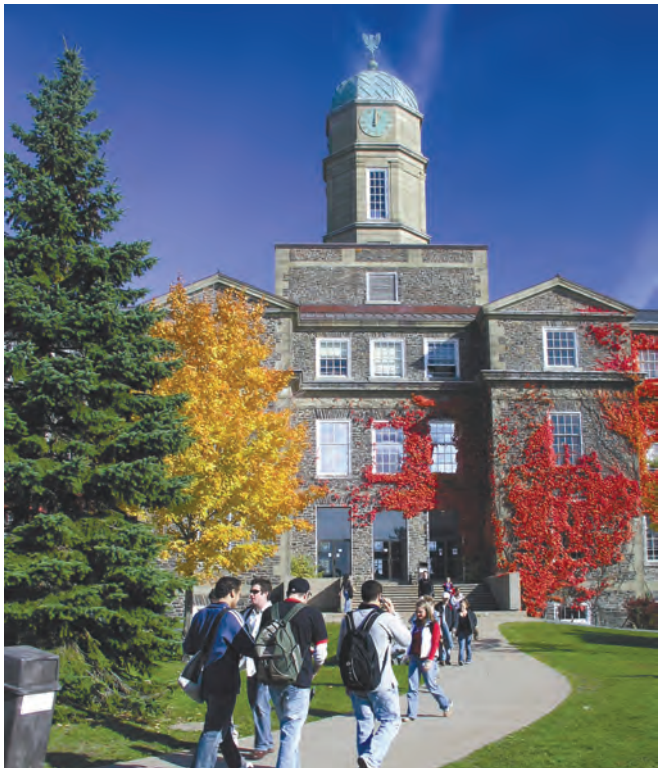
- Marine observation, prediction and response
- Marine living resource conservation, biodiversity and risk assessment
- Marine energy solutions
- Renewable fuels from marine algae
- Marine security
- Marine technology
- Marine governance and management

performance evaluation, vessel monitoring, and safety/evacuation as well as contributing to the various transportation activities that occur in the oceans' environment, including marine towing, navigation and communications and shipping.

What do you tout as the foundation, the core strength of the subsea cluster in your region?

In terms of uniqueness, Nova Scotia is a hotbed for companies and researchers involved in sensors and instrumentation. As mentioned, Nova Scotia has the highest per capita concentration in North America of companies that manufacture navigational and guidance equipment. In addition, we have the highest concentration of ocean technology researchers and a low cost environment for research and development.

Nova Scotia is Canada's University capital with 11 universities. Industry, academia and government work



Dalhousie University is home to more than 100 researchers focusing on the ocean

together to tailor specific programs to ensure students continue to graduate with the skills employers are looking for. In addition to developing our local talent, a sizeable number of technicians, scientists, and engineers needed to work in this sector already live in the province.
Our knowledge assets in the region include the Bedford Institute of Oceanography, the National Research Council's Institute for Marine Biosciences and the Halifax Marine Research Institute. Through these, we have access to professional and research networks essential to product innovation, development, and commercialization.

Aside from the aforementioned navy contract, what do you consider to be the major driving force for SUBSEA technology business in the region?

The major driving force is our people, our research and development capacity and the companies that operate here. In addition to the Halifax Research Marine Institute, our province has the Bedford Institute of Oceanography, Dalhousie University is home to more than 100 researchers focusing on oceans and ocean technology and the National Research Council's Institute for Marine Biosciences is home to the Industry Partnership Facility based in Halifax which explores the commercial potential of technologies in marine biosciences and life sciences.

When I visited Halifax in September 2011, I accompanied a group of European business and association executives who were in town to help forge business relationships. Please put in perspective for me NSBI initiatives to attract and interest companies outside of the province, outside of Canada to "set up shop" in your region?

We are home to one of North America's most competitive business climates. We work closely with government partners, industry, and academia to ensure Nova Scotia's business environment is attractive for investors and can sustain growth in the long-term. We also share information, relationships and expertise to help with a successful transition to the province. We understand that cash flow and profitability are a defining part of any businesses success. Our Business Financing team helps companies increase both. Through loans and guarantees, incentive and rebate programs, we structure financial solutions to meet companies' needs.
Companies around the globe have discovered the benefits of doing business in Nova Scotia. We have the distinct advantage of being located along the Atlantic Ocean on Canada's East Coast. We're a short flight away from major North American markets, and because of our time zone, our workday overlaps with both the United States and Europe. Our state-of-the-art port infrastructure and international airport make it easy to travel and trade. Competitive costs, coupled with a stream of skilled talent from our 11 universities and a province wide community college system, are key success factors for companies operating in Nova Scotia.

"We are 17 weeks into a 30-year project. Irving Shipbuilding has started the negotiating process for these contracts with the federal government and it is expected that work on the first ship will begin in approximately 2-3 years. It will take time for the impact of this opportunity to be felt across the province. This being said, this is the perfect time for businesses to learn more about how to become prepared to join the supply chain. It is also time for students to think about a career in shipbuilding and workers to think about retraining. This opportunity brings 30 years of sustainable jobs and spin-off opportunities for many more not directly involved in building ships."

David Daniels, Nova Scotia Business Inc. (NSBI), Director, Science & Technology

Specifically, are there any types of organizations, associations, or technologies in particular that you are looking to attract?

We work to attract high-value, sustainable business investments to Nova Scotia. In pursuit of this goal, we take a targeted sector-based approach to ensure a strong fit between opportunities and our province's key assets. With a large cluster of economic activity in acoustics, sensor, and instrumentation, we use this competitive advantage when looking to attract investment into Nova Scotia. We are also always looking to attract more companies involved in research and development, and service and manufacturing of high technology products. Nova Scotia is a diversified economy, and that's one of our strengths. We know that the ocean technology is a growing sector in Nova Scotia generating revenues of over $500 million and employing 14% of the province's workforce We however want companies to come for the right reasons – it has to be good for them.

How has the global economic slowdown, now passing its third year, impacted business in the region?

Nova Scotia did not see much of a recession in the ocean's sector. It is partly due to the fact that we are sheltered by a strong public sector, military presence, a post-secondary education network and a well-diversified economy. Despite the economic uncertainty globally, there is significant opportunity in our oceans sector in Nova Scotia.

What initiatives do you see coming in the next 12 to 24 months that you feel will have the biggest impact on Subsea business in the region?

Irving Shipbuilding's contract to build Canada's combat vessels under the National Shipbuilding Procurement Strategy (NSPS) will have a positive economic benefit to suppliers of marine goods and services. The recent launch of Nova Scotia's Ocean Technology Council will complement the research capacity we have in our province and will help raise the profile of our ocean technology sector, its successes and continue to build on its solid foundation.

MTR What do you consider to be the biggest challenges to expanding the subsea business and influence of the region in the coming 12 to 24 months?

Daniels One of our biggest challenges is awareness. When travelling, many people do not know where Nova Scotia is. We are always looking to find new ways to generate awareness about our sector, our province, and the opportunities and resources that we have here, especially to companies looking to expand their global footprint.
We continue encourage international players to consider Nova Scotia as a place to do business, a place to forge partnerships, and a place for foreign investment.

"All of the studies in my lab are based on understanding on how the marine ecosystem recovers from oil spills naturally and how we can speed that process up."

(Photo: Greg Trauthwein)

Dr. Lee in front of BIO's Wave Tank Facility.

Dr. Kenneth Lee is the

Spill Stopper

Dr. Kenneth Lee is a world-renowned authority on the use of chemical dispersants in the clean-up of oil spills. A pivotal player in some of the world's biggest oil spill clean-up events over the last 30 years, Dr. Lee and his team are dedicated to continually learn about and work in harmony with Mother Nature to help restore affected habitats as quickly and environmentally sound as possible.

By Greg Trauthwein, Editor & Associate Publisher

An oil spill is much like a snowflake, in that no two are alike and both are ever-changing. Different water temperature and environmental conditions, differing types of oil and response capability, and the sensitivity of the habitat in the area of concern and its living resources are just a few of the factors that conspire to make each oil spill event unique.

While the nature of oil spills may differ, the approach by Dr. Lee – a Research Scientist and Executive Director of COOGER, the Center for Offshore Oil, Gas and Energy Research for Fisheries Oceans Canada – is unwavering. While he is an expert on the use of chemical dispersants in remediation of oil spills – having taken up the study in the early 1980s – the central theme to the work of Dr. Lee and his team at COOGER in Halifax is working with Mother Nature to restore the affected area as quickly, and least intrusively, as possible. "What we want to do is understand natural recovery, because natural recovery is much stronger than people think," said Dr. Lee. "There are natural oil seeps around the world; petroleum hydrocarbons are not new to the environment," Lee said. "Natural bacterial populations have adapted to its presence and break it down as a food source. If it wasn't for natural biodegradation of oil, we'd be knee-deep in oil right now." In the case of large, concentrated spill, Dr. Lee said nature simply is not equipped to metabolize the oil fast enough. "The question is this: how can we enhance that rate of natural recovery?"

While there are dozens of factors that make the treatment of oil spills tricky, adding cold, icy waters to the equation quickly escalates the difficulty of operation. Lee, who is co-chair an International Maritime Organization (IMO) Working Group to establish Guidelines for the use of dispersants in the treatment of marine oil spills, finds his time increasingly devoted to studying protocol in the handling a major oil spill in cold waters and harsh environments including the Arctic.

Challenges in Ice

When it comes to marine and subsea activities in the Arctic, the stakes become much higher. The risk of oil spills in this region is ever-increasing due to increased marine traffic associated with community growth, the growth of the ecotourism industry, the recent lengthening of the ice-free period, and the growth of industries such as mining and offshore oil and gas. Indeed, as the world's onshore oil and gas reserves increasingly deplete on land, the world turns to offshore sources, more and more to frontier areas such as the Arctic where technology allows oil companies to discover and recover resources in ever more remote and deep portions of the planet.

Setting up shop and producing oil and gas in hostile environments is one thing; preparing for and enacting an oil spill response plan in the event of disaster is entirely another. "There's concern that an oil spill will occur in the Arctic, and the question is 'do we have the countermeasures in place to protect the environment and its resources," said Dr. Lee. "When you're talking about battling an oil spill in the Arctic the big challenge is working in the Arctic environment itself," said Dr. Lee. "Besides the weather, you have the major problem of logistics, as you're not able to get people or resources to a certain spot as quickly, and where do you deposit the waste from clean-up operations?"

In addition, there is the problem of how oil interacts with ice, which is significantly different than how it interacts with water. "What do you do when you have broken or solid ice; what would you do if you have a subsea blowout during the winter seasons?," asked Dr. Lee, "Unfortunately, most of the current equipment for physical recovery of oil has been designed and tested for use in ice-free waters."

Dr. Lee and his colleague maintain a busy pace today evaluating new techniques and technologies being devised to deal with such an occurrence. "There are a lot of environmental challenges: extreme cold temperatures, limited daylight hours, and also the fate, behavior and biological effects of oil in a cold water harsh environment."

Dispersants

"I support the use of chemical oil dispersants under the right conditions. Our research team has been conducting ongoing studies to see the long-term effect of dispersants in the water column. It is always important to remember that low toxicity does not mean no toxicity," Dr. Lee said. "But there is something people forget when you talk about oil dispersant use. Would I add chemical oil dispersants to a pristine environment? Of course not. But what you have to understand is that when you have an oil spill, you have a contaminated environment that you need to remediate, or bring back to where it was. We are treating a contaminated site, and we're trying to reduce the detrimental effects. Before we use dispersants, we always conduct a Net Benefit Analysis. And in some instances, we simply decide the best measure is to let nature takes its course."

Courtesy of a diverse background, Dr. Lee started working on oil dispersant in the early 1980s. "I did a post-doctoral fellowship in chemical oceanography on the West Coast in the Institute of Ocean Sciences in British Columbia, and as it turned out because I had an interest in hydrocarbons and expertise in microbiology; I worked on oil dispersants."

Work today focuses on new formulations of dispersants that are more efficient in the break-up of heavier oils. "If you would have asked me 10 years ago would we use oil dispersants off the east coast of Canada I would have said 'no', because it was thought that the hydrocarbons off of Newfoundland – those waxy crude oils – were too viscous to use a dispersant," Dr. Lee said. "Of course now, with several major oil spills being heavier oils such as Prestige and Erika, there are new formulations and it turns out that they are effective for some of these heavier oils, so we started studying chemical oil dispersants again. In addition, we built a wave tank facility at Bedford Institute of Oceanography (BIO) specifically for that." As it turned out, this investment would prove beneficial in the Gulf of Mexico.

BIO's Wave Tank Facility

At Dr. Lee's base at BIO in Dartmouth, NS, he spearheaded the construction of a unique wave tank which allows scientists to closely study the interaction of oil and water in a raucous real-world wave environment. The wave tank was co-funded by the U.S. and Canada, and it was designed to generate wave energy similar to that in the environment, including breaking waves. The platform allows the team to test types of crude oil and dispersant combinations in the push to deliver guidelines for dispersant use. In addition, the open flow-through nature of the system (to mimic current flow) allows the team to conduct toxicity tests to determine the combination's effect on the water column under realistic exposure conditions.

Dr. Lee points to specific 'knowledge gaps,' gaps highlighted by a U.S. National Academy of Sciences report which reviewed the use of chemical oil dispersants, that BIO's wave tank helps to fill, including:

- Under what conditions do oil spill dispersants work? We know for them to work, we also need energy to break the oil into smaller droplets, Dr. Lee said.
- If they do work, how efficient are they? And how do you measure their efficiency?
- The role of Bacteria: Bacteria can only attack oil at the oil/water interface. If you can increase the surface area of the oil, ie. break the oil into smaller droplets, you can enhance and expedite the breakdown of oil.
- If the dispersants do work, what are their short and long-term biological effects?

When you use chemical oil dispersants, you are trying to break the oil into very small droplets, which are then diluted in the water column to concentrations below that that has biological effects, Dr. Lee said.

By virtue of Dr. Lee's career accomplishments, and the fact that his team already had collaborative project in place with techniques to monitor dispersant toxicity, he services following the massive Gulf of Mexico blowout and resulting spill was a natural.

According to Dr. Lee, there was a keen and immediate interest in using dispersants in the GOM spill for two main reasons:

- The Wetlands: There was the concern that the oil would breach sensitive ecological wetlands and kill the plants. If you kill the plants and lose the roots, massive erosion could effectively wipe out the wetlands.
- Human Safety: There was so much oil around the rig (and the rig drilling of the relief well) that there was a very high concentration of Volatile Organic Compounds (VOCs), making it unsafe for humans. To work they were forcing them to wear protective gear, slowing productivity to stop the leak.

Because of the volume of oil spilled, however, there was concern regarding the volume of dispersants entering the environment. This led to a world first: the direct injecting of the dispersant at the wellhead at a depth of 1500 meters. Taking this drastic step was deemed necessary, as "You knew that you were applying the dispersant directly to the oil. Also, as oil surfaces through the water, it becomes emulsified, and emulsified oil – which basically has the consistency of mayonnaise – is much harder to deal with."

In total his team spent four months in the region, not only advising on the use of dispersants but monitoring their effects on the environment, and even tracking the much reported sub-surface 'oil plume' through the Gulf.

While Dr. Lee's career and knowledge base is inextricably linked to the use of chemical dispersants, he is always quick to stress the overriding nature of his work: "All of the studies in my lab are based on understanding on how the marine ecosystem recovers from oil spills naturally and how we can speed that process up."

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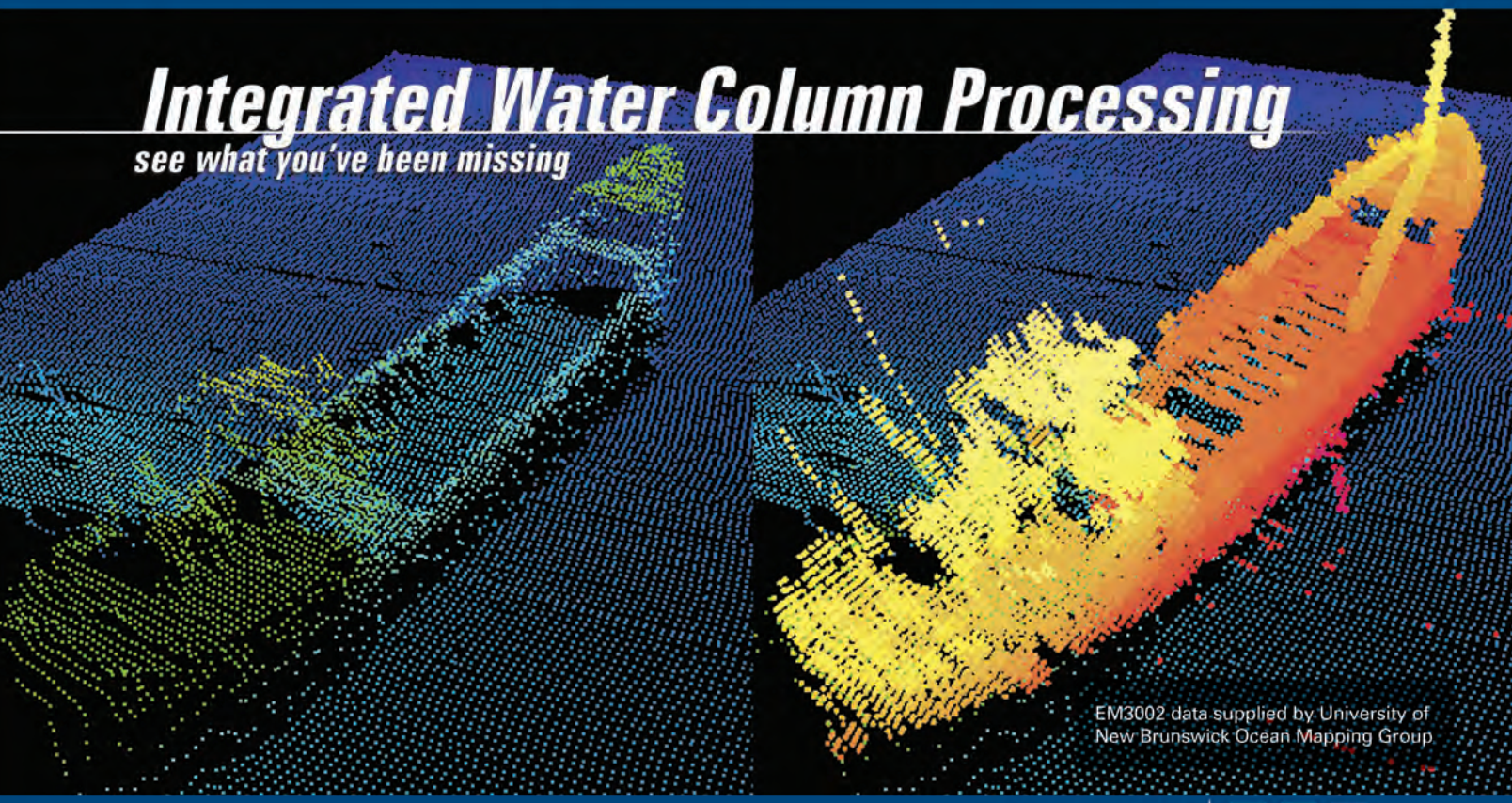

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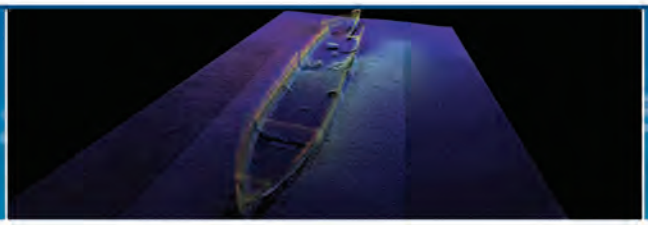

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SAUC-E

Student Teams Receive Realistic Challenges in Vehicle Construction & Operation

Sure you can create an underwater robot, but can you teach it do tricks in La Spezia Harbor? ***By Edward Lundquist***

Students studying science, technology, robotics or engineering can put their knowledge and skills to the test at the Student Autonomous Underwater Challenge – Europe. (SAUC-E). Held since 2006, the SAUC-E competition challenges the next generation of engineers to design and build an autonomous underwater vehicle (AUV) capable of performing realistic missions.

SAUC-E '12 will take place July 6-13 at NURC in La Spezia, Italy — www.sauc-europe.org

"The event is designed to encourage students to think about underwater technology and related applications while fostering innovation and technology," says Vladimir Djapic, a scientist at the NATO Undersea Research Centre (NURC) in La Spezia, Italy, and technical director for the SAUC-E 2012 competition. "It also aims at getting young engineers and scientists to consider careers in the field."

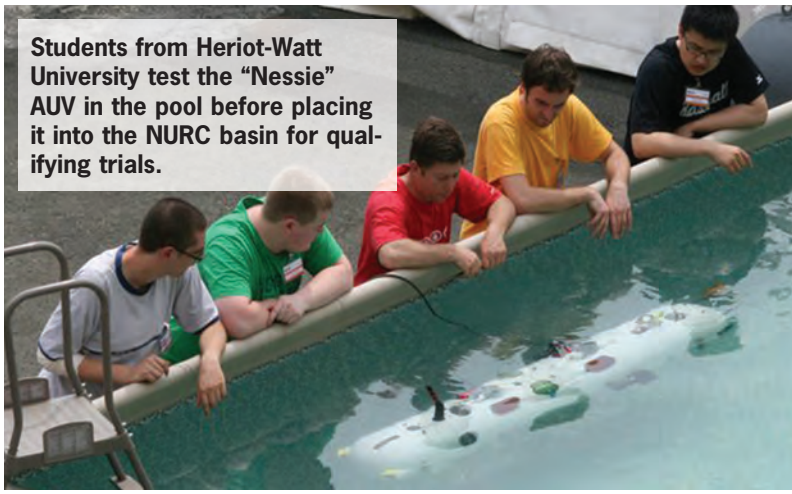
Djapic says that the boat basin at NURC is a very realistic and challenging environment, open to the sea and the elements. "It is not a pool. Participants must contend with wave action, variable visibility, salinity, and tidal conditions."

"Following some spectacular nose dives into the bottom last year—and the resulting reduction of UW visibility making it extremely difficult to find and recover the vehicles—we're asking the teams to install strobe lights on their vehicle. At least this way I have a fighting chance to dive and recover them if they go rogue!," says Royal Navy Lt. Cmdr. Nick Gwatkin, the SAUC-E event coordinator.

Another development for 2012 is the creation of a NATO Engineering Support Team (NEST), which will increase the engineering capabilities of the students designing AUVs by letting students ask questions, share ideas, solutions and even hardware, sensor and software designs and code, and allow them to ask experts for advice. There will also be advice to prepare teams to operate in the real-world environment found in the NURC basin. "This will lead to an increase in the state-of-the-art in AUV design and will also enable teams to develop algorithms for more advanced systems," Djapic says.

Djapic says NEST will also establish a hardware library where student teams can borrow equipment such as acoustic modems. In return, the students will be expected to share the sensor integration code and sensor data they developed with the loaned gear on the NEST web page.

Not only will NURC's NEST experts be available to provide assistance where possible, they hope to also conduct some onsite visits to helps teams at their school laboratories. "We have NEST experts who can assist with software engineering, sensor signal processing, mechanical/naval architecture, and control theory, all of which are directly applicable to AUV design," Djapic says. Teams of students from universities all over Europe compete using vehicles they have designed and built themselves, and competing on a course where they must complete a series of predefined tasks. Teams are judged on the ability of their AUVs to complete these tasks, as well as technical merit, craftsmanship, safety of design, and fund-raising efforts. Ten teams from across Europe took part in last year's competition. The 2011 winning team came from the University of Luebeck in Germany. Each the 2011 teams have already indicated interest in participating in the 2012 competition, and two new teams will join in 2012—The University of Las Palmas de Gran Canaria, also known as the ULPGC (Spanish Universidad de Las Palmas de Gran Canaria) and Team SONIA (Système d'opération nautique intelligent et autonome) from École de technologie supérieure in Montreal, Canada, which was the AUVSI RoboSub 2011 competition winning team. Major sponsors for SAUC-E 2012 are the Office of Naval Research and ONR Global.



Students from Heriot-Watt University test the "Nessie" AUV in the pool before placing it into the NURC basin for qualifying trials.

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Small Beginnings, Global Impacts

By Raina O. Clark

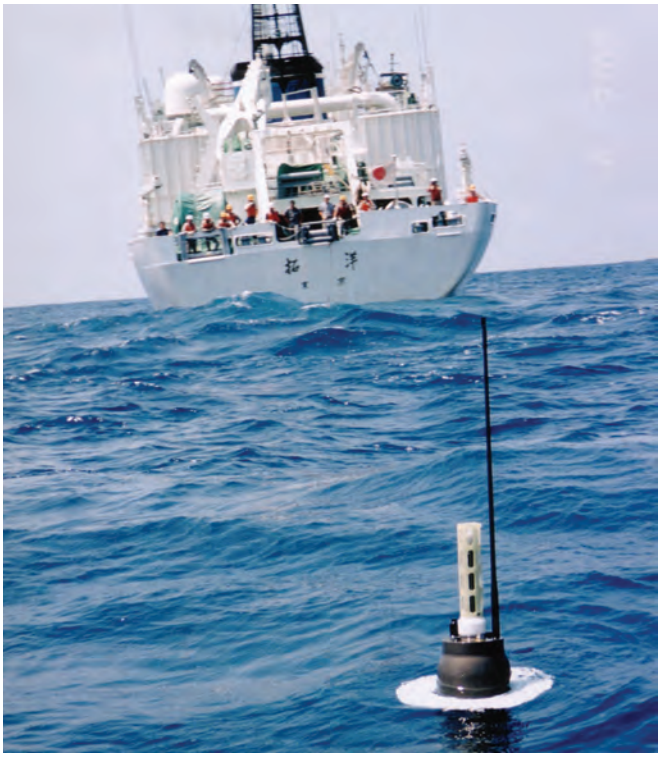
Sea-Bird Electronics began humbly in 1978 from the home of Art Pederson, an engineer in the Applied Physics Lab at the University of Washington. Pederson took early retirement from the University and acquired a commercial license for a couple of designs he had been working on in the lab, instruments for measuring Conductivity and Temperature in the ocean. Integrating these sensors with a commercial pressure (Depth) sensor, Art built Sea-Bird's first CTD. These three elements, CTD, determine density, which in turn drives ocean currents. These currents are key to scientific inquiries such as climate change analyses, as well as shorter-term tasks like fisheries and port management, hurricane preparedness and search and rescue.

When Pederson named the company, he chose "Sea" for his home city of Seattle and "Bird," his wife's maiden name, in recognition of her part in the start-up. Sea-Bird started out building CTD research instruments for university scientists, then began supplying science agencies like NOAA, EPA and USGS.

"Sea-Bird really got its legs and reputation for the very best measurement you can make in the 80s and early 90s" under Pederson's tenure, said current president, Dr. Norge Larson. Ken Lawson, Sea-Bird's second president from 1991 to 2005, grew the company from 27 to 84 employees in his years at the helm and transitioned its original custom products into a diverse line of standard instruments. Fast forward to today and Larson says "there isn't a university or research institute in the world involved in this field that doesn't use our instruments." Sea-Bird now employs about 110 people. In addition, Sea-Bird has created an umbrella group — Sea-Bird Scientific — currently comprised of four companies employing more than 200 people at five locations around the globe. "Our ability to help customers achieve their goals has really grown,"

(Photo by Truman Buffett)

Dr. Norge Larson, Sea-Bird Electronics' President



(Graphics provided by the Argo Program www.argo.net and www.argo.ucsd.edu)

A research vessel deploys an Argo float carrying Sea-Bird's CTD sensor .

Larson said.

Sea-Bird has witnessed and participated in the maturation of oceanography as a science. Modern electronics and computing power led to a huge growth in the ability to make measurements with an accuracy never before possible. One important result of this technological advancement has been a deeper understanding of density and the ocean's complex circulation patterns.

"If you know the density you have a much better idea of the three-dimensional motion of the ocean," Larson explained. "Ocean currents are driven by pressure gradients revealed as density gradients, and play a dominant role in influencing weather and the climate. There are plenty of instruments that measure simple motion and current at a point in time and space, but density data from high-accuracy, highly stable CTDs provides the essential information for an additional element — predicting and forecasting via numerical models."

Two other oceanographic research instrument companies, WET Labs and Satlantic, have affiliated with Sea-Bird. WET Labs makes underwater sensors to measure inherent optical properties and detect biological, chemical and geological processes, and Satlantic specializes in measuring light from the sun that is altered by ocean processes. The combination of these companies provides better support for integration of multiple sensors in one package.

Sea-Bird's founder retired in 1991 and stayed associated as a consultant for some time. Pederson still lives in Seattle and travels the world. "He's off trekking in Switzerland now," Larson said. "It's a great image of retirement."

Partnering with the Scientific Community

Larson earned his PhD in Ocean Physics from the same Applied Physics Laboratory, where Pederson was his department manager. When Larson joined Sea-Bird in 1988 he had a choice between taking a position in academia or going into business with Pederson's young company.

"The scientist in me has no regrets," Larson said. "I believe that Sea-Bird has enabled other scientists to make great contributions. That is very satisfying."

At Sea-Bird, Larson's job was to formalize the work Sea-Bird does with the science community. Being a scientist himself and a co-practitioner helped Larson understand

what customers were trying to do. "I did a lot of field oceanography during my degree work — lots of time on ships." This helped him translate input from the field back to the company and further improve Sea-Bird's instruments.

The central theme has always been "how do we improve the data?" Larson said. "We've had an unwavering focus on the quality data that scientists need. The business has to follow that focus. Often the meaningful improvements are the result of a long, slow unrelenting pursuit of what's not working well and how to fix it."

Larson said there are four parts in Sea-Bird's quest to continually improve the quality of data available to the scientific community: make the instruments as perfect as possible, work with scientists to improve the methods by which the instruments are used, work around the practical restrictions aboard research vessels and develop defensible corrections for any errors in the data.

It's not only about having the best instruments possible, it's about enabling scientists to use them in practical ways to get the highest quality data. "We began to involve ourselves heavily in the use of these instruments. We worked with scientists to do things better."

Larson also acknowledged that there are very practical limitations for using these types of instruments aboard ships. "Our personal contacts and relationships with scientists allowed us to observe deployments, develop methods to get around these restrictions and provide advice on future deployment techniques. That's only possible when you have that relationship and that credibility."

That kind of credibility leads to some exciting inquiries from the scientific community. "Scientists doing cutting-edge work come to us with interesting questions," Larson said, citing one group whose Sea-Bird instruments were measuring super-cooling, sub-freezing temperatures in the ocean, yet the water was not frozen. "Could the measurements be for real?" they wanted to know, "and, what does this imply about the physics of freezing water?"

"These kinds of questions make it a really fun place to work," Larson said. "We can bring both our own scientific knowledge and our knowledge of instruments to bear. It's very rewarding to be able to work on fundamental questions in nature."

Managers are the New Market

Managers in many related fields are benefitting from the advancement of oceanography and its scientific tools,

(Photo by Truman Buffett)

Sea-Bird Electronic employees at the company's Bellevue, Wash. location, June, 2011.

including fisheries, public health and safety, ports, water quality, natural disaster preparedness, search and rescue and weather forecasting.

For example, during the Macondo oil well spill in the Gulf of Mexico, agency managers needed to figure out where the oil was going. They thought that the flow of oil from the well was greater than the amount of oil appearing at the surface. Sea-Bird CTDs determined the density of the water in the vicinity of the well, while fluorometers from WET Labs detected the oil. The combined measurements revealed that a cloud of oil rose to a specific density of water at mid-depth, then spread out at that density, rather than settling to the bottom or rising to the surface. "Our instruments gave managers a lot of information as well as the environmental context and could tell them where the cloud of oil was and where it would go," said Larson.

New instruments for managers have opened up a new set of markets for Sea-Bird. These new instruments are "the same thing we've already built, but they work a little more autonomously or automatically. We've discovered ways to make our instruments more turn-key," Larson said. This makes it easier for the non-specialist to use scientific-grade instruments and get high quality measurements. The post-processing that scientists have usually done in the lab can now be done by the instrument itself, in the field. The instrument cuts out some of the steps by doing data processing internally and outputting finished data. A good example is Sea-Bird's MicroCAT, "a very focused instrument measuring temperature, salinity, pressure and oxygen in the water," Larson explained. Managers can use the MicroCAT, along with other data, to make decisions about opening and closing fisheries. "It allows managers to be much more sophisticated about their decisions, taking into account more than just present fish counts." They're able to forecast better because they know more about the conditions that will impact fish counts into the future.

"Managers need data about present conditions," Larson said, which has led to an increasing demand for real-time data. "Managers need to know what's going on now. We also build the communication devices that make that possible."

The Argo Project

One international initiative Sea-Bird is particularly proud to be a part of is the Argo project. This project consists of thousands of underwater probes around the globe monitoring the condition of the ocean. The probes are robotic floats weighing about 80 pounds each and carrying Sea-Bird's CTD sensors.

The Argo float is deployed from a research ship or aircraft into the ocean. It descends to a depth of 0.6 miles, drifts for ten days, then descends to 1.2 miles. The float's internal pump then inflates a bladder which causes it to rise to the surface. During its ascent it takes salinity, temperature and pressure measurements, then transmits data to a satellite when it reaches the surface. The data is posted on the Internet and used by oceanographers as well as weather and climate forecasting centers. The float bladder deflates and the unit sinks again to begin a new cycle. The battery life is designed to last for 150 cycles, about four years.

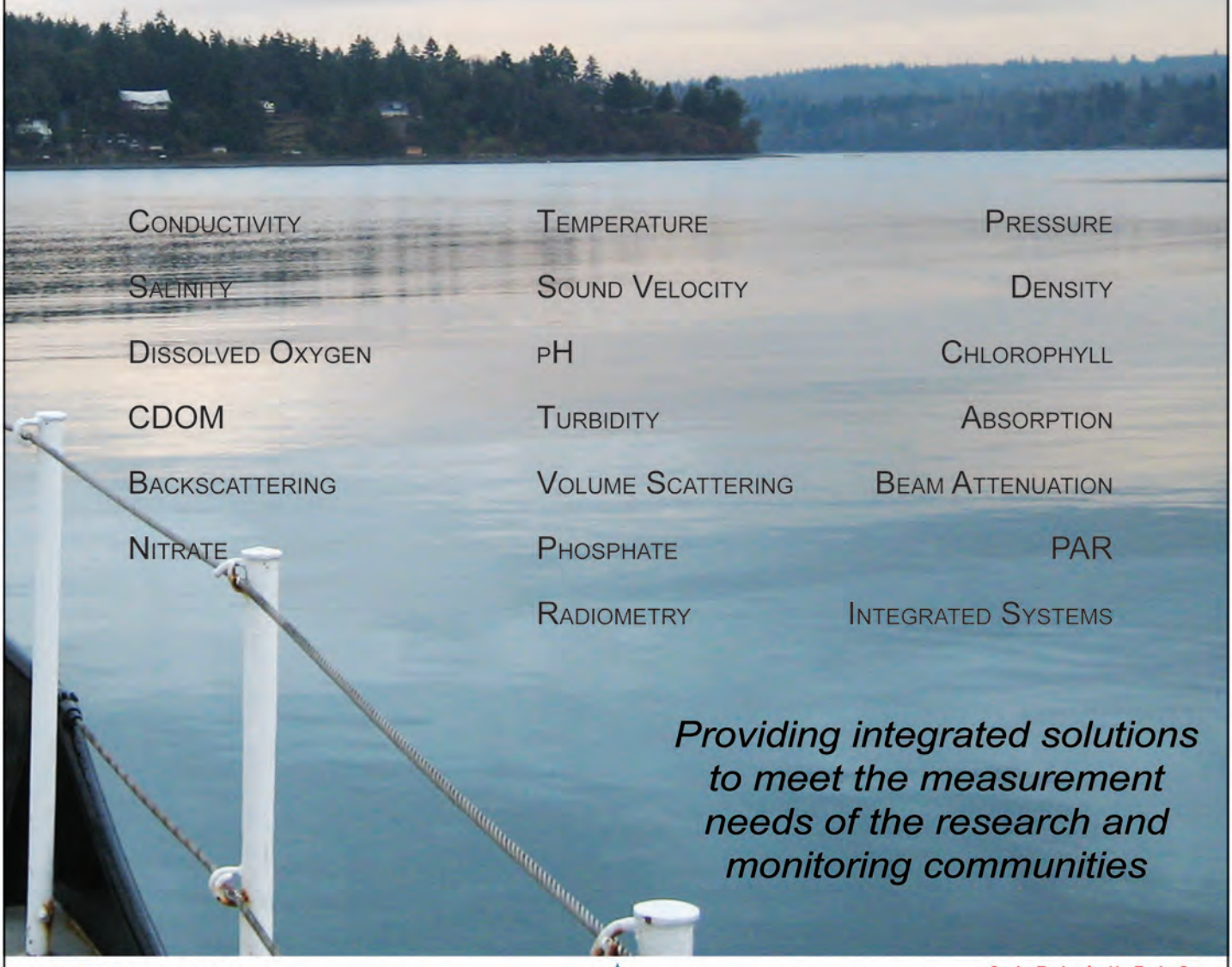
The Argo project launched its first probes in 2000. There are now about 3,500 throughout the ocean.

Of course, these types of undertakings frequently face funding battles and like these projects, Sea-Bird is also vulnerable to the economy, budgets and politics. What has helped, Larson said, is the success of oceanography as a science and the demand for data that comes with pressing human problems, like safety and climate change. "We've managed to grow at a reasonable rate," Larson said, "and we've grown every year." It's also heartening he said, that "there's a clear recognition of the need for our type of data in the President's budget."

Sea-Bird Scientific

Satlantic, WET Labs, and Sea-Bird Electronics: Partners in Instrumentation

Accurate, stable, and reliable aquatic instruments from the smallest streams to the deepest oceans



Conductivity	Temperature	Pressure
Salinity	Sound Velocity	Density
Dissolved Oxygen	pH	Chlorophyll
CDOM	Turbidity	Absorption
Backscattering	Volume Scattering	Beam Attenuation
Nitrate	Phosphate	PAR
	Radiometry	Integrated Systems

Providing integrated solutions to meet the measurement needs of the research and monitoring communities

SBE Sea-Bird Electronics
www.seabird.com
sales@seabird.com
+1 425-643-9866

WET Labs
www.wetlabs.com
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+1 541-929-5650

SATLANTIC
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sales@satlantic.com
+1 902-492-4780

GoM ROV Project

Potential for Delivering Survey Data Faster

Integration of multibeam and inertial navigation systems on a ROV of opportunity resulted in accurate data being made quickly available to engineers during a pro-active risk-assessment of a Gulf of Mexico artificial reef.

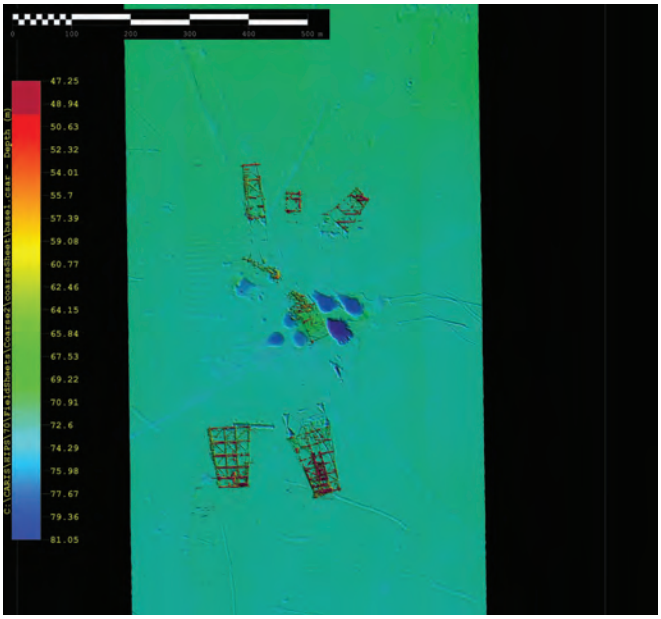
By Ian Florence, Subsea Acoustic Specialist, Kongsberg Maritime &
Craig Wallace, Senior Subsea Engineer, Kongsberg Maritime

Using multibeam on ROVs is certainly not a new suggestion to the market - but being able to use it to perform true survey tasks is a different matter. Traditionally the ROV multibeam solution has been used for touchdown monitoring of pipelines, checking for free span or large seafloor objects that may be interfering with the pipe. This process works well where the data points are on a single pass. A problem arises when several passes over the same location are required to merge cleanly.

In the event of an incident – such as prior extreme weather conditions – that requires an engineer to assess the situation of any subsea structure, the ability to produce quick, accurate and dimensionally correct images in an easy to read format is imperative. The information gathered allows the project engineering team to initiate procedures for any remedial action. Immediate needs may include vessel position, lifting, deployment of ROVs, safe working areas and diving operations.

The initial survey of the incident location would ideally be as detailed as possible however in many cases an overall view of the seabed situation is a priority. This overview will allow the project engineer access to location data in a short space of time, without having to wait a day for data processing. A recent survey project undertaken in the Gulf of Mexico in an area designated an artificial reef demonstrated how this need for fast, accurate data can be met.

Figure 1



The area consisted of several disused platforms either toppled or placed in the location at Eugene Island block 338 oil field. In addition to the structures there were various disused pipelines, debris fields, seabed disturbance from subsea construction and scars left by jack-ups and pipeline removals.

The location is in approximately 80 m (262 ft.) of water in a flat seabed area. The aim of the multibeam survey was to determine whether the area could be mapped accurately and quickly to give an overview of the location, and the areas of interest subsequently studied in more detail. The location, being in relatively shallow water, could in theory have been mapped by a surface vessel system, but it was decided to use an ROV as this would prove that the data acquisition could be obtained at any depth of an operating field.

Integrating multibeam and inertial navigation

As this project was effectively a survey operation that involved the acquisition of xyz data points from subsea structures, a multibeam echosounder, the EM2040 from leading hydroacoustic specialist Kongsberg Maritime, was chosen to provide the best results.

The EM2040 is the first system to bring all the advanced features of deep water imaging to the shallow water market. It consists of a nominal 300 KHz transmitter and receiver system which has the ability to adjust the operational frequency between 200 and 400 KHz. This means the user can choose whether to use a lower frequency and achieve 600 m range, or to use the high frequency for unrivalled accuracy.

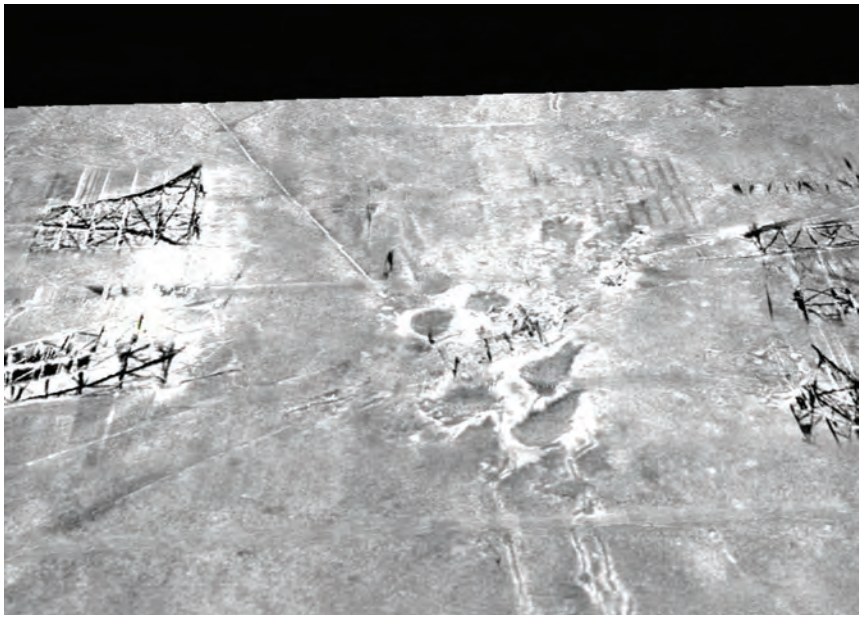
The highest resolution system will provide 0.4 degree

angular resolution in the along track and 0.7 degrees in the across whilst allowing 200 degrees of coverage with 800 beams per ping. Whilst effective on a surface vessel, the depth rating of 6000 m ensures the unit is capable of working in even the most extreme situations whether on AUV or ROV. The EM2040 is capable of resolving objects in the sub-decimeter range. This means that in order for several lines to synchronise cleanly, extremely accurate subsea positioning is required. In the past this was done solely using acoustics however this will never meet the sub-decimetre level required. High amounts of interpolation and post processing will be required leading to an increase of error margins; but the use of an inertial navigation system integrated with a subsea positioning system can provide the precision required. It was decided to use the KONGSBERG Hydro Acoustic Inertial Navigation system (HAIN), which uses the KONGSBERG HiPAP system along with an Inertial Motion Unit (IMU), Doppler Velocity Log (DVL) and Digiquartz depth sensor to achieve unrivalled subsea positioning. By utilising an advanced IMU that can give extremely accurate heading, we can remove a great deal of the calibration work previously required on such a system. For this project we chose a HiPAP 350PI system with an integrated IMU. Despite it being a portable system the HiPAP was still capable of utilising the new Cymbal technology pioneered by KONGSBERG, giving far greater range resolution and improved Signal to Noise Ratio (SNR) performance. With the integrated IMU the need for any calibration is removed allowing for a very fast mobilisation and more effective use of vessel time. The mobilisation of the equipment and ROV took just 18 hours.

Providing accurate results quickly

With multibeam data the acquisition is normally the easy part; it is the processing that is more complex. Backing out pitch, roll, heading, latency, navigation and sound velocity errors can be incredibly time

Figure 2



consuming. Using the HAIN system, raw data that required very little manipulation was generated and could be made available to engineers in a short space of time. The priority was to get an overview of a given area measuring 1600 m by 600 m. No prior information was given by the client except the presence of platforms that had been toppled or partially toppled – the exact location of each was unknown. The initial survey was carried out at an altitude of 50 m to obtain maximum coverage and to prevent the ROV from running into any debris. Five lines were run with an acquisition time of about six hours. From the initial results the toppled platforms, and one standing, could be clearly seen as well as the jack-up's footprints. [See Fig. 1 on page 72]

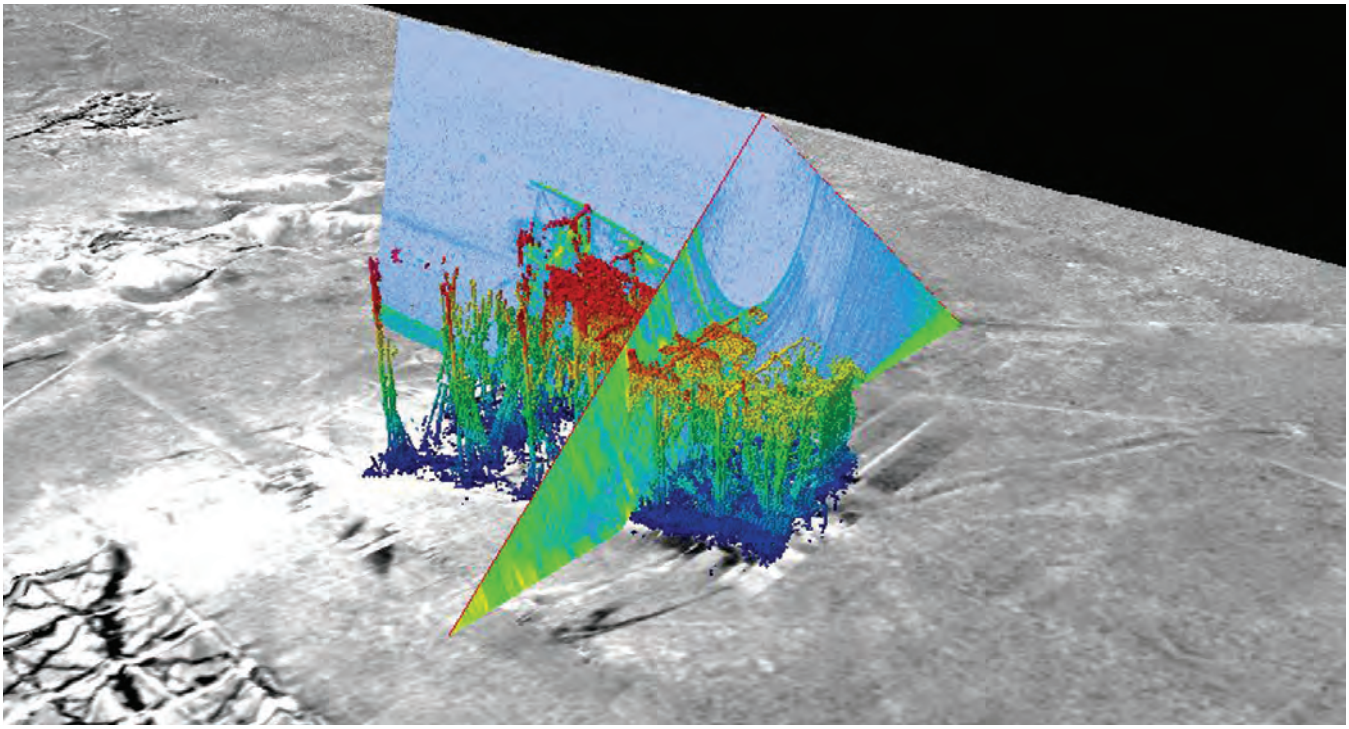
Partially buried pipelines could also be made out in the surface, however due to the relatively small surface protrusion they are not clearly defined. However, by using a backscatter image generated from the EM2040, it was possible to quickly enhance this. A backscatter image is generated by using the raw amplitude of each returning beam and plotting this geographically creating a map of the seafloor. The image in Fig 2 [revious page] depicts the reflectivity of the seafloor. Here, hard surfaces such as the structures will get a very strong signal response whereas the softer muddy sediments will absorb more of the energy of the sonar pulse, giving a weaker response.

By employing the backscatter method, the pipelines on the seafloor could be viewed with greater clarity — even those that have zero bathymetry. It should be noted that all this information is available from the initial six hour data collection, meaning that the surveyor can instantly determine the areas of interest for subsequent high resolution inspection work. Backscatter can also be used to determine the seabed type, whether sand, gravel or another type.

Further processing enhances value of the data obtained

The project proved that clear data sets for presentation in a short time scale and in a form that a non-sonar expert could easily interpret are achievable using a quick to deploy ROV and multibeam/inertial navigation configuration. In addition to providing an accurate, almost instantaneous subsea view, the data sets can also be converted into standard formats to be included into the companies GIS system. The integration of the navigation and multibeam means that the complete system can be checked prior to transportation to the vessel. The multibeam system is depth rated to 6000m and a low frequency HiPAP is also available to 6000m. The navigation system on this project was rated to 4000m. Further post-processing can be done to give 3D fly through visualisation, analysis of water column biomass, seabed classification and true 3D scaled reference frames. [See also additional image Fig 3 below].

Figure 3



Rapp Hydema Establishes Office in Stavangar


Runar Tunem

Rapp Hydema, the winch and deck machinery specialist, are opening a new office in Stavanger. "We are pleased to be present in Norway's most expansive offshore environment. This new establishment is both strategic and necessary to meet our customers' demands for service and support," said Inge Henning Andersen, Managing Director of RH.

Rapp Hydema has hired Runar Tunem to head the Offshore Sales Division in Stavanger, where he will be responsible for global sales and marketing. The company intends to grow in the offshore vendor market, "so the new office is strategically important to us," said Andersen. "Stavanger is a central location, not just for the Norwegian market, but also so as to position the company relative to international players. By moving closer to our customers, we are making sure that our growth aspirations in global offshore are attainable," he said.

"Runar's long track-record and genuine passion for the job mean we are delighted to have him on the team. This new office is an important step to meet customer demands for service and support, and a move they can look forward to," said MD Inge Henning Andersen.

Rapp Hydema AS is part of the Rapp Marine Group. Based in Bodø in Norway's far north, the Group is renowned for its production and sales winches and deck machinery for the global market. Hydraulic and electric winches are key to the range, featuring computerized control systems.

Mini ROVs

VideoRay ROVs for Dutch Navy

In early 2012, VideoRay along with Dutch partner Nautikaris BV of Ijmuiden, Netherlands, completed the site acceptance test of four VideoRay Pro 4 submersible systems with spare parts, accessories, and custom modifications. Training for operators and repair personnel was conducted in January. The contract was awarded to VideoRay in mid-2011, with a rapid turnaround. The missions required:

- Ship hull inspections
- Harbor wall & wharf piling inspections
- Bottom surveys in confined and very shallow areas
- Inspection of potentially dangerous objects, while maintaining a safe stand-off distance between the object and the operator
- Conducting quick look inspections/assessments prior to diver deployment
- Shipwreck inspections

The VideoRay Pro 4 was fully integrated and delivered with an Altimeter, Long Base-Line Positioning System, Ship Hull Crawler, Multi-Beam Sonar, Fan Lasers, Manipulator, a Lateral Thruster, and Customized Training along with the standard ROV features.

- Small object recovery

Objects of interest are primarily small objects such as limpet mines, sea mines, ammunition, as well as contraband and drowning victims. VideoRay has recently won contracts or sold multiple units to the U.S. Coast Guard, U.S. Navy, New York Police Department, Saudi Border Guard, Norwegian Navy, and several other governments and agencies. An advantage was VideoRay's hull crawling system. The latest improvements to this advanced crawler were funded with over $2m by the US DoD Combating Terrorism Technical Support Office, which summarized the project in their 2011 Annual Review:

"*Enhanced Remotely Operated Underwater Vehicle*
Securing ports and harbors remains a key mission in defending against terrorist acts. The U.S. Coast Guard (USCG) requires the capability to conduct timely and effective hull searches/inspections of vessels, piers, the seafloor and/or anomalous events (parasitic attachments, drifting or moored mines, and improvised explosive devices). The Coast Guard currently maintains Remotely Operated Vehicle (ROV) systems devoted to the port security mission. Current system performance is limited in certain capacities. This project aims to enhance the USCG's current ROV systems with an improved sonar, manipulator, image enhancement system, hull crawler, and an improved non-acoustic navigation system. These upgraded ROVs will provide better search capabilities in all water clarities and in very strong currents, keeping divers out of dangerous waters while searching for hazardous devices."

Most aspects of the mini-ROV systems consisted of off-the-shelf components delivered with VideoRay's Pro 4 Port Security configuration. However, for this contract Tritech Altimeters, and Desert Star Systems Long Baseline transponders were integrated, along with VideoRay lateral thrusters. This involved software additions to the VideoRay Cockpit software through the use of its Software Development Kit SDK. In completing the integration of these accessories, VideoRay's Protocol Adapter and Modifier (PAM) module, which allows several accessories to share the same 485 bus used to control the submersible, played a critical role.

The Pro 4 ROVs complement the capabilities of tools like the Remus 100 AUV from Hydroid, SeeByte SeeTrack, and the Navigator from Shark Marine. VideoRay will be further enhancing operational effectiveness through development partnerships with equally innovative companies such as SeeByte.

Springsteel Joins Liquid Robotics as CFO

Liquid Robotics said that Steven R. Springsteel, former CEO of Chordiant Software Inc. and President/CFO of Verity, has joined the company as COO & CFO.

Fugro Chance Makes Changes

Glynn Rhinehart

Glynn Rhinehart was named President of Fugro Chance Inc., which has 400 employees in Lafayette, LA and Houston, TX. Rhinehart has been with Fugro for 17 years, most recently as president of John Chance Land Surveys, Inc. He replaces Phil Stutes who has been promoted at Fugro's Survey Division.

Preston Named CEO of OIG

Offshore Installation Group said that Steve Preston will join the company as CEO and John Smith will join the company as Executive Vice Chairman. Both take up their positions in March 2012.

U.K. Subsea Stars Recognized

Subsea UK crowned its brightest stars at its sixth annual awards ceremony, which aims to celebrate and recognize innovation and outstanding achievements across the UK subsea industry. Sponsored by Forum Energy Technologies and SETS Ltd., the dinner attracted more than 750 people from the sector. The evening's top honor – subsea company of the year, sponsored by Brewin Dolphin — went to DUCO. With over 500 staff members, the company has seen turnover increase year on year with over £100m in new contracts awarded in 2011 alone. Winners included:

Subsea Company of the Year: DUCO
Sponsored by Brewin Dolphin

Innovation and Technology: Nautronix
Sponsored by Simmons & Company Intl.

New Enterprise: Specialist Subsea
Sponsored by Technip

Subsea Safety Leadership: Expro Group
Sponsored by Stork Technical Services

Global Exports: Bowtech Products
Supported by Scottish Enterprise

Young Emerging Talent: Robert Eddon
Sponsored by Maxwell Drummond

Horizon Marine Welcomes Three New Hires

Christensen

Nelson

Pelton

Horizon Marine, provider of operational oceanographic and environmental services to the offshore energy industry, recently added Physical Oceanographers Michael Christensen, Jimmie Pelton and Jill Nelson to the Marion office. Patrice Coholan, President of Horizon Marine, said "With the increase in deep water drilling activity and rig movements around the world, the demand for our routing and tracking service, Route Watch, has never been greater. With our expansion into Brazil and increasing line of services, the time is right to be hiring and strengthening the company for the benefit of our clients."

Christensen, M.S., a recent graduate of the University of New Hampshire's Graduate School, has joined Horizon Marine as Eddy Watch Analyst.

Nelson, M.S., holds a B.S in Professional Meteorology from Mississippi State University and recently completed her graduate studies in Marine Science at North Carolina State University.

Pelton, M.S., has joined Horizon Marine as the Route Watch Operations Manager.

www.horizonmarine.com

CTG Sold

Channel Technologies Group President and CEO Kevin Ruelas announced the acquisition of Channel Technologies Group (CTG) by Blue Wolf Capital, effective December 29, 2011. CTG is comprised of three divisions: Channel Industries, ITC and Sonatech, and a wholly owned subsidiary company, Electro-Optical Industries (EOI).

"With this acquisition, CTG has positioned itself to increase its foothold in our current markets, and to penetrate and expand into adjacent markets by leveraging our fundamental expertise in piezoelectric ceramics, transducer design and manufacturing, and acoustic systems engineering," Ruelas said.

Largest Offshore Wave Farm Planned for Scotland

Alstom and SSE Renewables signed a joint venture agreement to develop the Costa Head Wave Project, an up to 200 MW wave energy site located north of mainland Orkney, in The Crown Estate's Pentland Firth and Orkney Waters Strategic Area. Alstom and SSE Renewables will work together to obtain the necessary permits and intend to populate the site with AWS-III wave energy converters, a technology currently under development by AWS Ocean Energy Ltd, in which Alstom acquired a 40% equity share in June 2011. The Costa Head site is located in water depths of 60 – 75m approximately 5km to the north of Orkney Mainland. SSE Renewables and Alstom propose to carry out detailed site surveys and an environmental impact assessment (EIA),to develop the site with an initial phase of around 10MW, before moving on to install the full site capacity.

Velocious Strengthens Subsea Services with Mock ROV

Velocious Australia has added to its portfolio of innovative subsea engineering and remote technology services through the development of a new Mock ROV. Most recently used to test tools for Chevron's flagship Gorgon project off North West WA, the Mock ROV has the capability to replicate every function an ROV would carry out in a subsea environment to ensure safety and operational integrity. The Velocious Mock ROV has been designed and can be configured to any industry-standard work-class ROV, including the six most widely used ROVs in subsea construction. This enables the Perth-based subsea engineering and remote technology company to tailor its services to its clients' varying specifications and demands. The first unit was the culmination of four months research and development and over $500,000 of investment.

TM Master for Subsea 7

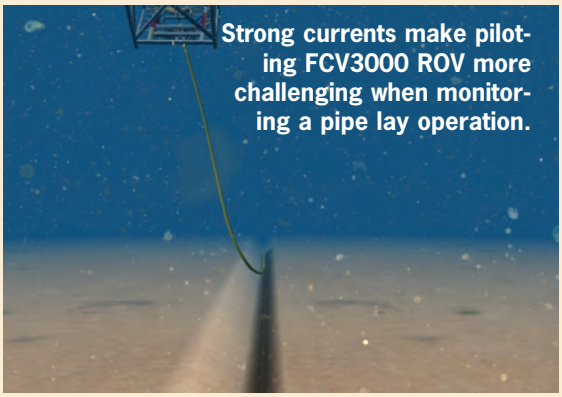
Tero Marine said Subsea 7 will standardize its Fleet Management System by implementing TM Master V2. Legacy Subsea 7 has been running TM Master since 2001, and received an upgrade to the newest version of TM Master V2 in 2008. It has always had a comprehensive solution of TM Master, including modules for fleet management, planned maintenance, certificates and trend analysis. Subsea 7 are currently running TM Master V2 from its offices in Norway, UK, Brazil, Singapore, France and on board their fleet of highly specialized vessels located worldwide. The company is a global leader in seabed-to-surface engineering providing services to the offshore energy industry worldwide. The conversion process started in November 2011, and the first vessel was Seven Eagle (ex. Acergy Eagle).

OceanWorks Contracted by Harris CapRock

OceanWorks International delivered two high power nodes to Harris CapRock Communications (HCC) as part of the Offshore Communications Backbone (OCB) system. The high power nodes represent an expansion of the successful OCB system which also includes the CSnet Tsunami Warning and Early Response Cyprus (TWERC) system off the southern coast of Cyprus.

The OCB subsea infrastructure, including five seafloor nodes which form the seafloor observatory portion of the TWERC system, was originally designed by OceanWorks under direction by Harris CapRock Communication (HCC). The TWERC system was deployed in the fall of 2010 and is now providing scientists with real time data from Mediterranean monitoring stations, covering several hundred kilometers of seafloor.

DeepWorks Simulator Models Complex Sea Currents



Strong currents make piloting FCV3000 ROV more challenging when monitoring a pipe lay operation.

Fugro Subsea Service's Robotic Technologies business line introduces 3D sea current profiles to its DeepWorks family of subsea simulators. Users can model currents as they vary with depth and location, enabling more realistic representations of current flows across large sea areas, in shallow waters and around targets. Complex current profiles can be quickly configured to better understand the physical effects on objects like the ROV tether as it moves through different current fields. A simple user-interface allows the operator to define the strength, heading and elevation of currents, at different geographic coordinates and depths as a series of current profiles in a simulation. Once setup, the user can readily modify values as required over the duration of the mission being simulated. Each current is defined as a 3D vector and a set of these vectors defines a complex current profile from the sea surface to the seabed. Full horizontal and vertical interpolation is supported, which allows the current's strength and true direction to be calculated and monitored at any point in the current field. This allows the operator to predict the effects of currents during a cable-lay operation, for example, to determine how far the vessel heading must be offset from the trench to compensate for the effects of the current. In deeper water fields, complex current profiles make it difficult, unaided, to predict cable touch down accurately. DeepWorks now enables different current settings to be tried in various scenarios, to determine the safe operating envelope and helps to validate procedures for optimal payout speed and vessel navigation. Modelled currents give more realistic environmental conditions for training ROV pilots in station-keeping, navigation and performing intervention operations involving moveable bodies, or working in close proximity to targets for detailed inspections. Knowledge of current behavior also provides dive teams with a better understanding of the safety constraints for payout and management of the diver's umbilical cable to avoid hazards.

www.rovtech.co.uk

Bell Gas Management Panel with Remote LCD

SurfaceSupplied launched a Bell Gas Management Panel with a remote LCD display. Built around a mechanical shuttle valve system that meets and exceeds the criteria laid down by IMCA Information Note D 04/11, SurfaceSupplied's Triton Bell Gas Management Panel also provides operators with the ability to remotely monitor the status and operation on the surface. The shuttle system is "energized" via a pressure bias between the various supply regulators. If loss of the surface supply gas, or excessive demand occurs, as would happen with a ruptured diver umbilical, the pressure from the surface supply regulator drops below the 30 psi bias, the upper valve of the shuttle assembly closes and the lower valve opens as the emergency regulators take over. In addition to the shuttle block providing automatic switching and isolation functions, it provides visual feedback to the Bellman via indicators on the panel. These indicators, mechanically interconnected with the shuttle block, give a visual display as to whether surface gas or emergency gas supplies are being used by the divers. A green display indicates normal surface gas while a red display indicates emergency gas.

Using a combination of solid state surface-mount electronics and piezo-resistive pressure sensors, the diving supervisor is able to see the status of a number of parameters from the panel. This includes the line pressure of both divers in the water, plus the Bellman along with the location of each valve on the panel. The data stream is transmitted to the dive control station via one twisted pair utilizing Heliox Technologies' proprietary communications protocol subseaIP.

Once the data stream has reached the surface station it is displayed on a 7-inch LCD in a graphical format representative of the panel.

www.surfacesupplied.com

Sidus SS471

When HD-SDI became a standard for transporting superior uncompressed video, operators began looking for an economical solution to take hold of full 1080p resolution for their operations. The optically corrected SIDUS SS471 high definition camera is just that. Yet the legacy cables, connectors and umbilical could not handle the bandwidth required for the new format. To solve this the SS471 includes independent 1080p HD-SDI and NTSD /PAL, allowing anyone to install high definition video in their existing processes. The SS471 is 6,000m rated with remote control the camera functions over RS485.

www.sidus-solutions.com

VN-100 Rugged Orientation Sensor

VectorNav debuts the VN-100 Rugged, an aluminum encased version of its VN-100 surface mount orientation sensor. The VN-100 Rugged is a miniature, high-performance and cost-effective inertial sensor built on a 9-axis suite of factory calibrated MEMS accelerometers, gyroscopes and magnetometers. Aerospace grade algorithms running onboard the sensor enable enhanced orientation measurements at rates up to 200 Hz with accuracies of better than 0.5 degrees in pitch/roll and 2 degrees in heading.

www.vectornav.com

AxDDM Dive Data Management System

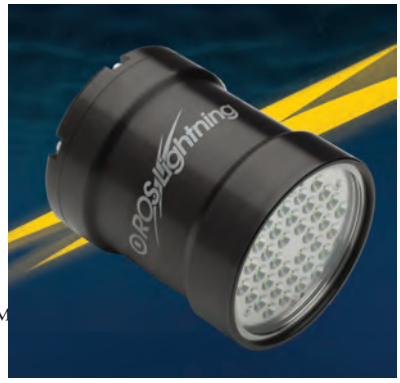
AXSUB's Dive Data Management System is an advanced and flexible portable diver management platform. When combined together with AxSee

57Ai SMART camera, the diver's parameters are monitored and transmitted to the AxDDM for immediate analysis and storage. Its dashboard features, assist you know what's going on, and support decisions in real time.

Supervising a diving operation can be a complex and demanding task. When making decisions, you want to depend on accurate data and to have the confidence in your calculations. The AxDDM can assist you to make these decisions and support your requirements for safety excellence and lower operation costs.

Email: info@axsub.com
www.axsub.com

ROS' Lightning™ LED



When Remote Ocean Systems began work on the development of a new LED light for the undersea market, it had several key objectives in mind: develop an LED light with outstanding output, provide variable input power options with complete and smooth dimming control and offer both spot and floodlight configurations. The new ROS Lightning™ reportedly meets all of these objectives and more. With more than 10,000 lumens of light output at 150 watts of input power, it is one of the most powerful LED lights available. The ruggedized housing can withstand pressures down to 6,000m and is offered in both anodized aluminum or stainless steel. The ROS Lightning has a thermal sensing feature that allows the light to operate safely for extended periods. With optional flood or spotlight configurations, practically any lighting demand can be satisfied with this one single light. One of the key revolutionary aspects of this LED technology is the electronics. Using a software driven power driver, the ROS Lightning™ has the capability to have input powers of 18-30 VDC and 108-132 VAC. In addition, it has the capability of dimming throughout the entire dimming range in any voltage configuration, from 10% light output all the way to 100% light output and with any dimming control; forward or reverse phase control, 0-5 VDC analog, 0-10 VDC analog or RS-485. The revolutionary software in the ROS Lightning has the unique capability to program how much power the light will draw and prevents the possibility of fuse blowouts. A variety of connectors are available and are easy to service or change out. With no external ballasts, the ROS Lightning is a sleek package that is designed to satisfy all lighting needs. The flood light configuration can be used in the corners of an ROV for ambient lighting and a spotlight version can be attached next to a camera for excellent video rendering and light right where you need it.

www.rosys.com

LED Conversion for HID Thru-Hull SeaLite

DeepSea Power & Light developed a powerful LED retrofit insert for the popular 150W HID Thru-Hull SeaLite. The success of the original 150W HID Thru-Hull SeaLite established DeepSea as a leader in underwater lighting for boats. Now, thousands of boat owners can upgrade from HID technology to the latest in LED technology without changing the fitting in the boat hull thanks to the new Matrix 150FS Thru-Hull SeaLite Insert. Even customers with lights that are nearly 10 years old can enjoy the benefits of LED technology.

www.deepsee.com

Optical Penetrator Line

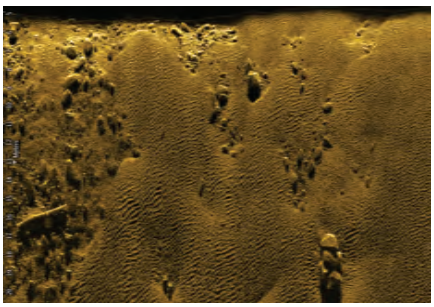
BIRNS, Inc. launched a new line of fiber optic penetrators. The design is tailored for the rigors of the subsea environment and can be adapted to a wide range of different cables. The new BIRNS fiber optic penetrator line comes standard with pressure rating of 70 bar (1,000 PSI/2,300 FSW), but can be specified to a higher rating, depending on the application, from ROV and AUV use, to defense submersibles and sonar arrays. These rugged penetrators are meticulously engineered to enable reliable fiber transmission through a bulkhead and are extremely durable—constructed of AISI 316 stainless steel that's passivated per

ASTM A967-05. They are rated for use up to 80°C (176°F) when fabricated with neoprene (polychloroprene) cable jackets, or up to 95°C (203°F) with optional CSPE cable jackets.

www.birns.com

EdgeTech 2205 Series

EdgeTech debuts a new sonar solution specifically designed for AUV's, ROV's, USV's and other hosted platforms. The new 2205 Series is the latest generation of electronics, transducers and software specifically optimized for the demanding size, power and cost constraints present in hosted platform systems. With hundreds of sonar systems installed on numerous AUV, ROV and USV platforms around the world.



44 PMGS Transponders Ordered

LinkQuest received an order for 44 PMGS (Precision Marine Geodetic System) transponders and a PMGS surface station from the Japan Coast Guard. This special investment in the PMGS systems is based on the measurement results obtained by Japanese scientists after the Magnitude 9.0 earthquake that occurred on March 11, 2011. Up to 24m of horizontal seafloor movement was detected. These new transponders will form several new arrays at Japan's ocean floors, further expanding the coverage of the areas of interest. They will be periodically monitored by research vessels in years to come. The complete Precision Marine Geodetic Systems (PMGS) are capable of detecting the movement of the ocean floor with 0.5 centimeter of accuracy for ranges up to 7,000 meters. These newly ordered PMGS transponders, are combined with more than 100 systems already deployed in the field.

www.link-quest.com

Oceanology 2012

This month in London the subsea technology world gathers for Oceanology 2012, the world's largest gathering of subsea technology professionals. To help navigate the hallways, Marine Technology Reporter presents here a snapshot of the companies that plan to launch innovative new products and technologies on the show floor.

AC-ROV 100

The AC-ROV 100 from AC-CESS Co UK Ltd. is a portable underwater inspection system. A single case system, deployable in less than 3 minutes with good mobility and robustness. A single operator system, 100m depth rated with 190mm fly through capability. The AC-ROV 3000 fly out offers visual inspection support for host vehicle operations in busy, congested and high risk environments to 3000m. Complete with a TMS providing up to 75m excursion for the AC-ROV 3000 or the AC-ROV 100. The AC-CELL 100 is a crawler vehicle fully compatible with the AC-ROV topside power and control system. 100m depth rated with 100mm drive through capability.

Booth No. E505
www.ac-cess.com

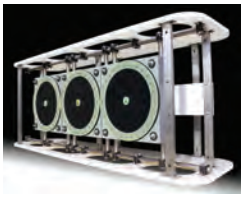
Aquatec Group

Aquatec are designers of underwater instrumentation, with a range of products covering applications in the ocean science and offshore energy sectors. On display for the first time at Oceanology will be:

- **AQUAmodem Op1** – an underwater optical modem designed to assist ROV operators to communicate transparently with subsea instrumentation without making physical connections
- **LEAKlog** – a range of underwater leak detection equipment, including long range fluorometers for the detection of dyes and hydrocarbons, as well as acoustic and thermal leak detection probes
- **HYDROlog** – subsea process pressure and temperature.
- **AQUAmodem 500** – data acquisition (temperature, pressure, CP potentials, etc).

www.aquatecgroup.com

Subsea Tracking & Seismic Survey



Applied Acoustics will be exhibiting its range of subsea tracking and seismic survey equipment with several new additions. Complementing the series of Easytrak USBL tracking systems will be the new compact version, the Alpha Portable, and adding to the sub-bottom profiling range will be an innovative triple boomer, the S-Boom that will significantly increase penetration without loss of data quality.

Booth No. i400
www.appliedacoustics.com

ASCA: SeaExplorer Glider

The SeaExplorer glider has recently demonstrated outstanding performances in freezing environment (-2°C) in Swiss fresh water lake and in rough conditions at sea. Main characteristics are: large interchangeable payloads, dedicated nose cone including 4 puck ports, good maneuverability and wingless concept. SeaExplorer is powered by rechargeable batteries only.

Booth No. B300
www.underwater-gps.com

AXSUB

AXSUB designs, fabricates and supplies tools to the commercial diving and hyperbaric industries. The usage of its products makes possible REAL TIME diving data management of diving operations: gas analysis, depth

monitoring, project management, specialty cable, underwater cameras & lights.

Booth No. R100
www.axsub.com

Bowtech Products Ltd

Bowtech will be demonstrate its range of underwater cameras and lights, plus:

- The newly released Mini and Micro cameras, the tiniest underwater cameras in our range
- Latest upgraded LED lamps
- Compact 3D-SD camera
- Mini Video Controller
- Upgraded tooling cameras 650TVL Color or 700TVL Monochrome

Booth No. E10
www.bowtech.co.uk

Calecore

Calecore through its operational divisions Calegeo and Calesurvey provides offshore site investigation solutions including geotechnical, geophysical, environmental and specialist ROV survey services from its own vessels, and innovative containerized packages to its clients vessels and vessels of opportunity.

Booth No. N550
www.calecore.com

CDL

In keeping with an established reputation as a company that delivers constant innovation, CDL are committed to working on an ever increasing number of new products that enhance current capabilities and provide more flexible single source solutions to clients. This innovation will be ever present at Oceanology International 2012, as CDL will be presenting several highly anticipated product launches. Along with these launches, CDL will also exhibit products including the MiniPos3, POS-NAV3, DMV, MiniTilt and MicroTilt, just to name a few. For additional information regarding the CDL product range please visit www.cdltd.net.

Booth No. E400
www.cdltd.net

Cetus Innovate Ltd.

Cetus Innovate Limited is an independent knowledge-based consultancy firm providing enhanced value over traditional approaches to technology assessment, bespoke technology design & development, and project delivery. The Company's key strength is its in-depth knowledge of various marine sciences, offshore technologies and business management. This is reflected in the diversity of projects that have been undertaken, encompassing wide-ranging disciplines and sectors.

Booth Number: M650G
www.cetusinnovate.com

Channel Technologies Group (CTG)

CTG is a vertically-integrated manufacturer and supplier of piezoelectric ceramics, transducers and complex systems and services. CTG's products and services are used by various customers in the defense industry, including several departments of the US Navy and many leading defense contractors. In addition CTG products are used in a wide range of commercial applications by medical device manufacturers, oil service and exploration companies and other enterprises worldwide.

Booth No. A360
www.channeltechgroup.com

New Arm 5E Micro

Designs & manufactures a range of hydraulic and Electric Subsea Manipulator Arms for ROV manufacturers and the Offshore Industry. They offer various advantages, differ in size and facilitate maintenance on board. CSIP will show for the first time the brand new ARM 5E micro, a super light electric arm of 2,5kg in the water, fitting on very light underwater vehicles.

Booth No. A200
www.csip.co.uk

ECA Robotics

Autonomous and Remote Controlled Unmanned Underwater and Surface Vehicles and a multi-mission vessel for Imaging and Bathymetry for Hydrographic/Oceanographic Survey, Offshore Survey, Close Inspection, Mine Warfare and Homeland Security. First show offs will include ALISTER 9, a man portable AUV and ROVING BAT in the HULL CLEANING configuration.

Booth No. A200
www.eca-robotics.com

Fischer Connectors

Fischer Connectors is a leading company in the design, manufacture and distribution of high-performance, reliable interconnect solutions. Rugged, sealed IP68/69K and compact, our products are ideally suited for use in many underwater systems.

Booth No. I350
www.fischerconnectors.com

Vector Series Compass

Hemisphere GPS will feature its new line of Vector Series GNSS compasses. Hemisphere GPS will introduce: V103 all-in-one GPS compass for commercial marine applications; VS131 professional compass and H320 dual-frequency OEM module for professional heading and positioning. In addition, Hemisphere GPS will be featuring its complete portfolio of GNSS antennas, receivers and OEM modules.

Booth No. I500
www.hemispheregps.com

Work Class ROV Manipulators

Hydro-Lek will be showcase its new range of work class manipulators – the 5 function HLK 40400 and the 7 function HLK 40500R. Power required for this arm can be kept to a minimum and, as all joints are hydraulically locked in dormant mode, there is no need for constant flow to maintain position. Hydro-Lek will also be showing HLK 14000 series of new compact hydraulic cylinders which have been designed to be extremely lightweight, compact and highly versatile, manufactured out of hard anodized aluminum.

Booth No. M100
Email: enquiries@hydro-lek.com

The Launching of icListen HF

Simplify broadband acoustic listening with the icListen HF. The icListen HF is a compact all-in-one smart hydrophone with a bandwidth of 10-200,000Hz with 24-bit resolution. No additional hardware, software or technical expertise required. Plug it into a computer and get calibrated waveforms, spectral, or event data. This smart hydrophone contains 32GB of storage and can be used as a stand-alone data logger and/or streaming digital hydrophone. Use an external battery for extended projects.

Booth No. F300
www.InstrumentConcepts.com

Kongsberg Maritime

Kongsberg will have a stand focusing on the core product areas of underwater sensors, positioning and remote and autonomous vehicles.

- **Integrated Environmental Monitoring System:** The purpose of this project with partners IBM, DNV and Kongsberg Oil & Gas Technologies is to demonstrate solutions for continuous environmental monitoring of operations in sensitive areas covering all phases of an offshore operation. Kongsberg Maritime's cNODE based communication infrastructure will feature strongly in the project.
- **New Motion Reference Products:** Also available to view at Oceanology International will be two new Motion Reference Units from Kongsberg Seatex.
- **New Multibeam Applications:** Another stand highlight will be the EM 2040 echo sounder, which is the first multibeam system to bring all the advanced features of deep water imaging to the shallow water market.
- **New Underwater Positioning and Transponders:** Kongsberg Maritime will also display latest range of HiPAP acoustic underwater positioning systems and cNODE series transponders, designed to harness the power of the Cymbal spread spectrum signal processing protocol, while also being backwards compatible with the HPR 400 protocol and analog transponders.

Stand No. E600
www.kongsberg.com

New Sonars

Marine Electronics Ltd will debut two new products: the new MEL Pin-Point Diver Detection Sonar that has been developed to provide a precise 3D presentation of intruders active in the water column; and Marine Electronics Limited will also be adding an advanced new tool to the armoury of hydrographic surveyors with the introduction of its WideView 3D interferometric side scan sonar.

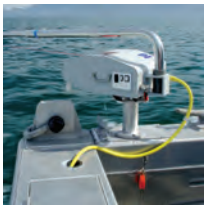
Booth No. E525
www.marine-electronics.co.uk

Multi-Electronique AURAL-M2

Multi-Electronique promotes its AURAL-M2, an autonomous underwater sound recording device for passive acoustic in operation all around the world. It is designed to record underwater sounds, pressure and water temperature over a period to one year with total autonomy. People can assist to a live demonstration at booth R115.

Booth No. R115
www.multi-electronique.com

Oceanscience Group



The Oceanscience Group will showcase its sensor deployment systems, the UnderwaySV and UnderwayCTD, which offer highly-accurate and repeatable CTD and sound velocity profiling on vessels of opportunity while underway at over 10kts. Instead of stopping the vessel for a lengthy CTD or sound velocity (SV) cast, Oceanscience customers can obtain these critical profiles without any survey disruption at all.

Booth No. J350
www.oceanscience.com

RJE

RJE introduces a navigation solution that mimics surface GPS receivers. The DNC diver navigation console is small battery operated platform that uses internal sensors to provide "dead-reckoning" navigation to divers in real time. Using a retractable GPS receiver, the DNC takes an initial geodetic starting point on the surface and, using built-in sensors, calculates the diver position underwater. A LCD displays the diver's navigation solution in real time using waypoints, routes, and other posted data.

Booth No. R355
www.rjeint.com

Rockland Scientific

Rockland Scientific Inc. (RSI) specializes in the measurement of ocean turbulence and manufactures instrument systems for deployment from ships, gliders, moorings, autonomous floats, or AUVs. RSI equipment is used world-wide in a variety of disciplines,: Climate Research, Renewable Ocean Energy, Coastal Management and Erosion Studies, and Fisheries Research. RSI has recently introduced the MicroSquid, an eddy correlation measurement system that integrates high-resolution, fast-response sensors for temperature, conductivity, and oxygen with an acoustic Doppler velocimeter.

Booth No. R100
www.rocklandscientific.com

SeaBotix

SeaBotix and Sound Metrics have combined expertise to produce a revolutionary new integrated solution. The vLBV provides an unprecedented stable and capable platform, where the ARIS produces 2D sonar images with incredibly clarity. To further enhance the package the ARIS sonar is capable of 180 degree roll providing a new dimension that allows the operator to assimilate a 3D perception.

Booth No. K455
www.seabotix.com

New Multibeam Echosounder

Teledyne Odom Hydrographic introduces Multibeam Echosounder, the MB1. The new 120° sonar operates on a user selectable frequency from 170 kHz to 220 kHz. MB1 features Phase & Amplitude bottom detection, 24 Bit Water Column Backscatter data, Sidescan, Snippets, light weight Titanium & Acetal construction, optional integrated Motion Sensor and GPS heading system.

Booth No. D100
www.odomhydrographic.com

Saab Seaeye

- **Panther** XT Plus: The Panther XT Plus sees a breakthrough in power management that has created a vehicle with 50% more power, fitted with ten powerful thrusters.
- **Cougar** XT Compact: A compact version of the successful Cougar range has been created to minimize the effect of current, making it an ideal vehicle for operation in high currents and shallow waters.
- **Falcon**: With more than 260 Falcon ROVs in use around the globe, the Falcon's success has come from being small enough to manhandle into the water, yet powerful enough to hold steady in strong cross currents and operate tooling of all kinds.

Booth No. J100
www.seaeye.com

SAIV AS

Manufacturer of oceanographic/ hydrographic sensors/recorders for high accuracy measurements in the field: CTD/STD w/Sound Velocity and multiparameter facilities: Oxygen, Turbidity, Fluorescence Tide/Pressure/Depth and Water Level recorders. SAIV debuts new model SD208 with the highest CTD accuracy and built-in wireless communication feature for set-up and transfer of data. Also the unic Automatic

Profiling Buoy APB505 with integrated webserver is presented.

Booth No. 405
www.saivas.no

SONAR EQUIPMENT SERVICES

Sonar Equipment Services

SES services the global offshore energy sector as a manufacture and rental specialist of seabed survey and inspection equipment.

SES products include the SeaBug digital drop camera system proven to 3000mwd with high resolution 14.7 mega pixels camera offering "On The Fly" capture upload. We specialise in innovative product development including systems for depth of burial surveys, UXO detection and DV inspections. We also offer a wide range of winches for marine applications.

Booth No. N100
www.sonar-equipment.com

Sonardyne: "A Deeper Understanding"

On Day 1 Sonardyne will showcase its wireless communications platform which is capable of transferring subsea data at speeds comparable to broadband. Also making their debut at the show will be the uComm range of small, high performance and affordable acoustic modems. Oil spill prevention and response is a key theme at this year's conference. With this in mind, Sonardyne has chosen OI2012 to premier its new Automatic Leak Detection Sonar (ALDS) designed to detect hydrocarbon leaks around offshore installations and pipelines. Sonardyne's vessel operating in the dock will enable visitors to the show to gain a hands-on view of the tech.

Stand No. G300
Email: PR@sonardyne.com

SubCTech

SubCtech GmbH presents the complete product range of pCO2 analyzer and environmental monitoring systems e.g. for vessels. Recently this product family has been completed with new systems especially designed for buoy and subsea applications, launched at OI 2012. In addition, the company provides subsea Li-Ion PowerPacks (e.g. 14.8V 1.7kWh) to supply energy and realize autonomous surface and subsea applications.

Booth No. 205
www.subctech.eu

Teledyne RD Instruments

Teledyne RD Instruments will be marking its 30th year of providing acoustic Doppler products for measuring water in motion and motion in water. On display at OI 2012 will be our full line of Acoustic Doppler Current Profilers (ADCPs), including the new next-gen Sentinel V ADCP; our Citadel CTD products; and our growing line of Doppler Velocity Logs (DVLs) for underwater navigation.

Booth No. D100
www.rdinstruments.com

Tritex Multigauge 4000 ROV Metal Thickness Gauge

Tritex NDT upgraded its Multigauge 4000 Series ROV Thickness Gauges for mounting onto most work class ROV's. The range includes the Multigauge 4100 and Multigauge 4400 which are for use in depths of 1000m and 4000m respectively. The Multigauge 4100 is now made from Acetal and the Multigauge 4400 from Titanium for extra durability.

Booth No. K600B
www.tritexndt.com

Teledyne TSS

Visitors to the Teledyne TSS stand at Oceanology will be among the first

to view the newest additions to this well-respected company's advanced product range. The DMS-535RP will be seen for the first time at the show as the latest addition to the company's new DMS-500 group of products. These have all been developed specifically to meet the needs of users who require a top-quality motion sensor with Ethernet connectivity, but do not require the subsea-rated housings that typify Teledyne TSS products.

Booth No. D100
www.teledyne-tss.com

Titanium Industries

Cut TI Logo

Titanium Industries is a large independent stockholder and processor of Titanium and high performance metals with current stocks of over $55m in titanium alone. Titanium Industries are a world class supplier of only qualified titanium and high performance metals to Gas & Oil, Aerospace, Medical, and other High Technology Industries operating from 17 sites around the world. The HPM stock range includes 625 and 718 alloys.

Booth No. N150
www.titanium.com

Tritech

Tritech specialises in the production of high performance acoustic sensors, sonars, video cameras and mechanical tooling equipment for professional underwater markets including; defence, energy, engineering, survey and underwater vehicles. Tritech remains the industry leader in the provision of sensors and tools for ROV and AUV markets. Visit us on stand J400, to learn about our latest products for 2012; including the SeaKing Hammerhead package and the Gemini Multibeam Family. The

stand will also launch our new brand as we reach a milestone 21st year in business in 2012.

Booth No. J400
www.tritech.co.uk

Cyclops Submersible Fluorometer now available for 6000m

Turner Designs will debut 6000m version of its Cyclops-7 Submersible Fluorometer. The Cyclops-6K is presently available for Chlorophyll, Crude Oil, and CDOM detection with more optical configurations available soon. The reinforced Titanium housing and specialized optical head allow the Cyclops-6K to reach abyssal depths. Offering the same low power requirements, high performance, and long-term stability as the Cyclops-7, the Cyclops-6K is designed with system integration in mind.

Booth No. F550
http://www.turnerdesigns.com

Watson Industries

Watson Industries has been serving the gyro and magnetometer user community for 31 years. Watson is a leader in Coriolis gyro technology with many patents and published technical papers. Its newest product is an attitude and heading gyro system that incorporates a two-antenna GPS receiver to provide precise, static/dynamic, non-magnetic, gyro stabilized True North heading reference.

Booth No. S340
www.watson-gyro.com

Xenubis

In a Maritime Counter-Piracy environment, Xenubis provides innovative situational awareness, tracking, beaconry and communications solutions to suit all types of vessels from plug and play trackers for fishing vessels, bespoke one off's for Yachts or extended systems on tankers. Established in 2010 as a response to growing market requirements, Xenubis is a privately held UK company.

Booth No. P150
www.xenubis.com

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75	IROBOT	www.irobot.com/mtr	(888) 776-2687
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5	SeaBotix Inc.	www.SeaBotix.com	(619) 450-4000
19	Seacon	www.seaconworldwide.com	011 44 149 365 2733
76	Sidus	www.sidus-solutions.com	(886) 978-1276
9	Sonar Equipment Services Ltd	www.sonar-equipment.com	44 1493 443363
27	Sound Metrics	www.soundmetrics.com	Please visit us online
93	Specialty Devices, Inc.	www.specialtydevices.com	(972) 429-7240
66	Subsea Photo Contest	http://photos.seadiscovery.com/rules-and-terms.asp	Please visit us online
83	Teledyne Benthos/Webb/Gavia	www.webbsearch.com	Please visit us online
17	Teledyne Marine	www.teledynemarine.com	Please visit us online
29	Teledyne RDI	www.rdinstruments.com	(858) 842-2600
79	Teledyne TSS	www.teledyne-tss.com	44 (0) 1923 216020
32	The Columbia Group	www.columbiagroup.com	Please visit us online
91	Turner Designs, Inc.	www.turnerdesigns.com	(877) 316-8049
25	Valeport Limited	www.valeport.co.uk	44(0) 1803869292
73	VectorNav	www.vectornav.com	(512) 772-3615
C2	VideoRay LLC	www.videoray.com	(610) 458-3000

Next generation Feature Pack

Visit us at Oceanology International 2012 in London
You can find us at stand G100 where you can get PDS2000 demos and sign up for SeaBat 7125SV2 boat demo tours.

Experience the new Feature Pack 3

RESONs Feature Packs are a series of software and hardware upgrades that improves the functionality and performance by increasing features available on of your SeaBat. Feature pack 3 (FP3) is the latest release in the series and is now available for the SeaBat 7125SV2 hardware platform, whilst Feature Pack 2 (FP2) is available for the SeaBat 7125 ROV2 hardware platform as well as the SeaBat 7101 and SeaBat 8125-Hybrid. For a Feature Pack 3 upgrade, you need to have Feature Pack 2. In addition to the standard Feature Pack 3 Base, two optional variants allow you to choose the feature-set that matches your operational requirements. RESON are proud to launch the revolutionary *FP3 X-Range* (FM transmission) and *FP3 FRDH* (Full Rate Dual Head)

FP3 Base consists of the features currently supplied in FP2 plus the next generationTracker autopilot and the a new graphical user interface interface.

Tracker is a completely automated mode of operation where the system sets all parameters including range, gain, power and swath width based on the quality of the data being collected. This differs dramatically from the existing autopilot which is based on a lookup table.

The new graphical user interface runs under Window7 64-bit to provide the optimum in processing power and brings a fresh new feel to the user without losing the critical information the operator needs to correctly and optimally use the system.

FP3 X-Range is a software and hardware feature which provides extended range performance for the SeaBat 7125 (both at 200 & 400 kHz) and also improves significantly system immunity to external noise. The basis of X-Range is a frequency modulated transmission combined with advanced signal processing techniques to extract the maximum possible performance from the SeaBat system. This feature is optional.

FP3 FRDH (Full Rate Dual Head) uses X-Range to achieve dual head operation which has the effect of both range increase plus an even faster ping rate. The current dual head implementation in SeaBat 7125 uses time multiplexing to achieve synchronised operation resulting in reduced ping rate per head and asymmetric sea floor swaths. Now using FRDH the SeaBats are synchronised and ping simultaneously at a high rate, ensuring both wide coverage and characteristic SeaBat bottom detection performance. This feature is optional.

www.reson.com

Feature Pack 3 FP3

FEATURES LIST

FEATURE	FP1	FP2	FP3
Roll Stabilisation	✓	✓	✓
Quality filter	✓	✓	✓
Normal	✓	✓	✓
XYZ offsets	✓	✓	✓
Uncertainty output	✓	✓	✓
Channel normalisation	✓	✓	✓
Flex mode (optional)		✓	✓
Vari-Swath		✓	✓
Manual gates		✓	✓
Head tilt		✓	✓
Wide mode		✓	✓
On the fly freq change		✓	✓
On the fly beam mode selection		✓	✓
Autopilot		✓	✓
Tracker - autopilot			✓
X-Range (optional)			✓
Full Rate Dual Head (optional)			✓
New Graphical User Interface			✓

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