Ocean technology Enterprises:

Inside the Minds of Companies

This is the third in a series of essays, exclusive to The Journal of Ocean Technology*, that focus on the role of ocean technology in society today. In our last issue, "Ocean Science and Technology" explored how science drives the development of new ocean technologies, and how new technologies can, in turn, enable science. Where new technologies come from and how they find traction in the marketplace is this issue's theme.*

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Author Steven Johnson takes issue with the belief that discoveries happen in a Eureka moment as a result of the innovator working alone. In *Where Good Ideas Come From: The Natural History of Innovation*, he notes that breakthrough ideas in science labs tend to occur at the conference table at the weekly lab meeting when everyone is sharing their latest data, findings, and mistakes – an environment he dubs the "liquid network." His view is that the "jostling" of diverse backgrounds, interests, and ideas provides fertile ground for innovation.

The lone innovator, says Johnson, is more fabled than real. And rather than a sudden flash, discoveries tend to have a long incubation period – a "slow hunch" that sits on the back burner until conditions ripen. He points out that, in his autobiography, Darwin said the idea for natural selection occurred in a Eureka moment, but in fact, after reading Malthus on population, Darwin had been jotting down ideas in his notebooks for some time. "He had the full theory for months before he had his alleged epiphany," notes Johnson.

Further, innovation happens when people allow their hunches to connect with the hunches of others. "We should value the premise of connecting ideas," he observes, "not just protecting them."

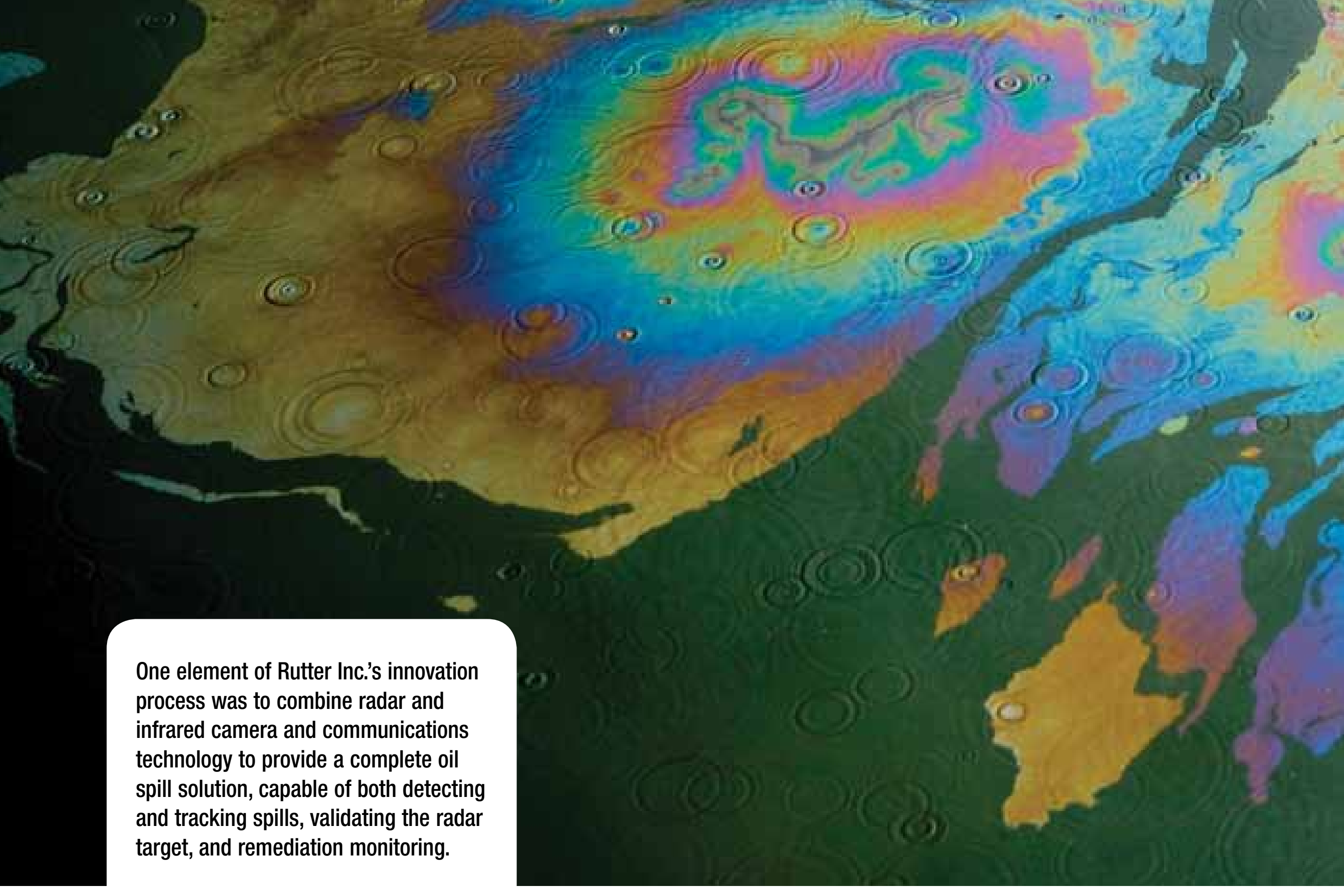
In the technology game, the end user plays a key role in the process.

In 2002 while completing his Master's degree in Naval Architecture and Ocean Engineering at Memorial University of Newfoundland, Dean Pelley and colleague Jason Dawe co-founded Mad Rock Marine Solutions, Inc. to design and commercialize a better lifeboat. Pelley developed a conceptual design but before continuing, company mentor Dr. Brian Veitch suggested he talk to some potential customers before taking the project any further. Veitch arranged a meeting with Petro-Canada who was developing the Terra Nova offshore oil project on the Grand Banks of Newfoundland. "I gave a presentation to a group of very seasoned individuals," Pelley recalls, "but they were only interested in getting the lifeboat in the water safely." He took the cue and started to research lifeboat launching and learned that there had been many accidents resulting in injury or death during the lifeboat launching process. "I had stumbled upon an enormous problem in the industry regarding lifeboat accidents," Pelley observes. Mad Rock decided to change direction and began focusing on redesigning the hook system that releases the lifeboat during launching, rather than the lifeboat itself. The company's RocLoc lifeboat release hook became the first to incorporate a fail-safe design that prevents inadvertent release, and 369 sets of the next-generation lifeboat release gear system have been installed internationally to date.

Often, the company is further down the new product development road when it receives crucial input from the end user.

When Jake Arsenault was a mechanical engineering PhD student at the University of New Brunswick, his thesis topic was to develop a radiation-based diagnostic imaging tool to provide a means to expose hospital patients to low-dose radiation from CAT scans. As it turns out, that application presented difficulties for commercialization. But since the tool can also image through steel and concrete, with further research he identified market applications for inspecting culverts in civil structures, aircraft wings, and pipes in industrial process installations. Inversa Systems of Fredericton was established in 2006 to commercialize these applications. Seeing a significant opportunity in the offshore oil and gas sector, Inversa Systems President John Bowles arranged to demonstrate the imaging tool's ability to gauge wall thickness in pressure vessels and large-diameter insulated steel pipe for an offshore oil and gas operator.

In the collaboration process that ensued, the oil company and their inspection partner first sent Inversa Systems insulated steel test parts with pre-manufactured defects, and they identified the dimensions of the defects. After the proof of concept was confirmed, a week of



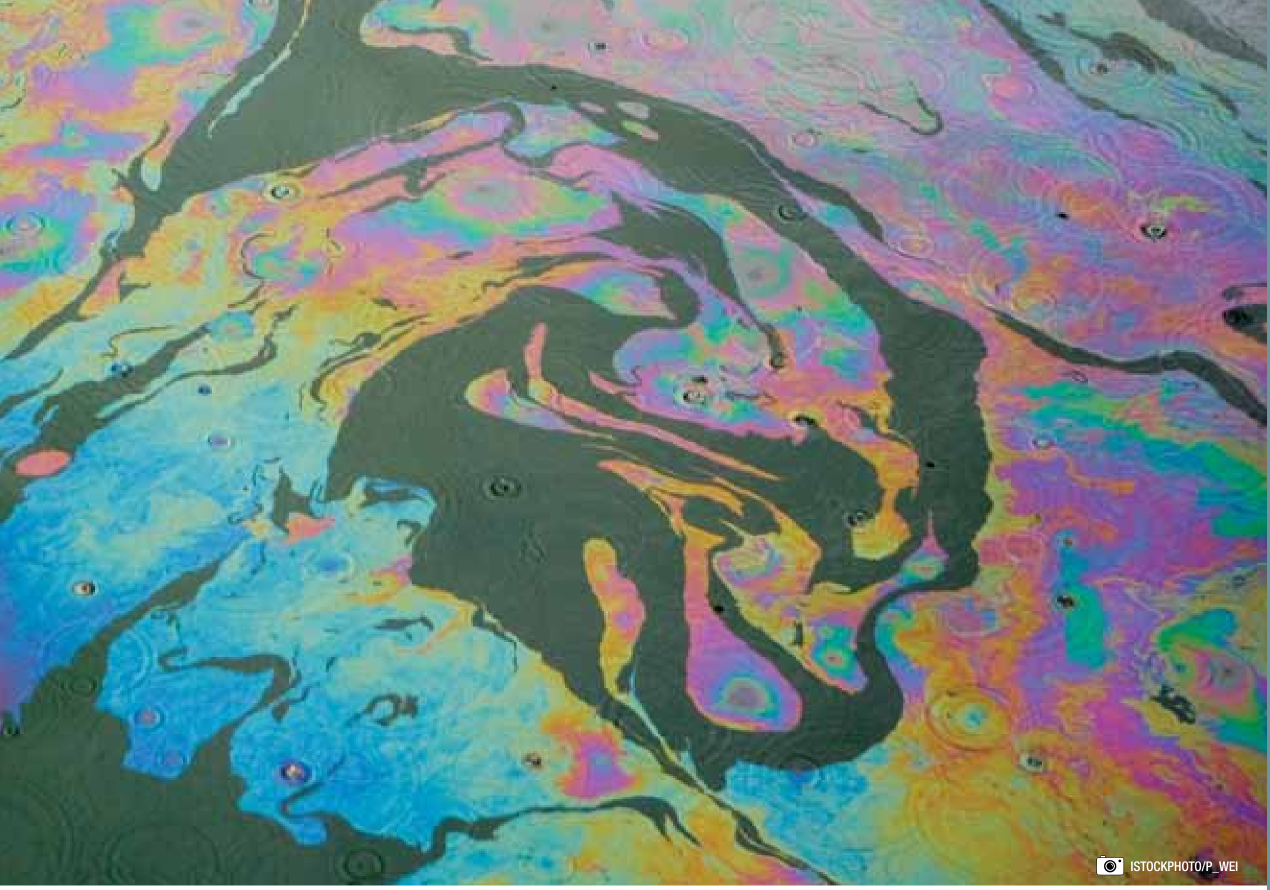
One element of Rutter Inc.'s innovation process was to combine radar and infrared camera and communications technology to provide a complete oil spill solution, capable of both detecting and tracking spills, validating the radar target, and remediation monitoring.

on-site trials followed. Inversa Systems' ability to successfully conduct the initial tests was greatly enhanced through direct partnerships with the oil company and their inspection partner. "They provided the a *priori* knowledge of the defects of interest which enabled us to tailor our hardware and software to meet those needs," explains Bowles. "Since we knew in advance what we were looking for the first time we did the test, we knew the geometries to expect so the computer code could take that into consideration. Since we had a controlled test object for comparison, we could see what was different." Inversa Systems is currently negotiating to license the technology to the inspection company for offshore use.

Meeting the specific requirements of an end-user is also key to ensuring that a new product will work optimally once it is deployed. When the Marine Institute of St. John's purchased a multibeam echo sounder to do advanced mapping on their inshore research/training catamaran, *Atlanticat*, the manufacturer, Kongsberg Maritime of Dartmouth, Nova Scotia, contracted a local company to design and build a gondola to hold the sonar transducers. "The *Atlanticat* has a unique hull shape," explains Nick Burchill, Kongsberg Maritime Subsea Sales Manager, "so we configured the system to allow for that. The Marine Institute gave us the information about the boat and we worked very closely with them to implement a system that performs within their technical specifications."

Burchill says that one of the secrets to his company's success is that they always stay close to their customer's needs. "We make sure they have access to the best technology," he adds, "and they, in turn, study our products' performance, often writing papers on how the technology performs, and give us their feedback, which we, in turn, incorporate into our product development cycle."

As Steven Johnson notes, innovation tends to proceed along a path of slow hunches. In



our previous feature article on the relationship between technology and science, Dr. Robert Ballard explained that it took over 30 years for technology to catch up with his vision of telepresence. Sometimes, the technology comes first and the market opportunity follows. In the early 1990s, Byron Dawe, Vice-President of Operations for the Canadian Centre for Marine Communications in St. John's, was looking for industry applications for promising new technologies. He saw a fit for Sigma Engineering's specialized radar for oil spill detection. "I knew the Norwegians were doing trials," he recalls, "and tried to line up funding to get Sigma Engineering over there, but we weren't successful in getting it over there." Several years later, inspired by an up-and-coming market for voyage data recorders, he helped to found Rutter Inc. by partnering with Sigma Engineering and Consolidated Technologies and utilizing their technologies to develop one of the first recorders.

In addition to developing the voyage data recorder, Rutter also acquired the Sigma S6 radar signal processing and display technology and began using it in the ice navigation and maritime security markets. Then, in 2007, a Norwegian Coastal Administration patrol vessel discovered the system could also detect an oil slick, confirming Dawe's hunch 13 years earlier. Following three years of trials, in 2010 the Norwegian Clean Seas Association certified Rutter's oil spill detection system. "To date," says Dawe, now President of the Rutter Technologies Products Group, a division of Rutter, Inc., "the Sigma S6 is one of only two systems in the world to be given the green flag indicating it meets the stringent requirements of vessels operating under jurisdiction of the Norwegian Clean Seas Association."

A further element of Rutter's innovation process was to combine radar and infrared camera and communications technology to provide a complete oil spill solution, capable of both detecting and tracking spills, validating the radar target, and remediation monitoring. To accomplish this, Rutter teamed with Aptomar AS of Trondheim, Norway, to co-develop an Integrated Oil Spill Response and Management System.

Any new technology a company develops has to either save money or time (increase efficiency) or save lives, says Neil Chaulk, Vice President of ICAN Ltd. of Mount Pearl, Newfoundland, which designs and develops sophisticated communications and navigation software. As an example, he cites providing a weather overlay on top of an electronic charting system which allows ships to save money by planning routes around storms. "Those are the kind of gems you look for when you're doing this kind of development," he says.

ICAN Ltd. spotted an opportunity two years after 9/11, in 2003. "There was huge interest in multi-departmental cooperation," Chaulk recalls. "Many organizations had come to realize there was no single agency – not even the U.S. Navy – that could protect the ports in the U.S. from terrorist threats. What was needed was cooperation between the Navy, U.S. Coast Guard, National Marine Fisheries Service, and Customs and Border Protection agencies. But they didn't have the means to communicate with each other." Having worked with coast guards, police agencies, and other organizations that have a security mandate, ICAN developed the first secure but unclassified Automatic Identification System (AIS) network to allow interdepartmental cooperation in monitoring vessel traffic in U.S. coastal waters. The U.S. Coast Guard was their first customer.

"You start exploring the real user requirements in more depth with the customer," Chaulk explains. "Usually the customer isn't even aware of it, but when they start to use it, a whole new set of requirements get identified. It's like looking down a well if you don't have a flashlight. Until you have one, and can't see what's down there, you don't know what you can take out of it." He adds that once a company has established a reputation, the idea to develop something new sometimes comes from the end user. A new technology ICAN

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Ltd. is currently developing for the U.S. Army Corps of Engineers is a case in point.

As Chaulk noted, after 9/11 there was a great need for New York police and fire departments to have a system that would enable interdepartmental communication. This led to the adoption of software-defined radio, a radio communications system that uses software, instead of hardware, to integrate communications system components such as mixers and amplifiers.

In 2004, Karl Kenny and his colleagues at Marport Deep Sea Technologies Inc. in St. John's, Newfoundland, were looking for a way to implement underwater sensing and communications systems they had developed for the deep sea fishing industry, in the underwater defense, ocean science, and offshore energy markets. "We realized we would be competing with much larger companies," recalls Kenny, Marport's President and CEO. "It would be foolish to say we could be better than them, but we could be different." They noted that the subsea products that were being developed were limited by hardware-centric architecture, and Kenny wondered if they could overcome this limitation by applying the principle of software-defined radio to sonar. "I called our engineers and asked them if we could do this in the sonar world," he notes. After looking into it, they said it was a long shot, but possible, and the company proceeded to invest in developing a new architecture to support software-defined sonar (SDS). Marport's first products were commercialized in 2009, and the company is applying its new technology platform to develop products for anti-submarine warfare, mine countermeasures, and underwater robotics. Marport is currently engaged in a multi-million dollar R&D initiative for General Dynamics to build next-generation military sonar systems based on SDS. "The next market we will be turning our attention to is the offshore energy sector," says Kenny.

The companies that innovate new technologies and products for the ocean sector speak with one voice: the end user has a critical role in the development process. This led the JOT to

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In the offshore oil and gas industry, reducing risk, ensuring the safety of operations, extending the safe working life of assets, enabling production in previously uneconomic fields, and reducing production costs are key drivers for technology adoption. Above is an image of Seadrill's *West Sirius* oil rig.

SEADRILL

speak with representatives from the primary industries that use ocean technology products: the fishing, shipping, and offshore oil and gas industries.

Ocean Choice International (OCI) of St. John's is Canada's largest wild fish quota holder. Asked where the ideas for new technologies come from, Paula Kieley, Special Projects Coordinator, says, "We have some of the world's best fishing experts working for our company. Our captains have been on the sea for 30-plus years. It's hard to find someone with expertise that's more hands-on." With input from their fishing captains, the company identifies potential improvements and then works with an in-house team as well as outside consultants to develop them. Trade shows provide another source of innovative ideas. Kieley pointed to a $5 million state-of-the art facility in Fortune, Newfoundland, that processes both fresh and salt cod, utilizing Icelandic equipment the company first saw at a trade show. The equipment produces very little wastage, reduces water consumption, and enables OCI to maximize their yield by making byproducts from every part of the fish, including the bladder. At a groundfish plant in Marystown, Newfoundland, the company is testing water-jet cutting technology that is primarily used in the chicken industry to form chicken nuggets. The system cuts yellowtail flounder close to the bone by means of a computer program that was jointly designed by plant personnel and an outside consultant.

"We also work in close collaboration with the Marine Institute," reports Kieley. One project is focused on increasing yields by improving techniques to reduce the bruising of fish when landed. Another is creating an electronic system for their captains' log books to improve the analysis of data, and to have "everything at our fingertips." The latter is being developed in conjunction with an Iceland-based consultant and Fisheries and Oceans Canada.

A veteran of the shipping industry, Oceanex Inc.'s CEO Captain Sid Hynes says the St. John's-based provider of intermodal transportation is "always searching for ways to reduce costs, be more efficient, and to have better valued solutions. One way to do that is to reduce your costing model, and technology does help you do that at times. You can't let the grass grow under your feet." For the past two years, Oceanex has been engaged with architects in designing a 210-metre ship that will be put into service over the next few years. Anticipating their needs for the next 35 years has been key to the process, while their focus has been on achieving the best fuel efficiency, the smallest environmental footprint through reduced gas emissions, safety, and optimizing space for the cargo they transport. "A ship that would be specific to our needs does not exist today," Hynes says, noting that the latest electronic monitoring and control systems are being incorporated into the new design.

Reducing fuel costs is a major economic driver in the shipping industry because fuel represents a large percentage of costs. Even a 1% fuel savings could save Oceanex $30,000, Hynes noted, as their annual fuel consumption has exceeded $30 million a year. He adds that the price of fuel has increased from $170 a tonne ten years ago to $988 today, and the trend is up. "If someone comes to us and says they can save us money, obviously we're interested. If there's an opportunity to save money without creating any additional risk, we're game."

Reducing sulphur dioxide emissions is another priority, as Hynes sees the regulatory regime becoming more increasingly demanding in the future. "We're always scanning the market," he says, paying close attention to the classification societies and the institutes around the world where studies are being conducted.

Besides reducing costs and impacts on the environment, technology is also enabling Oceanex's customers to track the location and progress of its ships anywhere in the world. On a foggy day, if a large box store manager is concerned that his order may not arrive, he can remove the guesswork by logging on to www.oceanex.com/public/content/_vesselPositiondo.

Hynes noted that while most shipping companies are sending vessel position information via shore station, which is limited to a 30-mile range, Oceanex's vessel position information has no distance limitations because the Automatic Identification System (AIS) link to the Internet is provided via satellite.

In the offshore oil and gas industry, reducing risk, ensuring the safety of operations, extending the safe working life of assets, enabling production in previously uneconomic fields, and reducing production costs are key drivers for technology adoption. "A lot of the technology development comes from major service and supply companies like Schlumberger, Baker Hughes and Halliburton," says Dave Finn, Chief Operating Officer of Petroleum Research Atlantic Canada (PRAC) of St. John's. "It's driven by minimizing the cost of production." Offshore Newfoundland, innovations that have enabled development on the Grand Banks include a net that C-CORE developed to tow icebergs and a disconnectable turret that SOFEC, Inc. of Houston designed and engineered for the Terra Nova floating

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production storage and offloading unit. This system permits the vessel to disconnect and reconnect to its mooring to avoid icebergs and severe ice conditions, and has since been used on other offshore oil and gas projects in ice-prone waters.

In addition to providing funding to support the commercialization of R&D, PRAC also facilitates the technology implementation process. A case in point was Inversa Systems' demonstration of its diagnostic imaging tool for the inspection of pressure vessels for an offshore oil company (see above). "We hooked them up with an engineering and inspection service provider who gave them a field trial to look at potential applications," reports Finn, "and they love it. Now we're trying to help them get to the next stage and further adapt their technology." Along with the National Research Council's Institute for Ocean Technology, PRAC also provided funding to Mad Rock Marine Solutions, Inc. to support the development of a protocol for lifeboat hook testing.

According to one oil and gas industry veteran, some companies have such a good grasp on the rate at which new technology is developed that they anticipate key enabling technologies and plan their projects around them before they are introduced. The game-changing technologies he cited are directional drilling in the 1990s and ROVs which have eliminated the need for divers in many subsea applications. He added that autonomous underwater vehicles (AUVs) are at the point of technology development where ROVs were 20 years ago, the main advantage being that they do not require a support vessel. He said the AUV is also becoming a platform for other technology payloads, citing the collection of 3D data of iceberg keels as one of many potential applications.

In the oceans sector, the "liquid network" of innovation, as Steven Johnson describes it, joins the needs, real-world requirements, and experience of the end user with the technical know-how and creativity of the technology developer. At the end of the day, the products that find traction in the marketplace are the ones that increase efficiency and profitability, contribute to the safety of operations, or support environmental sustainability.