Issue 1 | June 2015

# FOCUS

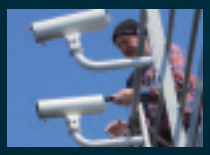
## Sensing success

How advancing sensor and data technologies help us all make better decisions.









BMT Group

"Where will our knowledge take you?"

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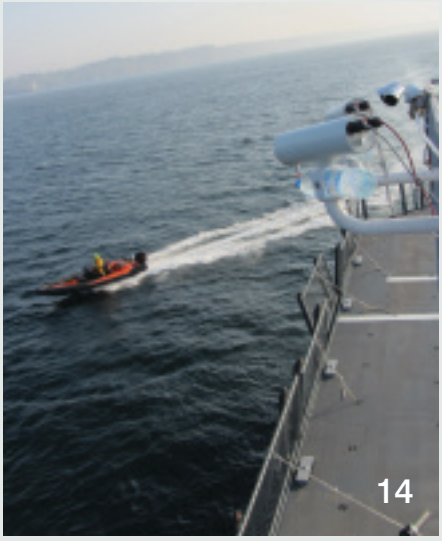


# Editorial

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Help us be green. This publication is now available online at www.bmt.org/focus, where you can also sign up to receive future editions by e-mail.

Welcome to the latest issue of Focus. In this edition we look at technology as the interface between humans and machines or humans and the environment and, in particular, focus on the use of sensors. Advances in sensing are allowing us to access environments that are either inhospitable to humans or too large to inspect by conventional methods. Combined with improvements in data transmission technology, information can now be gathered, aggregated and analysed far more quickly and efficiently than ever before, allowing complex decisions to be made in real time.

However, speed and enabling decisions are not the only ways of adding value. The work of the Wendy Schmidt Ocean Health XPRIZE demonstrates that there is no substitute for lateral thinking and raw innovation in proving elegant solutions to a problem.

Peter French
Chief Executive

## In this issue

We look at how BMT is using sensors to add value in the fields of fleet performance management, ocean exploration using undersea gliders and environmental consulting.

Dr Paul Bunje discusses how the Wendy Schmidt Ocean Health XPRIZE is promoting ocean sensor technology that is both appropriate and cost effective and Tom Cane from the IPATCH consortium explains the role of advanced sensing technology in providing early warning of attacks by pirates.

I hope you enjoy this issue and would like to thank all our authors who have given their time to provide us with their views and insights. We always welcome your feedback on the magazine. If you have any thoughts on any of the subjects we have covered or would prefer to receive this publication in electronic format, please send your feedback to our editor at jwilliamson@bmtmail.com.


# Passing the Litmus Test

The Wendy Schmidt Ocean Health XPRIZE is promoting ocean sensor technology that's both appropriate and cost effective.

The rapid advances in technology in the later years of the 20th century and the first fifteen years of the 21st century have led to the erroneous perception that science will always provide ready-made answers to the world's evolving problems. In the field of sensing and measurement, this disconnect between perception and reality became very clear through growing awareness of the causes of climate change. Acidification of the oceans which is brought about by rising carbon-dioxide levels in the atmosphere is a major concern.

## A pHistory of acidification

Acidity is measured on the pH scale, ranging from strong acids (pH 1), through neutral pure water (pH 7) to strong bases (pH 14).

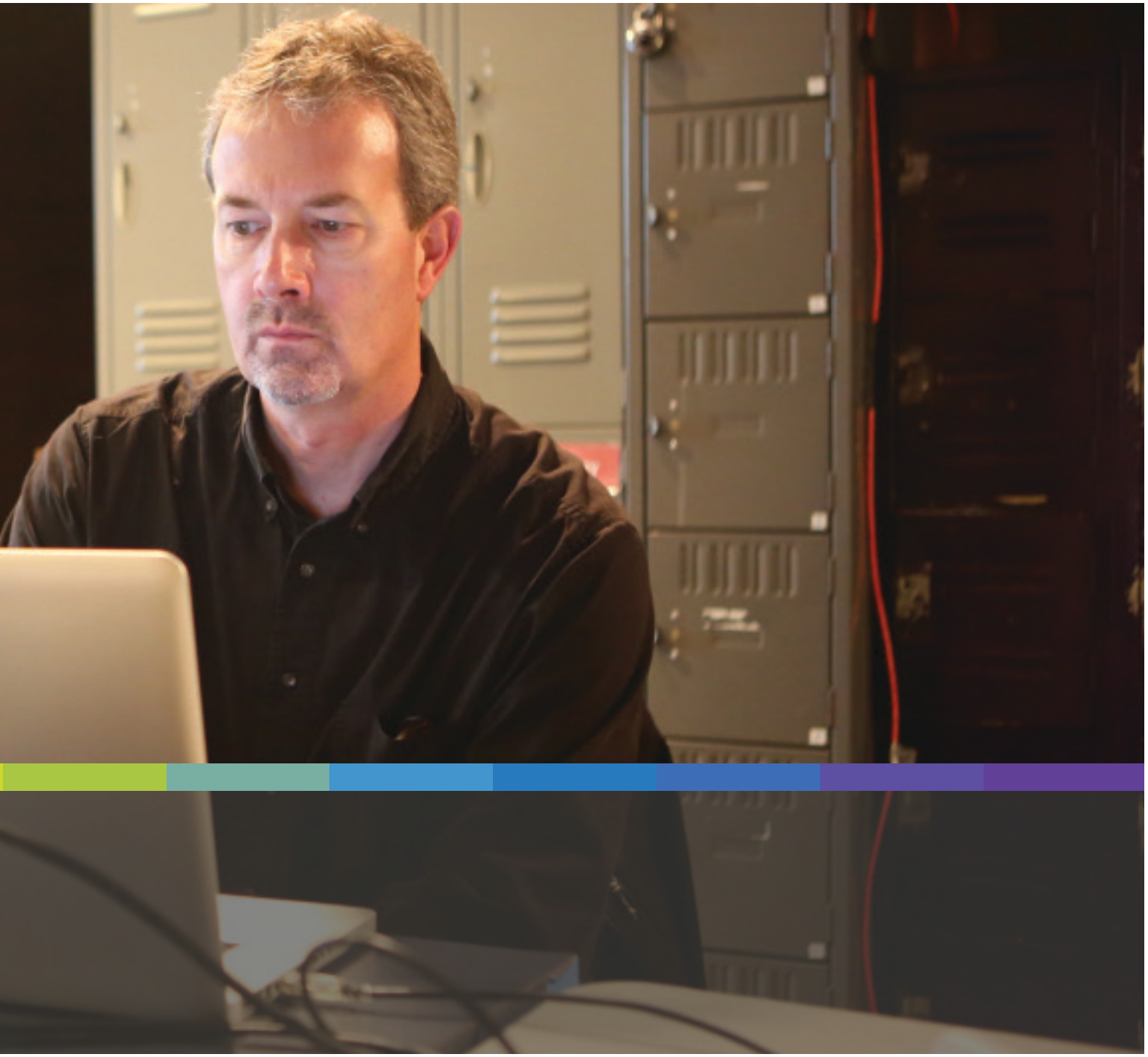
At the dawn of the industrial revolution in the mid-18th century, the ocean's surface waters had a pH of 8.2. In the subsequent 160 years, our oceans are estimated to have absorbed about one third of the carbon dioxide emitted by the burning of fossil fuels, with a reduction in average surface pH to 8.1. What looks like a trivial fall actually equates to a 25% increase in acidity as the pH scale is logarithmic.

The long-term consequences of this acidification are unclear, but historical events suggest that such changes in pH could be of geologic consequence and have been implicated in mass extinctions of sea-creatures that have shells and skeletons made from acid-soluble calcium carbonate or calcium phosphate.

Preliminary studies suggest that some of these animals are already finding it harder to survive than they used to. If that is true, and the problem of acidification gets worse, everything from tropical coral reefs to temperate-water mussel farms may be affected. That will in turn have an impact, albeit indirectly, upon organisms further up the food chain with unwanted knock-on effects.

## Understanding, measuring and monitoring

Unsurprisingly, there is a pressing need to properly understand, measure and monitor the pH levels of our oceans amongst other parameters, from the surface to the depths, but to date there has been a huge lack of investment in measuring ocean chemistry,



despite its global significance. The oceans are far away and opaque to many people and without legislation or a business imperative driving investment, the initial capital investment in ocean sensing is often perceived to be too large and too great a risk.

Contemporary seawater pH monitors have been produced as part of academic projects rather than high volume commercial enterprise. However, they cost around $10,000-$20,000 each, and cannot be deployed at depth because the pressure there will damage them. What is required is a technology that mimics the humble litmus paper: cheap, robust, delivering instant results and requiring no power and minimal training to use.

## The XPRIZE answer

In a bid to tackle this challenge, the XPRIZE foundation, a charity that runs technology competitions with a difference, introduced the Wendy Schmidt Ocean Health XPRIZE, a $2 million global competition that challenges teams of engineers, scientists and innovators to create pH sensor technology that will affordably, accurately and efficiently measure ocean chemistry.

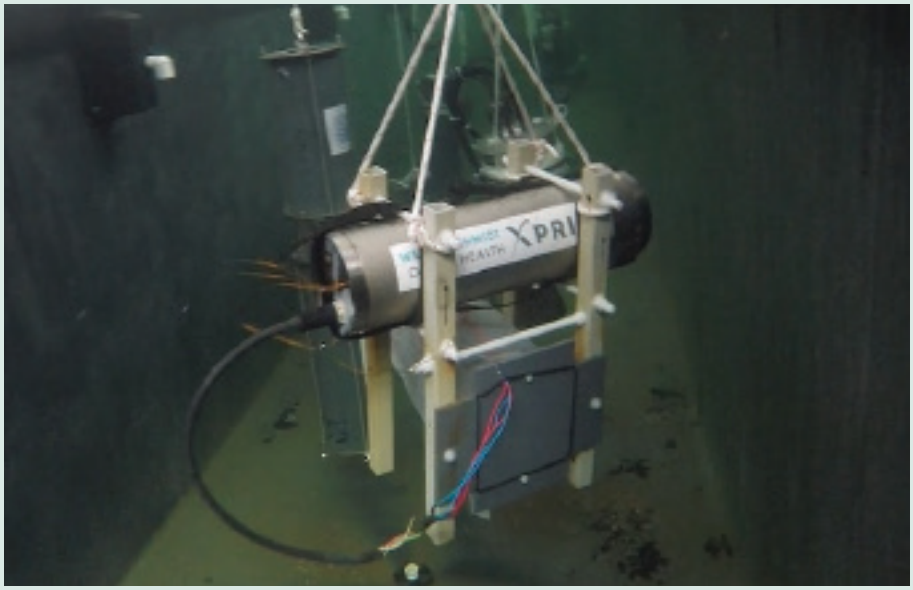
By leveraging the power of the prize purse and the glory of competition, XPRIZE aggregates lots of simultaneous investment in the development of ocean sensors. This approach drives down initial cost and reduces barriers to entry. By incentivising the development of ocean sensors more broadly, the XPRIZE foundation identified the opportunity to create and develop a new multi-billion dollar market. The possible impact can be estimated by considering the growth of the $10 billion/year market in weather services predicated on publicly available weather data. By incentivising innovators to approach ocean sensing in the same way, there are huge opportunities to develop a virtuous cycle of data being turned into services, creating a profit motive for yet more data.

As part of the democratisation of science and technology, large companies such as Boeing have broadened their outlook and are now willing to sell their undersea vehicles to private companies as well as governments and the military. With greater volumes being produced, costs are being driven down providing access to advanced platforms for ocean sensor R&D.

## Deep sea trials

The finalists of the Wendy Schmidt Ocean Health XPRIZE have commenced a week-long deep sea trial to assess ocean pH values at the time of writing and the competition has demonstrated that there are far more innovators across the world than previously thought.  Locations as diverse as Austria and Ohio and backgrounds including foodstuff science and nanotechnology have precipitated remarkable new thinking and dramatic new approaches with the competition revealing at least five different ways of measuring ocean pH that have never been tried outside a research laboratory. Furthermore this new generation of ocean pH sensors has been packaged to be easy to use and deployable by a huge diversity of user-groups.

While only four of the teams will potentially win the cash prizes directly from XPRIZE, others within the competition have already secured outside investment and are moving to production. Furthermore, the knowledge that has been gained has already been deployed by private companies to develop different types of sensors, measuring other parameters of ocean chemistry. The field of ocean sensing is still very much in its infancy but the work done in pursuit of the Wendy Schmidt Ocean Health XPRIZE has already established a robust and exciting technology baseline. As more resources are deployed the sector will undoubtedly grow and flourish, providing valuable insights into our planet's oceans.



## About the XPRIZE foundation

The XPRIZE foundation is a charity that runs technology competitions with a difference. Its global competitions incentivise technological breakthroughs that can tackle grand challenges in sectors as diverse as space exploration and healthcare. XPRIZE targets technologies that can drive exponential growth in a range of areas including the economy, data, uptake by consumers or exponential impact on numbers of people through a tool that promotes self-learning and can scale up rapidly.

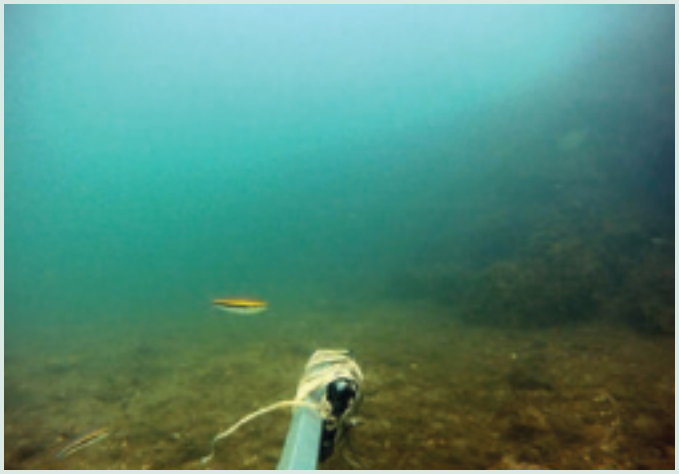
## About Dr Paul Bunje

Dr. Bunje brings his enthusiasm and unique ability to bridge the gap between science and society to the Wendy Schmidt Ocean Health XPRIZE, to help lead the identification of solutions to the challenges facing our world's oceans. With more than 12 years of experience in science, policy, education and environmental leadership across the US, Europe, the Middle East and the Pacific, Dr. Bunje has first-hand insight into the diverse challenges we face in protecting critical habitats and communities. Dr. Bunje is trained in biology, with a B.S. from the University of Southern California and a Ph.D. from the University of California, Berkeley.

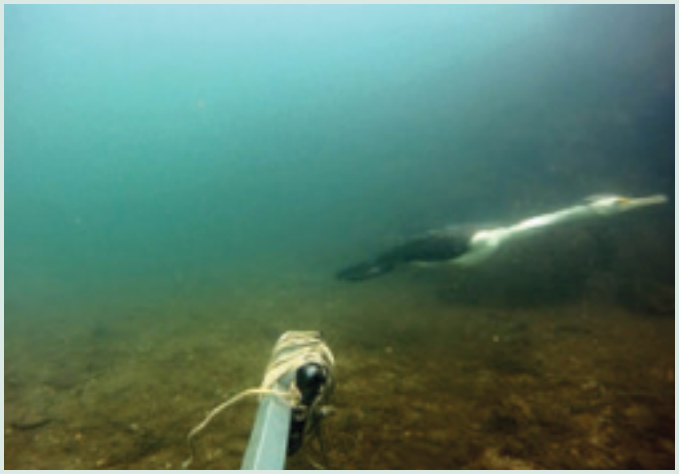
**Dr Ralph Rayner** Sector Director for Energy and Environment at BMT Group and member of the Ocean XPRIZE advisory committee

The work being promoted by XPRIZE is very close to my heart, especially as the Wendy Schmidt Ocean Health XPRIZE aligns closely with the  challenges being addressed by BMT Scientific Marine Services. Developing and applying advanced sensor technology in ever more innovative ways to deliver added value to clients is pushing the boundaries of what is currently possible.

A key element of the success in this field is not only accurate sensing but also ensuring robustness, resilience, survivability and stability of instruments. Both BMT Scientific Marine Services and the Wendy Schmidt Ocean XPRIZE contestants are addressing these issues, albeit for different aspects of monitoring. To be successful, sensors need to be incorporated into instruments that are going to work reliably over long periods of time  while maintaining calibration. This is especially challenging in the deep ocean or where intervention to recover instruments is difficult. The Ocean XPRIZEs are pushing the boundaries of what is possible in the oceans. The novel technological solutions that they will stimulate will deliver benefits to all of us.



# Look but Don't Touch



Sensors and other remotely operated instruments provide a means for scientists to measure and observe marine ecosystems without entering the water.

Read more >>

BMT WBM utilises leading-edge 'diverless' instrumentation to provide accurate and non-intrusive observations of marine habitats and species. The use of diverless technologies has obvious workplace health and safety benefits, particularly where there is a risk of interactions with dangerous marine life, such as sharks, crocodiles or marine stingers. Diverless technologies can also provide many other benefits over traditional approaches in terms of cost efficiencies, data accuracy and quantity, and logistical considerations.

Remotely controlled underwater video and camera-based systems have a wide range of applications. One such application is the quantitative sampling of marine fish communities using baited remote underwater video systems (BRUVS). The BRUVS unit consists of an underwater camera, a bait basket, and a pole connecting the bait to the camera. Fish within the field of view are filmed over a standard period of time, and fish are then identified, counted and measured for length by marine ecologists. Non-destructive and cost effective, the data provides empirical estimates of fish abundance and diversity, including sharks and rays that are difficult to survey using traditional net or baited line-based methods.

### Informing seawall development

BRUVS have a wide range of applications for surveying fish communities in 'clear' waters. BMT recently used BRUVS in Moreton Bay, Queensland, to quantify fish assemblages using rock walls at the Port of Brisbane. The results were outstanding with a large numbers of species recorded, including numerous species of fisheries significance. BRUVS allows port managers to understand particular locations that have higher biodiversity/fisheries values, and to validate predictions made in impact assessment studies regarding the beneficial impacts of seawall development.

Furthermore, the video imagery also provides an excellent communications tool allowing port managers to engage with the general public regarding the more positive aspects of port development. By utilising underwater video cameras developed for the consumer market, BMT has developed an innovative, cost-effective tool to verify environmental impact assessments that adds value for its clients.

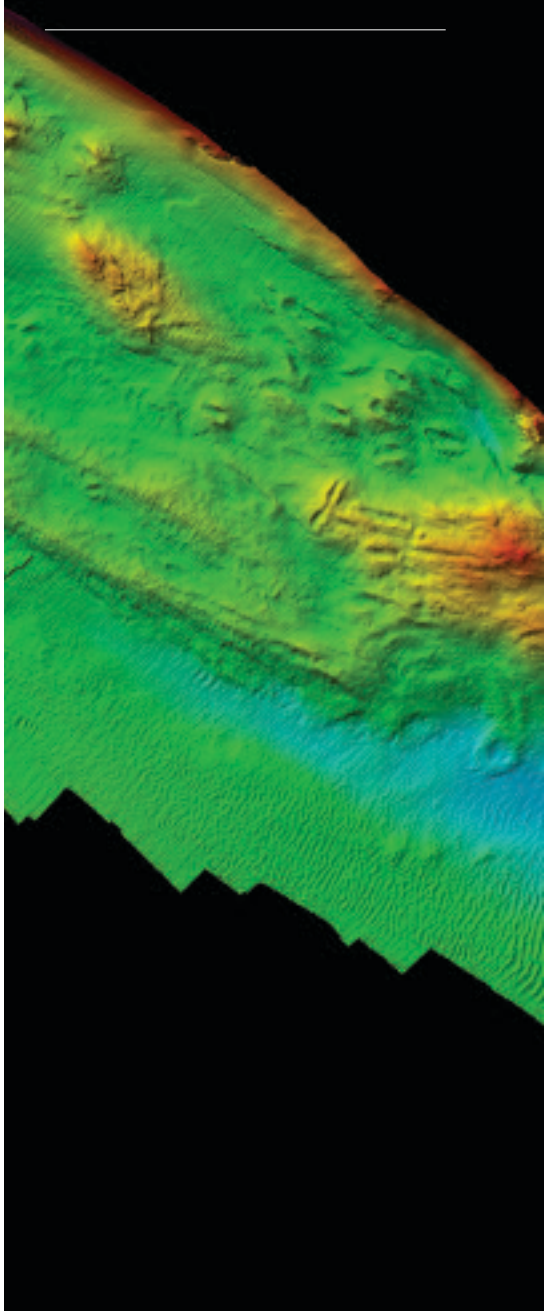
### Cost-effective surveying

Seafloor and river bed habitat mapping methods used by BMT eliminate the need for field staff to enter the water. In particular, sonar-based methods provide a means for accurately mapping reefs and soft sediment substrate types. Other diverless methods, such as remotely operated underwater videos, beam trawls and grab sampling, are then used to validate and refine sonar-derived habitat data. This approach allows large areas of seafloor or riverbed to be cost effectively surveyed, including deep waters and waters with low visibility.

To date, BMT has successfully deployed diverless sensing technologies for many purposes including conservation park planning, documentation of baseline conditions for impact assessment studies, designing environmental monitoring programs and selection of new offshore dredged material placement areas. By leveraging technology that has been developed by other industries, BMT offers innovative, value-added solutions to measure and monitor marine and aquatic ecosystems.

**Dr Darren Richardson, BMT WBM**

Darren is a consulting ecologist with over 21 years' post-graduate experience in research and environmental consulting. He has considerable experience in marine environmental impact assessment and has a detailed understanding of the issues relevant to such areas. Darren has particular expertise in the design and implementation of field surveys for the purposes of monitoring and assessment of benthic community structure. Darren is also experienced in designing statistically rigorous environmental monitoring programs using a range of statistical techniques relevant to ecological and impact assessment studies.

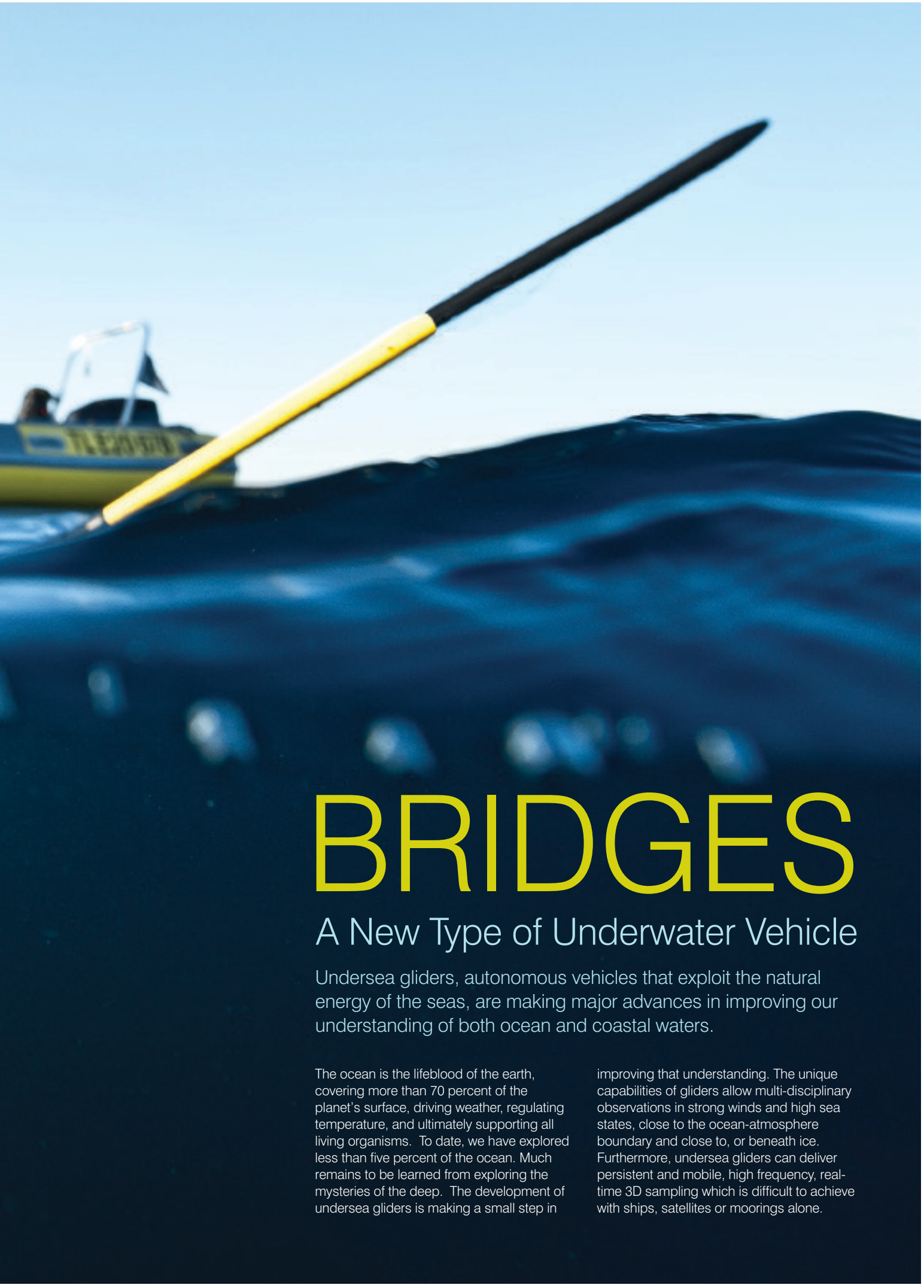


## Funding innovation: BMT Oceanica evolves the ROV

Sister company BMT Oceanica also has extensive experience of using diverless techniques including BRUVS, ROV and ocean gliders. Through a collaborative relationship with Professor Euan Harvey from Curtin University of Technology, BMT utilised BRUVS for Chevron Australia's Gorgon Gas project to assess the environmental impact of construction on the fish communities.

It has also provided offshore support in partnership with Neptune Marine Services for the Thevenard Island and Apache Varanus Island projects which involved the use of an ROV for habitat mapping. Further, BMT has employed ocean gliders to monitor produced formation water from three Woodside offshore oil and gas facilities. Recognising that diverless techniques including the use of ROVs is becoming ever more prevalent, BMT Oceanica has recently secured innovation funding from BMT Group to develop these techniques further.


SEAEXPLORER.FR

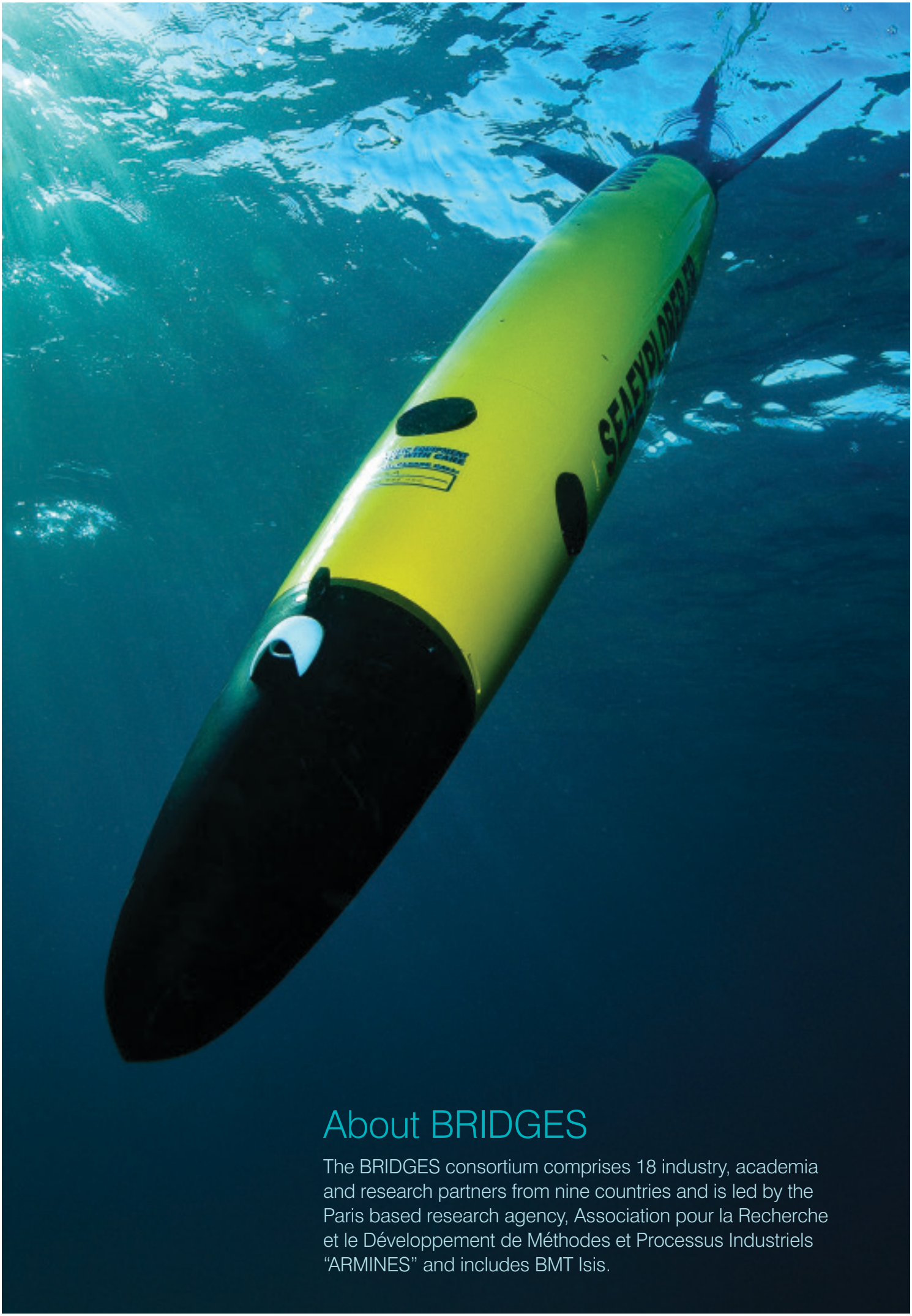


# BRIDGES

## A New Type of Underwater Vehicle

Undersea gliders, autonomous vehicles that exploit the natural energy of the seas, are making major advances in improving our understanding of both ocean and coastal waters.

The ocean is the lifeblood of the earth, covering more than 70 percent of the planet's surface, driving weather, regulating temperature, and ultimately supporting all living organisms. To date, we have explored less than five percent of the ocean. Much remains to be learned from exploring the mysteries of the deep. The development of undersea gliders is making a small step in improving that understanding. The unique capabilities of gliders allow multi-disciplinary observations in strong winds and high sea states, close to the ocean-atmosphere boundary and close to, or beneath ice. Furthermore, undersea gliders can deliver persistent and mobile, high frequency, real-time 3D sampling which is difficult to achieve with ships, satellites or moorings alone.



# About BRIDGES

The BRIDGES consortium comprises 18 industry, academia and research partners from nine countries and is led by the Paris based research agency, Association pour la Recherche et le Développement de Méthodes et Processus Industriels “ARMINES” and includes BMT Isis.

## So what is an undersea glider?

Think of it as a type of Autonomous Underwater Vehicle (AUV): a robot which travels underwater without requiring direct input from an operator. In the same way that a conventional glider uses atmospheric thermal currents to generate lift which it then converts into forward motion to create additional lift over the wings' aerofoils, an undersea glider couples small changes in its buoyancy created by the changing temperatures and salinity in the sea, together with the ocean currents and "lift" generated by small wings. Combined, these convert the vertical motion into longitudinal movement.

The advantage of this approach is that traditional AUVs are limited by the capacity of their battery pack. Most are limited to missions of no more than eight to ten hours before they need to be recovered on board a mother ship and their batteries recharged. Even a very long endurance AUV only has 48 hours on lithium-ion batteries. This is more than acceptable to meet its task, but scientists who wish to study the world's oceans or engineers seeking a persistent monitoring solution, need something that they can rely upon to operate autonomously at sea for months, not days or even weeks. This is where the undersea glider comes into its own.

## A winning consortium

BMT Isis is part of the winning consortium selected by the European Union (EU) to undertake research into undersea gliders as part of the Bringing together Research and Industry for the Development of Glider Environmental Services (BRIDGES) project. This €8m project, funded under the Horizon 2020 programme, aims to develop tools for further understanding, improved monitoring and responsible exploitation of the marine environment, while assuring its long-term preservation.

Most undersea gliders are currently designed and built in the United States; the BRIDGES research programme was initiated to help develop this technology within the EU and the consortium has chosen to use as its basis the sole European undersea glider, SeaEXplorer, produced by French company Alseamar, from which it will develop two new gliders. It will be modularised and new sensors developed to meet the needs of the three main clients: environmental scientists, offshore oil and gas and the embryonic deep sea mining industry.

## New needs, new capabilities

The BRIDGES consortium plans to enhance the existing range of sensors carried by SeaExplorer and develop new capabilities to meet client needs.

These will include sensors to measure:

- Essential ocean variables (temperature, salinity, oxygen, nutrients, inorganic and organic carbon, pH, optical properties) and ecosystem-related parameters through a growing range of miniaturised sensors, including reagent based lab-on-a-chip, and imaging. This is aligned with the European Commission's Marine Strategy Framework Directive (MSFD) which is driving the development of cost-effective, in-situ, re-locatable and sustained monitoring technologies.

- Oil and gas-related (O&G) parameters such as polycyclic aromatic hydrocarbons, crude oil, refined oil, methane, drill fluids and acoustic noise.

- Sea mining-related parameters such as acoustic sensing and factors related to the nepheloid layers which are needed to support the exploitation of polymetallic nodule deposits and sediments rich in metals in the deep ocean, which now represent the major world metal reserves.

The project will also incorporate some cross-cutting capabilities including a system to obtain water samples at programmable locations and depths to allow on shore analysis, on board capabilities for active/passive acoustic and imaging monitoring.

## Packaged for different applications

For the MSFD package, passive acoustics and an imaging camera will be considered for noise and litter respectively. Sensors to sample nitrate, phosphate, ammonia and silicate will be the basis of the package for living resources exploitation.

The O&G package is expected to integrate sensors for detecting polycyclic aromatic hydrocarbons, crude oil, refined oil, turbidity, and noise levels.

The sea mining package will host turbidity, particle counter, video and active acoustic sensors. Finally, algorithms required for on board data processing and information extraction will be developed to support smart sensing. Particular attention will be on the imaging camera as this technique has proven its capacity to describe the "marine snow" and nano/micro phyto and zoo plankton with ship-borne profilers. Miniaturisation is particularly challenging for lighting and on board particle recognition.

This is an exciting and challenging project of which BMT is proud to be a part. We look forward to reporting at the end of the project in 2019 when it is anticipated that, as a result of this work, the EU will be at the forefront of undersea glider design.


### Ralph Dodds

Ralph joined BMT Isis in 2014 following a 32 year career in the Royal Navy where he served as a naval aviator with both squadron and ship command experience. Ralph is the Head of Business Development within the Aviation and Transport team covering both military and commercial aerospace together with ports and civil maritime, road, rail and renewable energies, and has worked on some high profile projects including safety support to Exelis ATC radars and Independent Safety Auditor for Lynx & Wildcat. He has a Master's degree in Technology and is a Fellow of the Institute of Leadership & Management.

# IPATCH

## IPATCH Helps Improve Visibility of Threats from Pirates

Advanced sensing technology is being developed to provide early warning of attacks by pirates.

Although the word 'pirate' might conjure-up the romantic image of a Captain Jack Sparrow character happily plundering along the Spanish Main, the reality is very different. Piracy is a very real problem for the maritime industry in the 21st Century, particularly in the waters between the Red Sea and Indian Ocean, off the Somali coast, and also in the Strait of Malacca and Singapore, which are used by over 50,000 commercial ships a year. With estimated worldwide losses of US$16 billion per year and the potential for injury or loss of life, as well as the wider implications of lawless, no-go areas on the high seas, the international community rallied round to address the problem.

Current countermeasures are unsustainable. Multi-national naval operations, combined with enhanced self-protective measures including rigging the deck of the ship with razor wire, rigging fire-hoses to spray sea-water over the side of the ship to hinder boardings, having a distinctive pirate alarm, hardening the bridge against gunfire, creating a "citadel" where the crew can retreat in the event pirates get on board, or even deploying armed private security guards have been successful to an extent. However, these countermeasures are not only unsustainably expensive, but can be legally and ethically inappropriate in certain locations and circumstances.

The modus operandi of the modern-day pirate frequently involves using small attack/boarding vessels often launched from a larger "mother-ship" that can extend their range to over 100 miles out to sea. Taking advantage of the small number of crew members on modern cargo vessels and the limited capacity for lookouts, pirates are often able to approach vessels to within a close proximity without the alarm being raised.

### IPATCH

In order to address these shortfalls, the IPATCH (Intelligent Piracy Avoidance using Threat detection and Countermeasure Heuristics) project aims to combine data from a variety of technological devices to alert crews to suspicious behaviour by other ships and small craft before an attack ensues. With funding through the European Union's FP7 Programme for Research and Technological Development, IPATCH is developing a proactive, early warning system that will help protect the ship, captain and crew. Research carried out amongst officers and crew who have experienced attacks from pirates indicates that early warning of an attack is one of the most powerful tools available.

### Sensing the threat

By combining data from visual spectrum cameras, infra-red and thermal sensors, radar, AIS (automatic identification system), GPS and weather and climate monitoring, IPATCH will provide an on board ship decision support tool providing the operator with a robust, real time threat assessment and mitigation tool for piracy threats. To achieve this, the project team is developing cutting edge computer vision technologies where live video is analysed digitally, frame by frame, using a series of algorithms and compared with a pre-defined 'threat' profile derived from analysis of pirate behaviour. The automated system reduces human error and negates the risk of a watch-keeper missing an incoming pirate vessel.

The output of the analysis will be displayed on a single screen on the bridge giving details of the perceived threat, with images of the suspect craft, its course, speed and heading. The system will provide decision support information to the captain and any on board security team regarding countermeasures that might be useful in that situation, their level of effectiveness, as well as legal and ethical implications. It will also provide back-up to any reporting required after an incident as all the information is gathered and stored in real time.

While computer vision is now regularly deployed in land-based roles for vehicle and pedestrian tracking, it has been rarely used for civilian maritime operations. The nature of identifying and tracking an object at sea with the challenges of reflection and target loss due to wave height combined with a dynamic background, calls for more complex algorithms and more processing power. The cameras themselves must also be suitable for their working environment, both in terms of robustness for the marine

**Tom Cane**
Since joining BMT as a Research Scientist, Tom Cane has worked on various EU funded research projects in transport logistics, supply chain security and intelligent surveillance systems. Tom has a BA and MEng in Information and Systems Engineering from the University of Cambridge and is currently studying for a PhD in computer vision for maritime situational awareness at the University of Reading.

environment, but also appropriately inert and electrically safe to allow deployment on oil, LNG (liquefied natural gas) or LPG (liquefied petroleum gas) tankers.

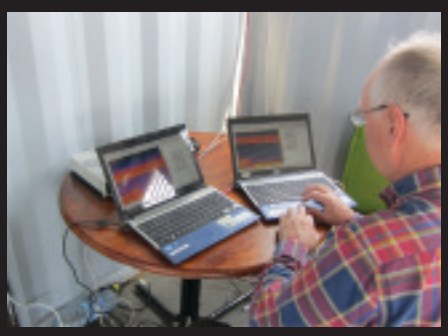
## Even pirates have rights

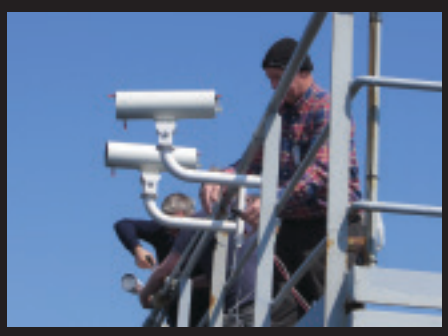
Perhaps perversely, one of the issues that the IPATCH team has to address is data protection. European data protection legislation is applicable to surveillance technology and, despite the fact that pirates present a threat to both life and property, they too have rights. Privacy issues also come into play when vessels enter port as the sensors remain live to ensure that protection is maintained.

The maritime sensing technology that IPATCH is developing has applications beyond protection against piracy with automatic man-overboard recognition and tracking and floating debris collision avoidance as just two potential uses. Computer vision will certainly be a key part of any autonomous ship system developed in the future.

## About IPATCH

The IPATCH consortium brings together a group of partners whose knowledge and backgrounds include legal, ethical and criminological expertise, sensor technology, image and threat recognition, software development as well as project management and practical end user experience.





www.ipatchproject.eu

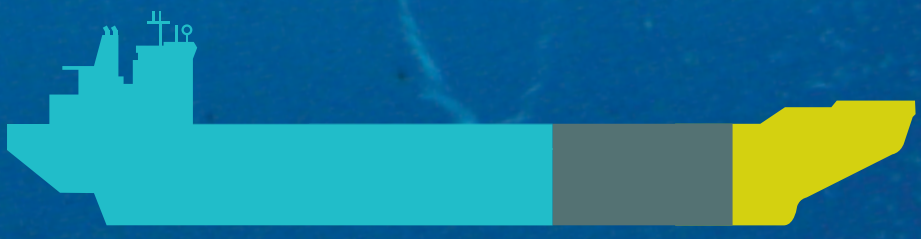
# The SMART Way to Manage Vessel Performance

Accurate measurement of vessel performance and energy use can deliver a wide range of benefits to ship owners, operators and charterers.

Over the past decade the shipping industry has undergone widespread disruption with a 'perfect storm' of unprecedented legislative changes and commercial pressures. The price softening and lack of demand in the market has led to large numbers of vessels being laid-up whilst the steady delivery of new build vessels into an already over-supplied market, coupled with an improving but still generally weak global economy, has put yet more downward pressure on freight and charter rates. In the mid-1990's estimates indicated that the shipping industry's share of global CO2 emissions could increase 20-30% by 2050. In response, the International Maritime Organisation (IMO) introduced a raft of new regulations including the ship pollution rules.

As a result, ships need to be operating at maximum efficiency to ensure they comply with environmental legislation and deliver an optimum level of profitability. The three major costs in ship operations are bunker fuel, crew and dry docking for maintenance. As crew numbers are governed by best practice and legislation, key savings must be made by making fuel usage as economical as possible and timing dry docking for maintenance to when it will be most beneficial in terms of performance and reliability. Bunker fuel costs can often account for up to 60% of total operating costs so the assessment of fuel consumption is fast becoming an integral part of ship owners', operators' and charterers' operational strategies and an understanding of vessel performance management needs to be high on the agenda. To deliver both economically viable compliance and commercially acceptable running costs, vessel performance now has to be measured and analysed at a level of detail never previously expected.

**The three major costs in ship operations**



| Bunker fuel (up to 60% of total operating costs) | Crew | Dry docking for maintenance |
|---|---|---|

**Peter Mantel**
Managing Director of BMT SMART, Peter Mantel is a Marine Engineering graduate, with over 20 years of senior marine management experience. He has a wealth of expertise working in the digital and e-navigation shipping markets.

### Market drivers of performance management

Vessel performance management is fundamentally about understanding the speed capabilities of vessels within a fleet and the fuel consumption required to achieve those speeds, based on both the vessel's current condition (draught, hull condition, engine condition, propeller condition, etc), as well as the prevailing environmental conditions (sea-state, swell, wind, current, water depth). In order to achieve this, BMT's SMART$^{SERVICES}$ utilises sensors to accurately measure and collect data from all the different parameters relating to a vessel's energy use and associated performance. Data from the vessel's relevant on-board power, propulsion and navigation systems is collected digitally and aggregated with external environmental data including wind, waves and current before being processed in real time and analysed against a range of different performance parameters. In addition, traditional noon reports can also be used as a data source.

SMART$^{VESSEL}$ and shore-based diagnostics continuously monitor sensor integrity and adopt a range of approaches rather than relying on single sensor readings to maximise the accuracy of derived performance data. In practice, inevitably, we rely more on the trending of sensor data. For example, the combination of GPS and current data – automatically collected by SMART$^{SERVICES}$ – allows for independent verification of speed through water to ensure maximum accuracy and as a back up to speed log data.

The key to understanding and assessing underlying vessel performance is the ability to filter out the impact of the environmental conditions. This is only possible in a reliable way by using accurate metocean data to identify the prevailing weather conditions as very few vessels have any on-board measurement for swell or wave height. Changes in the performance of vessels can then be quantified relative to an appropriate baseline such as sea-trial, first "post dry-dock" round voyage or charter party warranty speed-consumption curve and then ranked in comparison with other vessels in the fleet.

### Delivering benefits across a fleet of vessels

The reasons for performance management vary according to the entity's role in the shipping market. Owners whose vessels are on time-charter will be driven to monitor compliance against the existing charter party agreements, as well as using performance management data to construct new speed consumption curves for future charters to maximise revenue. As the owners of the vessel, they are also driven by the desire to maintain the asset as cost-effectively as possible. For example, degradation in engine performance could act as a predictive maintenance indicator.

A further driver for the owners is linked to the current challenge they face in retaining skilled crews on the same vessels, resulting in crews who cannot always build up an understanding of the optimal way of operating a specific vessel. Through the use of performance management, it becomes much easier to share best practice between different crews and, even if the crew is relatively new to a vessel, they can still operate it efficiently. Charterers on the other hand need to monitor performance to ensure on-time arrival of vessels to fulfil cargo delivery obligations (for example, by looking at actual versus ordered versus projected speed) whilst at the same time, monitoring the fuel consumption to confirm if any over-consumption is covered by the charter party warranty or not (for example, the percentage of good weather days). In addition, the overall voyage cost can be minimised by monitoring in real-time the actual versus budgeted cost.

### The SMART approach to adding value in the long term

Arguably, the greatest value that performance monitoring tools like SMART$^{SERVICES}$ can deliver becomes clear when one looks beyond the benefit to a single ship on a single voyage. Once multiple data-sets become available from multiple vessels over a period of time, the information can be used to benchmark performance and drive improvements across a fleet. Key indicators and trends that could lead to a positive change for future voyages can be leveraged, whilst single parameters that are causing a drop in efficiency can be identified and addressed. Dry-docking for maintenance and renewal of antifouling can be timed to take place just before any rapid drop-off in vessel performance, highlighted by historical and probabilistic efficiency and operational data.

BMT SMART has taken a very deliberate approach to focus on the shore-side performance management, rather than on-board optimisation, as well as fleet performance management and not just single vessel performance management. To achieve this, BMT has developed SMART$^{ACCESS}$, a powerful analytical tool and SMART$^{FLEET}$, an easy to use shore-based management tool. Whilst there are savings to be made through on-board optimisation, these are extremely hard to quantify in a verifiable way and these "decision-support" tools can be seen as a burden to the crew. Furthermore, developing an optimised voyage plan ashore is seen as being a more effective approach.

When this is combined with real-time tracking of the voyage, it becomes a straightforward matter to visualise how well the voyage plan could be followed. BMT SMART's aim is to make the crew's life on-board simpler, not to burden them with additional tools. They will no longer be required to manually fill in report forms, which are both time-consuming and have the potential to lead to inaccuracies, as the vast majority of the data required is collected automatically by the SMART system. Only qualitative data such as maintenance or fuel characteristics would need to be entered manually by the crew. Of course, not all vessels will be able to have automated data collection platforms. For vessels that are on short-term charter, the charterer is likely to have to rely on the noon data being sent ashore. BMT's SMART$^{FLEET}$ management application is specifically designed to be able to handle different data collection inputs and the output, from a Fleet Manager's perspective, is consistent within SMART$^{FLEET}$ regardless of the data collection process.

Looking to the future, it is not unrealistic to envisage a time when voyage planning is routinely checked against efficiency and emissions requirements to identify the most appropriate routing, whilst performance management reports can be produced automatically. The available technology and ongoing development of new SMART modules will provide a clear path to the digital ship, providing a unique insight on fleet vessel performance, with predictive maintenance modules and powerful benchmarking capabilities covering everything from environmental impact, hull and propeller efficiency and bunkering factors through to crew data, scheduled maintenance results, economic modelling and ship energy efficiency management plan (SEEMP) legislation.

The benefits of being able to use robust data to dynamically manage the performance of a fleet of vessels are hard to ignore.

# BMT news
## from around the globe

## Relocation Only Option for Solomon Islands Provincial Capital to Combat Tsunami and Climate Change Risks

BMT WBM has partnered with Buckley Vann town planners and the School of Civil Engineering at the University of Queensland to develop a comprehensive climate change adaptation plan for the provincial capital of Choiseul in the Solomon Islands. The climate change adaptation plan for Choiseul Bay, funded by the Australian Government's Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) programme, details the staged relocation of the Choiseul capital to the adjacent mainland. This is the first time anywhere in the Pacific Islands that a provincial capital with all its services and facilities will be relocated due to coastal hazards and climate change. The multi-disciplinary team consulted extensively with the Choiseul Bay communities to formulate a vision and future town layout that reflected the needs and values of the local Lauru people.

## BMT Introduces REMBRANDT Simulation Tool for Marine Collision Reconstruction

BMT ARGOSS and BMT Surveys have launched an innovative new service as part of its marine casualty investigation portfolio. Utilising REMBRANDT, the newly formed Collison Reconstruction and Simulation Team will be able to accurately reconstruct specific incidents involving collisions, to identify the root cause, including human factors considerations and any lessons that can be learned. The simulation uses data from the shipboard Voyage Data Recorder (VDR), radar images and regional AIS information combined with high fidelity ship models, to aid in the development of safety and promote pollution prevention measures which ultimately can support the industry from within.

## Foreign Secretary Philip Hammond MP Visits BMT in Bath

BMT's Bath based companies recently hosted the Foreign Secretary, The Rt. Hon. Philip Hammond MP, as part of his visit to the South West ahead of the UK general election in May. As well as a wide ranging discussion on BMT's offering for UK and international markets, Mr Hammond was taken on a tour of BMT Hi-Q Sigma's offices and met members of staff, including a number of graduates and apprentices. The Foreign Secretary, said: "It was a pleasure to meet one of Bath's largest employers and to hear how BMT plans to expand its businesses overseas. It is incredibly important for growing companies to have high quality office space and with the Government's investment of £36 million in the Bath riverside masterplan, I hope this will help secure BMT's continued growth here in the city."

## BMT Oceanica Secures Australian and International HSEQ Accreditations

BMT Oceanica has recently had its Health Safety Environment and Quality (HSEQ) Management System certified as meeting the requirements of AS/NZS 4801:2001, OHSAS 18001:2007, AS/NZS ISO 14001:2004 and AS/NZS ISO 9001:2008. The HSEQ Management System also meets the strict requirements of Chevron Australia's Contractor Health, Environment and Safety Management (CHESM) system and of Rio Tinto's Contractor Management System.

## BMT Design & Technology Celebrates 10 Years

BMT Design & Technology recently celebrated 10 years in business. Established in 2005, BMT Design & Technology is now recognised as one of Australia's leading independent defence and maritime consultancies.
Drawing on the pedigree of BMT Group, BMT Design & Technology was established to help support the Australian naval and maritime sectors. Over the last 10 years, the company has developed a reputable, indigenous capability, structured to meet the technical challenges of Australia's current and future naval fleet.

## BMT Asia Pacific launches Tri60

BMT Asia Pacific and McConaghy Boats have announced the development of the Tri60®. Short-listed for the International Yacht & Aviation Awards 2015 in the Yacht Concept up to 40m category, this exciting new 60' trimaran seeks to balance the desire for space, style and speed in a unique platform that is poised to create big waves across the global power boat sector. Boasting a modern, luxury design, the Tri60® is designed to provide an impressive power boat experience combining the comforts and pleasures of a day out on the water.

## Claydon Reeves and BMT Nigel Gee Present Project Chuan

BMT Nigel Gee and Claydon Reeves have launched the innovative Project Chuan concept. Developed from the earlier collaboration on the Oxygen project in 2012, the two companies have re-evaluated both the style, layout and underlying technical platform, based on BMT's Extreme Semi-SWATH (XSS) advanced catamaran hull-form. BMT's XSS hull-form has now been fully proven in the demanding offshore energy industry where speed and sea-keeping ability are critical to operations. A second XSS is currently under construction in Holland with ever larger variants under design development at BMT's Southampton based office.

## BMT Awarded Kizomba Maintenance Contract

BMT Scientific Marine Services has been selected by Esso Angola to provide maintenance services for systems installed on the two Kizomba Tension Leg Platforms (TLP) offshore Angola. This contract allows BMT to provide servicing and maintenance on system instrumentation exposed to offshore conditions and ensure continued function and accurate data. BMT's client support services plan will include twice-yearly service visits with calibration checks, software maintenance and updates, and remote technical support. In combination with its extensive monitoring system experience, BMT provides data management and technical analysis of data acquired by the various permanent and temporary integrated marine and structural integrity systems.

## Trearddur Bay, designed by BMT Nigel Gee, successfully completes sea trials

BMT Nigel Gee has announced that Trearddur Bay, its latest design for Turbine Transfers, has successfully completed sea trials in the Solent, achieving 31 knots with 8 tonnes DWT. With sea trials completed Trearddur Bay has immediately started work for Dong Energy. Trearddur Bay utilises BMT's well proven catamaran hull-form which is already recognised for its excellent fuel economy and seakeeping. The vessel is the first in the world to be fitted with the Voith Linear Jet (VLJ); an innovative propulsor unit offering very high efficiency and lower fuel consumption

## BMT WBM delivers successful EIS for AQUIS

The AQUIS resort Environmental Impact Study (EIS), to which BMT WBM was a major contributor, has been approved by the Queensland Government. This paves the way for development of the A$ 8.15 billion AQUIS Great Barrier Reef Resort Project in Cairns, north Queensland. It will be Australia's largest private, non-mining project and will compete on the world stage to attract more than one million visitors per year to Cairns and Far North Queensland.

## BMT SMART Partners with Aage Hempel

BMT SMART has announced that Aage Hempel has become an accredited service partner. This agreement will provide both organisations with the opportunity to enhance their propositions to help optimise shipping operations worldwide. As part of a two day workshop at Aage Hempel's head office in Algeciras, Spain, BMT will deliver both hardware and software training on its SMART range of fleet and vessel performance management software and services.

# Movers and shakers

### Dr Russ Morrison

Dr Russ Morrison, a founding member of Brisbane-based BMT WBM, has been recognised for his long, distinguished and innovative engineering career by the Senate of the University of Queensland who bestowed on him a Doctor of Engineering honoris causa. During his career at BMT WBM, Dr Morrison has worked on numerous and diverse engineering challenges from improving the reliability and performance of mining equipment, to the development of robotic machines and the design of hypersonic wind tunnels for scramjet engine testing.

### Paul Charlton

BMT WBM has announced the appointment of Paul Charlton as Managing Director of its Machinery Group. Paul has over 25 years' experience in the mining machinery sector, working for Hydramatic Engineering and Sandvik Mining & Construction before moving to Nepean in 2010. He holds an MBA from the Newcastle Graduate School of Business. Paul's remit encompasses meeting key customer/client requirements while achieving increased market share and developing new opportunities.