



Ideas for a changing world



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Our customers live in a world of ever-increasing change: growing compliance, new global competitors, the pressure to do more with less, ever faster innovation cycles and less time to exploit market positions or new technologies.

We bring domain experience coupled with management, engineering, science and technology know-how to help our customers compete in this world of accelerated change. To help them design, manage, maintain and improve their assets: to make them faster, cheaper, cleaner, greener, safer. We are, above all, specialists. We focus the wide ranging expertise of our consultants, engineers and scientists principally on the maritime sector, innovating creative responses to these challenges.

Here you will find some of the beliefs and principles that fuel that work. And from research projects to planning, the application of big data and design, you will also find examples of what we are doing to help customers anticipate change and unlock opportunity.

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1: With diverse staff and experience, BMT is international in outlook as well as reach.

2: Whether an engineer, designer, scientist or technician, everyone at BMT is above all else a specialist not a generalist.

3: We monitor vessels, structures and environments and turn that data into better decision making.



The independent mind

Post the financial crash, many people are waking up to the advantages of employee-owned businesses. BMT is such a business: our ownership resides within an Employee Benefit Trust. In other words, we are independent of external shareholders and are instead held in trust for the benefit of our staff. This offers our staff, our customers and the communities in which we work tangible advantages.

Independence means we are free to offer impartial advice unencumbered by ties to industry. It means we are free to act in our customers' best interests. Independence means we are free to focus on relationships and the longer term rather than short term returns.

Our independence translates into an independence of thought too. We are free

to choose our projects and partners and free to invest in growing our knowledge. Without shareholders to answer to, that investment pays dividends in the insights and technical abilities we share with colleagues and customers. We are also free to hold ourselves to high ethical and sustainability standards.



Giving back

We invest in the communities in which we work. Beyond initiatives like our volunteering days which see us contributing time to those communities, we have created a way to donate our knowledge as well. 'BMT Giveback' invites everyone in BMT to explore ways of resolving key social issues, from flooding and drought to sanitation and energy supply. Chosen from over 100 ideas, our first Giveback programme used our knowledge to bring sanitation to a village in one of our key markets, India.



Researching opportunity

We were born with a research heritage. Pivotal innovations in the design of ships, how they were tested and operated were developed in the tanks of the National Physical Laboratory and by the British Ship Research Association, the two forerunners of BMT. Today, that research-focused DNA sees us continuing to self-fund programmes exploring opportunities for and with customers, as well as pursuing contract research work.

Much of that contract research sees us working with the European Commission on the future of the maritime industry. That work gives us valuable perspectives on likely policies, technologies, logistics and security issues that will affect our other customers in the maritime world. With eMAR, for example, we are researching ways to increase the uptake

of more advanced technology in the maritime world and harmonise the data required by the port authorities of many different European countries.

Much of our research is of course inspired by the markets in which we work. There may not be a single formula for innovation,

but we find investing in conversations with customers, getting a closer understanding of their issues and collaborating more with them creates a fertile environment for new ideas and approaches. To borrow a phrase from Eric von Hippel, this 'lead user' innovation sees us working with ambitious customers exploring new answers.

Anticipating change

In some cases, the talent lies not in working with the market but in anticipating it. Our double-hulled auxiliary ship concept, Aegir®, is a case in point, anticipating as it did changing legislation in the naval tanker market. Aegir® also points to another strength. The breadth of our specialisms is itself a research asset: we are able to apply knowledge from one sector to another, from commercial marine, for example, to naval marine.



Research gallery

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1. The detection technology developed for the robotic fish in our SHOAL project to sense and record vessel pollution in port is now being put to use in SUPPORT, a project exploring the use of advanced sensors in improving port security.
2. Our research into the issues vessels face in detecting threats from pirates has resulted in iPatch: an early warning system that supports a master's ability to detect threats to his vessel.
3. With demonstrators from DHL and Proctor & Gamble to Interpol, EC project CORE sees us researching ways to make end-to-end supply chains more resistant, agile and efficient..
4. Project SafeGUARD sees us monitoring live trials for cruise ship evacuation, improving design and wayfinding.
5. Rather than fulfilling a single role, naval vessels are under pressure to meet changing operating profiles over their service life. The modular concepts born out of our research build flexibility into these big, expensive assets.

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Where do specialists look to upgrade their knowledge?

As specialists, we have to keep advancing our knowledge. But if you are the specialist, who do you look to when you want to upgrade that knowledge? Our active collaborations with universities dial in that cutting-edge, future-shaping thinking that moves our knowledge forward. As well as a network of leading academics who act as associates to review our work and push our thinking, we sponsor MScs, PhDs and chairs in our key disciplines. You can see some of those connections on this map.

- 1 Carleton University, Memorial University of Newfoundland and the Universities of Ottawa and British Columbia in Canada
- 2 Instituto Tecnológico de Aeronáutica and Instituto Nacional de Pesquisas Espaciais in Brazil
- 3 University College London, Imperial College London, Brunel and the Universities of Bath, Cranfield, Newcastle, Portsmouth, Reading, Southampton, Strathclyde and Warwick in the UK. One of our environmental consulting practices was itself born out of such collaboration (with the University of Aberdeen in the UK)
- 4 Technological Universitij in Delft in the Netherlands
- 5 Centre for Environmental Planning and Technology University in India
- 6 National University of Singapore
- 7 Universiti Teknologi Petronas in Malaysia
- 8 Australian National University, Curtin, Edith Cowan, Monash, Murdoch and Swinburne Universities and Universities of Adelaide, Melbourne, Queensland, Tasmania and Western Australia



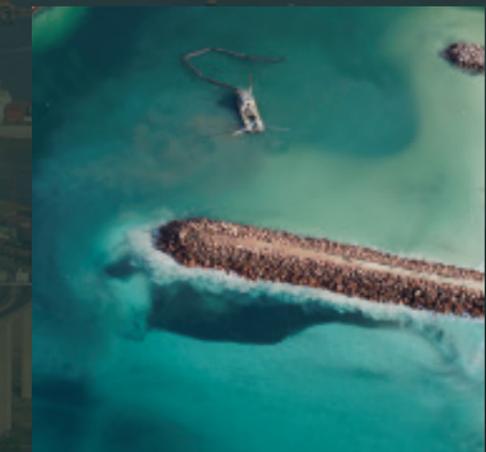


Planning futures

Uncertainty is the enemy of business. Inevitably it is at its greatest in the early stages when creating the case for a project. Our planning work is focussed on reducing investor uncertainty, helping our customers navigate their options with clarity and confidence: confidence that comes from knowing you have taken all factors into account and analysed them correctly.

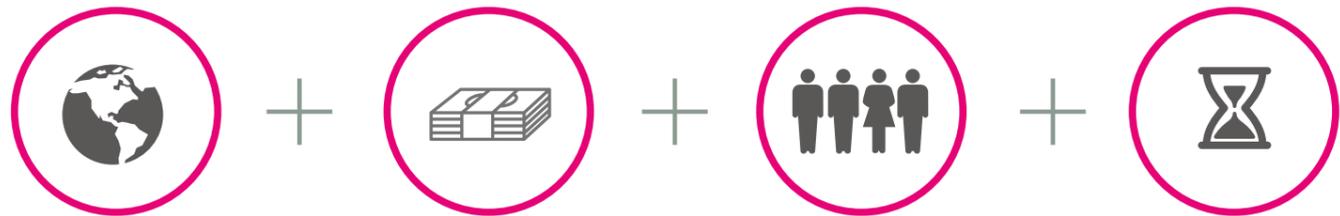
To understand risks and mitigate them, we help our customers turn unknowns and intangibles into tangibles: costs, time, contractability. This is not an abstract exercise in due diligence: our knowledge and experience of local markets is fundamental to assessing economic, social and environmental risks.

This combination of technical ability and local knowledge saw us appointed to assist with the Strategic Development Plan for Hong Kong Port 2030, guiding port development policy and investment, as well as working on LNG terminal plans in Singapore, flood planning in Australia and offshore oil platform planning in Taiwan.



Local knowledge

At BMT we do not have a centralised port planning capability. We believe there is no such thing as a best practice blueprint for a port. The right port plan will be one specific to and respectful of local factors, so quite deliberately we have a local presence in the markets we serve. As well as our knowledge of the local economy, environment, connectivity and communities, we bring quantitative tools to help customers have confidence in their site selection.



Land, capital, people, time: making the most of assets

Building a port can all too often feel like throwing money into the sea, either spending it on breakwaters in deep water or dredging in shallow water. Our understanding of wind, wave and current data saved the developers of Kijing Port in West Kalimantan from doing either.

Kijing deep water port will be a greenfield development in West Kalimantan on the island of Borneo, the third largest island in the world. We found a way to use an island just off the coast to shelter the port and create a plan with no need for breakwaters or additional dredging. Economics helped us forecast viable cargoes flows to identify both the quick wins and the longterm drivers. The approved plan takes our customer's assets – land, capital, people, time – and provides a structure to deliver the best from each of them.



Will the decision you make today still look like the right one in 20 years' time?

How do you start to manage risk for a project that will run for two decades before anything is delivered? That is our challenge working on the UK MOD's Maritime Underwater Future Capability programme, set to replace the Astute class submarines. We bring not just concept design and investment appraisal to this long-running programme, but also informed insights into where technology will move over that time.

Similarly, we are working with universities on Australia's SEA 1000 programme, looking at Australia's next generation submarines. Next generation submarines will by definition incorporate new technologies creating unexplored risks. We work to bridge those knowledge gaps and to make sure that decisions made on these long-term programmes today still look robust and informed in the future when the programmes reach maturity.



Turning big data into better decisions

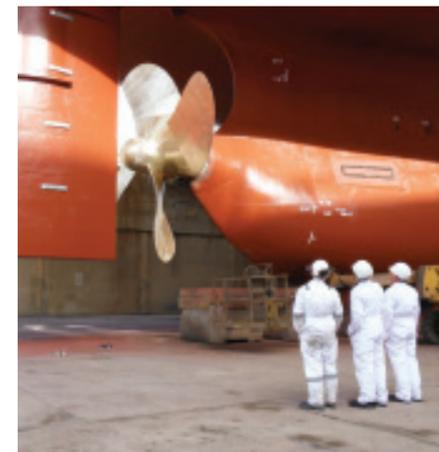
We work with customers to capture and mine the data that will help them make better-informed, more timely decisions: on the safety of their operations; the efficiency of their processes; the performance of their assets offshore, in the coastal zone and on land.

Increasingly, however, the problem is not capturing that data or ensuring its accuracy, but mining it. 'Big data' is just that: big. Difficult to mine, even difficult to move. From consequence modelling to structural integrity systems, we are helping customers learn more from that data and turn it into actionable information.

How do you improve cargo and port security? We're using the greater connectivity of graph databases to identify patterns and anomalies in behaviour that would be invisible to traditional relational databases. How do you train

multiple tug pilots in the safe towing of large vessels? We're putting meteorological and oceanographic data together with intuitive, realistic gaming technologies to simulate realtime conditions.

The licences and equipment required to run many of these large data sets have put much information out of the reach of smaller players. Increasingly, however, with data storage moving to the cloud, we will be looking to provide valuable tools and intelligence on a 'pay-as-you-go' basis.



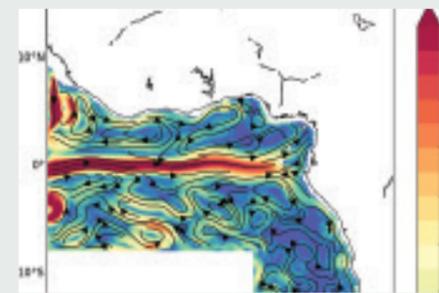
Smarter fleets

Is your fleet performing above or below average? Could your vessels perform better? How effective are different crews? Beyond conventional noon reports, fleet operators have had little to go on in answering these questions. We have taken metocean data and data from real-time monitoring of vessels and - with the help of powerful algorithms - put the answers to these questions in front of fleet managers in a simple online application.



20/20 hindsight

Oil and gas operators in the mid-Atlantic have lacked high quality data on currents vital to creating safe rig designs and reducing the risks of operating in the region. Working with the UK's Met Office and Oceanweather, we have brought together huge and detailed data sets to build a 20-year hindcast of high resolution, layered ocean current information (the Mid-Atlantic Current Hindcast). Validated against extensive in situ oceanographic measurements, operators now have access to velocity, salinity and temperature data at 75 points in the water column at any given hour.



Designing success

'Design' for us is a creative response to a challenge.

How do you safely change a sensor on an oil platform riser when it is 1,000 metres under the ocean? How can a landing craft reach the beach faster without making the occupants seasick? How do you land the windfarm maintenance team safely on an offshore pylon?

Our work in concept design, naval architecture and engineering design sees us respond creatively to these challenges, using design to unlock opportunity for our customers.

Good design always has some level of innovation, whether a new hull form, a new propulsion system or a new way to reduce maintenance. Many of our concept designs may have their origins in blue skies thinking, but we know that to be valuable, innovation needs to be grounded. Fresh thinking can mean taking a risk- rather than rule-based approach to design. The rule book alone can lead to design encumbered with redundant, heavy or expensive features. So we often find ourselves thinking outside of regulatory frameworks to create more intelligent designs. Educated debates with, for example, Class Societies and Flag States allow us to comply with principles rather than rules and create pragmatic, efficient designs offering equivalent levels of safety.

You can explore some of our designs and the beliefs that inform them here.



1 Design is a listening activity

The saying that we all have two ears and one mouth because listening is twice as important as speaking is never more true than in design.

We guide our customers through the design process. We listen carefully to understand their real needs then use the design process to reveal options and spell out the implications for cost or for maintenance or crew training.

Increasingly, we see customers' resources constrained and our role in articulating their requirements growing. With that comes the responsibility to listen to all parties and often help arbitrate between competing interests. After all, great concept design is not about showboating: it is about delivering a robust, coherent concept that answers those many needs in a demonstrable way.



2 Simplicity is key

'The designer achieves perfection,' it is said, 'not when there is nothing more to add to the design but when there is nothing left to take away.' We agree. The simpler the design, the lower the cost, the greater the reliability and the better the operability. We believe in continually stepping back during the design process to see how and where we can simplify the design.



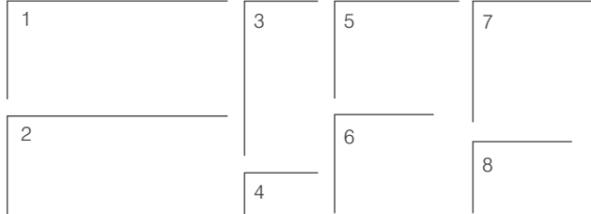
3 Concepts don't go wrong: execution does

In design, technical abilities are every bit as important as creative ones. The project managers in our design teams all have a strong technical bias. Bringing together disciplines from concept design to detailed production engineering not only maintains the coherence and intent of our designs, it also makes for an efficient build within a chosen yard's capability.



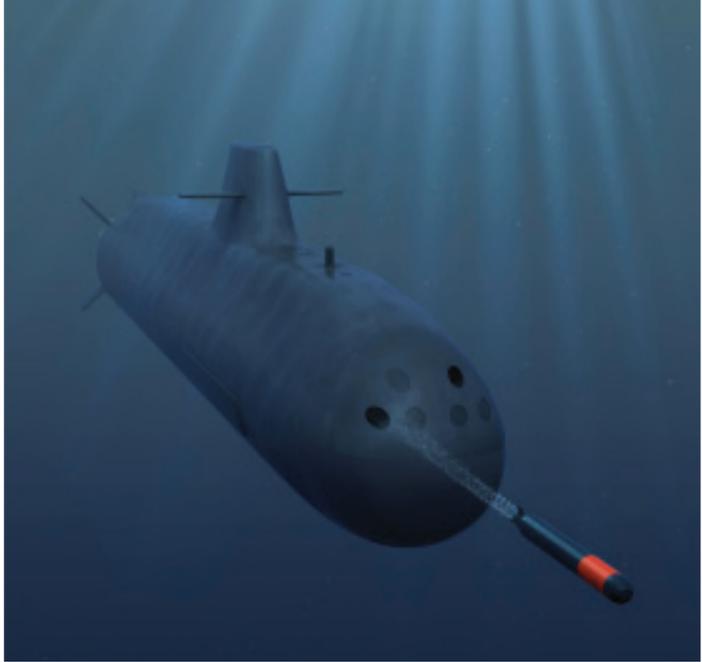
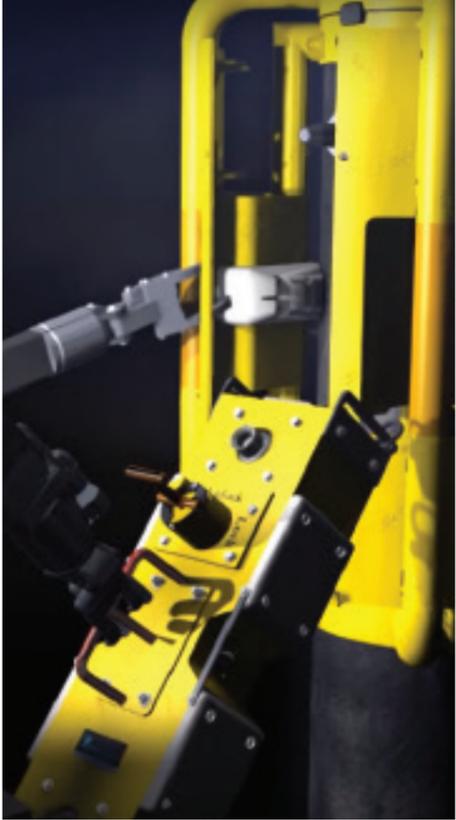
Design gallery

From our designs for strain gauges on oil rig risers to fast landing craft and submarines, you can explore some of our work here.



- 1. Aegir® double-hulled auxiliary concept already adopted by UK Royal Fleet Auxiliary and the Royal Norwegian Navy.
- 2. We are a founding partner of the Technology Innovation Group supporting Land Rover BAR's mission to bring home the oldest international sporting trophy: the America's Cup.
- 3. Designing a system for the safe interchange of sensors by ROVs in very deep water in the Gulf of Mexico.
- 4. Design for extreme climates: the Tulpar shallow draft ice breaker, designed for the challenging conditions of the Caspian Sea.

- 5. Safety and seakeeping: crew transfer vessel design for offshore windfarm maintenance.
- 6. Our adaptable Vidar® SSK submarine designs bring together advanced technologies with a detailed understanding of requirements including cost.
- 7. LNG and oil terminal design from UK to Indonesia, Malaysia, India and East Africa.
- 8. Scalable concept design for Caimen® family of fast landing craft.



BMT applies engineering, science and technology to help customers design, manage, maintain and improve their assets. Founded on a century's heritage in the marine environment, BMT is an independent organisation held in trust for its employees.



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