Independent centre of excellence for naval design and support
Delivering success in naval technology

Welcome to the third of our special bi-annual insights into the naval business conducted worldwide by the BMT group. BMT plays an important role not only in the UK, but for several overseas navies as a leading independent centre of excellence in naval design, assurance and support, based on our core abilities to innovate, design and deliver engineering success.

Whether you are already working with us or looking for a truly impartial critical partner you can rely on us to support you through your naval acquisition and through life management. We hope that by highlighting a number of innovative ways in which we have solved others’ problems, this briefing will help you identify solutions to meet and exceed your requirements.

Solving design and engineering issues is the core of the work performed by our naval architects, systems and marine engineers, information systems developers and safety and environmental consultants. This is true whether they are working closely together in ‘rainbow’ teams producing radical, innovative concepts and designs to deliver hitherto unrealised naval capabilities or working on the vitally important business of maintaining a naval unit’s ability to operate safely and capably at sea. This applies not just in the UK but increasingly for contracts won by BMT through our extensive network of subsidiaries sited in other countries around the world.

I trust that what you find within these pages will make you want to learn more about how we are continuing to provide successful solutions to our clients and how we might do the same for you. Please do not hesitate to contact us; our details are listed on the back page.

Roger Cooper
Managing Director,
BMT Defence Services
Thinking afresh for future naval combatants

The next generation of naval surface combatants must offer unprecedented flexibility, high availability and whole-life affordability. Balancing these complex and sometimes competing drivers is a challenging task requiring a comprehensive understanding of naval architecture, systems analysis and cost engineering.

BMT’s varied skills and intrinsic impartiality set us apart. Our corporate knowledge extends across all these disciplines, and has been employed time and again to meet the demands of our government customers. Acting as a customer friend and critical partner – the Tier Zero role – we are able to offer informed, unbiased assessments to ensure that defence acquisition organisations are able to gain a clear understanding of key cost, capability, risk, technology and programme drivers, and therefore derive the maximum benefit from the industrial base and the wider supply chain.

The UK’s Future Surface Combatant programme is a case in point. We recently supported the Ministry of Defence in the conduct of a Balance of Investment study examining the costs and programme risks associated with the procurement of a new class of complex surface warship. Our resultant report offered a robust understanding of a range of potential solutions, including new, derivative and military off-the-shelf designs. Each was assessed against a high-level requirement, with realistic options then reviewed against capability, time, cost and risk.

We have also undertaken studies on behalf of the Ministry of Defence to explore candidate platform and system options. Our involvement included a study to assess how a medium-size vessel derivative could be adapted with minimum risk to meet a specific capability gap, and work to examine the feasibility of a novel Mothership and Deployable Asset package concept.

Our accrued expertise was additionally brought to bear as part of the Sustained Surface Combatant Capability ‘Pathfinder’ programme, intended to deliver a capability-based roadmap for the Royal Navy’s frigate force beyond 2030. As a member of a rainbow team of MoD and industry stakeholders we played our part in examining how a robust Through Life Capability Management plan should be implemented for the programme in line with ongoing work on defence acquisition reform.

We are also examining how the application of modular open system architecture and spiral acquisition philosophies can deliver the flexible, adaptable and affordable warships required to fulfill the needs outlined in the UK’s Future Navy vision.

Fast sealift study outlines technology options

When the European Defence Agency (EDA) sought to explore how high-speed shipping could contribute to future sealift needs, it turned to BMT to provide an objective and impartial analysis of the relative maturity of commercial fast ship technologies, and the development of potential design solutions to meet European Security Defence Policy objectives.

By bringing together the combined expertise of BMT Defence Services and our sister company BMT Nigel Gee, we were able to produce a high-level assessment which reviewed all current and emerging technologies and established their relevance to requirements for a rapid maritime expeditionary deployment capability. We have a strong record of achievement at the front-end of fast ship design and technology, both companies having carried out a large number of market, environmental, concept, design, technology, engineering and operational studies.

For the EDA we focused on the applicability of the technologies for a fast transoceanic cargo vessel capable of sustained operation at over 40 knots at ranges up to 8,000 nautical miles. We collected, reviewed and assessed data on new and emerging developments in ship design and relevant technologies, and assessed how these technologies would affect operating parameters such as sustained speed, fuel consumption and payload carrying capacity. Based on this work, we developed illustrative monohull and stabilised monohull designs, offered an assessment of technology readiness levels, and identified potential technology enablers so as to assist the EDA in targeting its future research spend.

Our study work concluded that 35 knot monohull or 40 knot stabilised monohull solutions could be readily procured in the near term, offering a significantly enhanced strategic sealift capability. Far term development programmes may allow further solutions to be extended to much higher speeds if operationally necessary, or may mitigate some of the disadvantages of the technology enablers adopted for near term solutions.

Drawing on the complementary skills of BMT businesses, we have helped the EDA understand the opportunities offered by Fast Ship technologies, and provided a balanced analysis of the cost and capability to inform future policy formulation.
Canada’s Joint Support Ship project demonstrates how we are able to draw on complementary skill sets from our diverse and global enterprise, and in doing so apply innovative thinking to a unique operational requirement.

Faced with the need to replace its two ageing auxiliary oiler replenishment vessels, while at the same time identifying additional capability requirements for enhanced sealift and support of forces ashore, Canada’s Department of National Defence (DND) has developed plans for a new class of Joint Support Ship (JSS). These multi-role vessels will have the ability to transport large numbers of personnel, and function as a sea-based joint forces headquarters, as well as providing afloat support to a naval task group.

But translating this pioneering concept into a realisable ship design represents a major challenge, requiring a single platform that can properly synthesise and satisfy the three-fold capability requirement at an acceptable cost. To assist with that challenge, the DND has called on the expert and impartial advice offered by BMT.

We have been providing the JSS Project Management Office with comprehensive engineering, logistics and management support since 2002, helping underpin the transition of the programme from options analysis into its current project definition phase. This has included assistance with requirements definition, concept validation and the development of the procurement strategy.

The DND turned to us to develop reference ship concept designs; conduct requirement and specification reviews, contract technical development, explore combat and communications options, and advise on ship operability aspects (such as mechanical handling). We have also worked with the Project Management Office to examine a range of in-service support concepts.

BMT Fleet Technology has led our contribution to the JSS programme. Other BMT group subsidiaries providing input to the project include BMT Defence Services, BMT Designers & Planners and BMT Reliability Consultants.

Two competing industry teams are funded during the 14 month project definition phase to prepare costed design proposals for project implementation and in-service support. The JSS Project Management Office is benefiting from our independent expertise and advice to obtain best value from the implementation phase and subsequent introduction of the ships into service.

Engineering future submarine capability

Submarines are amongst the most complex engineering endeavours known to mankind. BMT is one of a select few companies worldwide with the knowledge and expertise to be able to conceive a new submarine, and deliver comprehensive design change management for in-service boats. And we have a proven track record in technical innovation and design optimisation that truly sets us apart.

Today, we are taking a prominent role in the concept design activities that will inform the performance and characteristics of the UK’s future submarine capability. This builds on our recent participation in a series of high-level customer-funded design studies intended to engineer whole-life cost reduction in the Astute class submarine programme.

Our marine engineers have already provided the Ministry of Defence with a range of technology options for the next generation of submarine secondary propulsion plant (the power generation and conversion equipment that takes heat output from the nuclear steam raising plant and converts it into mechanical and electrical power). Having considered the architecture and efficiency of existing secondary plant design, we developed and reviewed a range of alternative solutions, and quantified their potential according to criteria of cost, capability and risk.

These studies identified a number of technology options, including modern embodiments of steam machinery; a variety of hybrid arrangements; and integrated full electric configurations. Follow-on work will see each individual option explored in more detail to inform future submarine programmes.

We maintain our own technology watch programme to keep us fully informed as to the maturity, practicality and availability of emerging submarine techniques and technologies. Furthermore, our own research and development has delivered a suite of high performance software toolsets. A recent example is our application of commercial Computational Fluid Dynamics codes to gain an understanding of the hydrodynamic flows around a submarine platform at varying degrees of pitch and speed.
Taking a leading role in aircraft carrier design

The complex nature, high value and extended life of the modern warship demands the synthesis of multiple disciplines in order to produce balanced, affordable and adaptable warship solutions.

BMT offers proven expertise in concept design, naval architecture, marine engineering, power and propulsion, risk management, reliability assessment, and cost engineering to help major prime contractors deliver complex integrated warship solutions.

The UK’s flagship Future Aircraft Carrier (CVF) programme provides no better demonstration of this capability. We have deployed the full breadth of our expertise in the CVF assessment and demonstration phases, having played a defining role in the design and development of the innovative and inherently adaptable platform concept taken forward as the basis for the definitive CVF ‘Design Delta’.

As design agent for the core platform concept, we conceived a novel two island design offering reduced vulnerability, improved electromagnetic compatibility characteristics, enhanced operability and increased sortie generation rates. Our contribution to the Aircraft Carrier Alliance has subsequently included an extensive programme of model tests investigating the hydrodynamic characteristics of the ship’s hullform to ensure it meets powering requirements in the most efficient manner.

Although the UK currently plans for CVF to operate an air wing of short takeoff and vertical landing aircraft, the design allows for the flight deck to be reconfigured for the installation of aircraft catapults (steam or electromagnetic) and arrestor gear for conventional fixed-wing operations. This intrinsic adaptability resulted in the French government’s decision to examine the CVF core design as the basis for its own PA2 carrier programme.

At the request of the two governments, an expert team from BMT provided inputs into a joint industrial study that considered the potential for cooperation between the CVF and PA2 projects. We worked with other industrial stakeholders to conduct a top down review of how the CVF design might form the basis for PA2, examining issues such as internal layout, construction methodology, ship/air interface, power and propulsion, and associated impacts on cost and programme.

BMT has applied the breadth and depth of its capability to shape a new generation of aircraft carriers offering unprecedented utility, flexibility and effect, and inherently adaptable to meet changing defence needs over a planned 50-year lifespan.

Delivering submarine support solutions

The Submarine Support Management Group (SSMG) was formed in 1998 to provide Design Authority Support to the Royal Navy’s submarine flotilla. Since then SSMG has established itself as the prime source in the UK for submarine in-service technical support. DML, acting as prime contractor, is supported by BMT Defence Services and SEA as subcontractors and full risk sharing partners.

Since its inception, SSMG has consistently improved its efficiency, service and overall level of performance. It is also committed to a joint continuous improvement programme to help drive down the cost of submarine support over the next five years.

As part of SSMG, we provide a dedicated high calibre team backed up with the deep knowledge and wealth of expertise offered by our wider resource of naval architects, propulsion engineers and documentation managers. Our people have been deeply involved with numerous modifications, updates and associated design change management tasks required to keep the UK’s nuclear submarine fleet safe, operable and available.

Across the Atlantic, BMT Fleet Technology Ltd is a strategic subcontractor to the Weir Canada-led Canadian Submarine Management Group (CSMG), which is providing specialist engineering expertise and in-service support for Canada’s Victoria class submarines under the multi-million dollar Victoria In-Service Support Contract (VISSC). CSMG will deliver project management, engineering, logistics, material support, and repair and overhaul services.

The VISSC programme covers an initial five-year period, with options to extend up to 15 years. Significant work packages such as submarine refits and equipment overhauls will be added by contract amendment as emergent activities. The first refit, or Extended Docking Work Period, is scheduled to start in early 2009 and run for 18 months.
Aegir family offers affordable afloat support

With many navies around the world looking to acquire replacement fleet support ships, BMT has developed a scaleable, affordable and low-risk family of afloat support vessel designs offering outstanding performance and full compliance with the International Maritime Organisation’s environmental regulations.

BMT’s naval architects, system engineers and technical consultants have accrued unrivalled experience in whole platform design, platform support, design change management and certification across a wide range of auxiliary platforms. We have also undertaken significant work to examine how existing auxiliary ships can be modified to comply with increasingly stringent maritime environmental legislation.

Our wealth of knowledge has now been captured and embodied in the Aegir family of afloat support ships. Named after the Norse god of the sea, this portfolio of Auxiliary Oiler (AO) and Auxiliary Oiler Replenishment (AOR) vessels has its pedigree firmly rooted in a proven twin-skeg commercial hullform fielded by our partner, Skipskonsulent AS, and capitalises on our expertise and understanding to transform the baseline double-hull design into a highly flexible naval auxiliary. The result is a purpose-designed, new-build vessel that offers a competitive alternative procurement strategy to the conversion of a commercial tanker.

By judicious application of commercial shipbuilding practices and design standards, we have balanced the need for affordability and environmental responsibility with the unique naval features and capabilities demanded of an afloat support ship. These include Replenishment At Sea (RAS) rigs for abeam and astern transfer, and additional accommodation for the increased complement required for RAS evolutions.

Our understanding of the military requirement has allowed us to optimise the platform design without compromising the pull-through of commercial practice and standards. For example, Aegir’s powering and propulsion characteristics are matched to the speed and operating profiles required to keep pace with a task group operating at speed over an extended period. And the baseline design incorporates an integral hangar facility so as to enable the embarkation of rotary-wing lift.

Furthermore, we have engineered the Aegir family to cater for an extensive range of customisation according to navies’ specific requirements. Examples include enhanced close-in weapons, military tactical and communications systems, diesel-electric propulsion, NBC protection, deep magazines, aviation support, and dual-use tanks (AVCAT or Dieso).

Just as important in the modern era, Aegir is fully compliant to the latest environmental and safety standards. While navies are nominally exempt from these regulations, government owners increasingly recognise it is in their wider interests to comply with new and anticipated maritime environmental legislation.

Our Aegir design is low risk, supremely flexible and inherently scaleable. And since it is designed to commercial rules, the design can be built by any shipyard qualified to construct commercial vessels.

BMT is transforming the way that afloat support vessels are designed, specified and built, opening the way for navies worldwide to realise both cost benefit and operational advantage.
Extending the reach of the littoral submarine

By alloying practical expertise to fresh thinking, we are working to extend the capability of the conventional submarine by integrating an organic AUV launched and recovered from a Casing Mounted Hangar.

BMT was instrumental in executing the design and project management task that saw the Royal Navy successfully introduce its first submarine-mounted Dry Deck Hangar into operational service in 2004. Using our experience in delivering this complex and safety-critical project, we have subsequently conducted a series of engineering studies to examine the utility of deck hangar equipments to support the launch and recovery of autonomous underwater vehicles (AUVs) from conventional submarines.

AUVs are seen as an increasingly important force multiplier for submarines, offering a capability to extend their reach into the littoral battlespace and undertake tasks such as covert intelligence, surveillance and reconnaissance. However, the complexities associated with AUV launch and recovery from a torpedo tube, and the tyranny this imposes on the form and size of the vehicle, have led us to evolve an alternative solution based on a ‘wet’ Casing Mounted Hangar (CMH) facility.

Using the proven, off-the-shelf HUGIN 1000 AUV as a baseline, we have developed a concept design for a CMH facility suitable for installation on conventional submarines of approximately 2,400 tons displacement or more. Our analyses have considered relevant issues of stability, safety, speed, signature, manoeuvre and control, trim and compensation, and power management. We have also examined arrangement modifications and structural aspects, factors leading us to look at an engineering solution adopting a common bedplate design.

Various technologies have been investigated to enable the recovery of the AUV into the CMH. For example, we have looked at a simple and compact funnel dock previously developed by the Monterey Bay Aquarium Research Institute which would protect the vehicle on re-entry, and align it to the data and power transfer systems. Another candidate technology is Ballgrap, a proven self-activating mechanism for securing the AUV after docking.

We have also looked at an alternative ‘clean sheet’ hangar design concept which attempts to reconcile future submarine and AUV design aspects to optimise platform and system integration. The concept explored is based on an advanced ‘through sail’ design which would exploit the flexibility offered by non-hull penetrating masts to incorporate a hangar within its volume.

Combining innovative design with proven engineering solutions, our submarine hangar concepts offer conventional submarine operators a novel means to expand their operational capability.

Design change managed in partnership

Each and every naval vessel will undergo some form of modification or enhancement during the course of its career, but specifying and implementing engineering adaptations is a far from simple task given the often competing demands of varied stakeholders.

At BMT, we see design change management as a fundamental skill set. Exploiting our proficiency in the disciplines of naval architecture, marine engineering, power and propulsion, safety, regulatory assurance and environmental compliance, we offer a comprehensive capability in post-design services. This ranges from relatively minor alterations and additions through to major structural changes, refits, role conversions and service life extension programmes.

Our role in the through-life support of RFA Argus offers an able demonstration of our skills. Argus is a unique vessel, originally delivered in 1981 as a container ship but subsequently acquired from trade for conversion to an aviation training ship. She was later equipped with a hospital complex, enabling her to assume a secondary role as a Primary Casualty Receiving Ship.

Under a procurement reform initiative designed to improve the delivery of support to the UK fleet, BMT has joined with A&P Falmouth, Rolls-Royce Naval Marine and the Royal Fleet Auxiliary Support Integrated Project Team to develop a through-life partnering arrangement for Argus. Our design change management skills are being utilised as part of a ground-breaking effort to reduce in-service costs while at the same time delivering improved ship availability.

The success of this concept was proved during the ship’s recent refit and life extension. Working with our partners, we produced revised drawings and comprehensive plans for the removal and replacement of obsolete diesel generators. We also undertook extensive design work for the upgrade of Argus’s hospital facility, and improvements to her communications and aviation systems.
BMT Group is an international design, engineering and risk management consultancy, working principally in the defence, energy and environment, marine risk and insurance, maritime transport and ports and logistics sectors.

BMT invests significantly in research. Its customers are served through a network of international subsidiary companies. The assets are held in beneficial ownership for its staff.

Website - www.bmt.org