

# FOCUS

---

## Collaborative Autonomous Intelligence

Move to unmanned operations



---

Successful border control

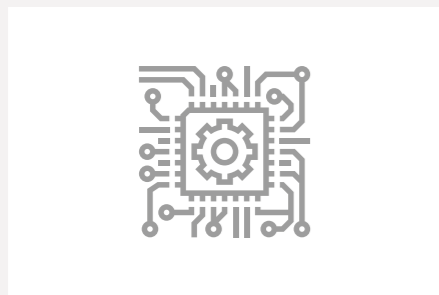


---

Trust, how much is enough?



# Contents



**4 Unmanned Marine Systems**  
BMT has been working with ASV Global on a wide range of exploratory projects to produce world class capability.

**8 Intelligent Aerial Sensor Network at External EU Borders**  
An overview to the development, and subsequent successful trials, of the SUNNY system.

**10 Pushing the Boundaries of Marine Autonomous Systems Technology**  
An overview to the five-year programme of MAS missions.

**12 Autonomy and the Fourth Industrial Revolution**  
Emma Parkin at ASV Global shares her perspective as a young professional.

**14 The Trust Paradox**  
Freyja Lockwood at Bristol City Council discusses the emerging challenges of building trust and public acceptance of autonomous systems, artificial intelligence and data-driven innovation.

**16 Overcoming the Regulatory Challenges for MASS**  
James Fanshawe, Chair of the UK's Maritime Autonomous Systems Regulatory Working Group discusses the regulatory implications of autonomous surface ships.

**18 The Fourth Industrial Revolution**  
Richard Westgarth, Head of Campaigns at BMT ponders the future for business as it considers how to adapt to 4IR.

**19 BMT in the News**  
Latest news from around the world.

FOCUS is published by:  
BMT, Goodrich House,  
1 Waldegrave Road,  
Teddington, Middlesex, TW11 8LZ, UK  
T: +44 (0)20 8943 5544  
E: enquiries@bmtglobal.com  
W: www.bmt.org

Edited by Jenni Williamson  
(jenni.williamson@bmtglobal.com)

Written by Richard Westgarth  
(richard.westgarth@bmtglobal.com)


Statements made or opinions expressed do not necessarily reflect the view of BMT. Permission for reproduction of articles in FOCUS must be obtained from the Editor.


The FOCUS mailing list is held on computer. If, under the Data Protection Act 1998, you wish to have your name removed or added, or alternatively have any other mailing list enquiries, please contact the Editor.

## Follow us

 [www.bmt.org/linkedin](http://www.bmt.org/linkedin)

 [www.bmt.org/youtube](http://www.bmt.org/youtube)

 [www.bmt.org/twitter](http://www.bmt.org/twitter)

 [www.bmt.org/facebook](http://www.bmt.org/facebook)

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

# Editorial

Welcome to the first issue of Focus for 2019. In this edition, we have selected the theme of Collaborative Autonomous Intelligence, one of our strategic campaigns. It draws together a series of articles written by a range of organisations exploring the rich seascape of perspectives covering legal, regulatory and people elements complemented by overviews of some of our projects and their achievements.



**Sarah Kenny**  
Chief Executive

## In this issue

In reviewing the material generated, I started mulling over how this theme of Collaborative Autonomous Intelligence applies to the future of BMT, looking at the three aspects:

- Firstly, Collaborative, I believe our future growth is through collaboration both internally across all our businesses, and with external partners. Key to this will be our ability to build networks that can work together.
- Secondly, Autonomous, I see our future based upon the contributions and willingness of individuals to take responsibility for their work, understanding our markets and their trends, identifying new concepts and ideas to meet these markets and building a highly innovative and delivery focussed organisation.
- Finally, Intelligent, using our breadth and depth of skills in new ways forecasting and addressing market and customer challenges, through insights and thought leadership, being unafraid to challenge the status quo and traditional thinking and shaping our future.

As we continue with our ambitious business transformation, these are the things which will make us truly special in the eyes of our customers. This edition of FOCUS serves to highlight a diversity of thought beyond the technology. Through our newly formed Innovation Strategy, I now expect to see even more challenging and interesting ideas and concepts emerge, backed by clear understanding of the business value they will deliver in increasingly dynamic and competitive markets.

The poet and philosopher Paul Valéry wrote "L'avenir est comme le reste: il n'est plus ce qu'il était" translated as "The future, like everything else, is no longer quite what it used to be", this is never truer in my view than now! As well as transforming our business we need to look at and anticipate the future as the Fourth Industrial Revolution enabled by technology develops.

I am delighted to see so many articles from outside of BMT in this edition. I am sure the articles will fascinate and inspire you, as much as they have me. I welcome the opportunity to discuss the topics in more depth, in particular where you may have alternative views, it is only through creating a diversity and depth of ideas and opinions that we will be able to guide ourselves, our customers and our partners as we march into this uncertain future.

# Unmanned Marine Systems

Working at sea can be tough. Many of us will have had the opportunity to experience the cold, the wet, the heat, the constant motions, the cramped spaces and the isolation from home life. On top of this are the dangers presented by heavy equipment, powerful machinery and the ever present risk of being knocked overboard or falling. All of this gets worse as we become tired after days, weeks or months of exposure.



## Dan Hook

Dan Hook CEng, FRINA is a qualified Naval Architect and Chartered Engineer with over 16 years' experience in the unmanned marine industry. Upon graduating from the University of Southampton, Dan worked as a naval architect on the development, testing and trials of a wide range of specialist craft.

Dan was one of the founding members of L3 ASV and prior to his recent new role as Senior Director (UK) – Business Development, Dan held the position of Managing Director and Technical Director. L3 ASV is a company at the forefront of developments in unmanned marine systems for the Military, Offshore Energy, and Science and Survey Industries.

As well as his role at L3 ASV, Dan maintains an active role in industry. He is currently the Chairman of the Maritime Autonomous Systems (MAS) Council run by the Society of Maritime Industries, and is a member of the Solent Marine and Maritime Steering Group. He is an active participant in marine robotics conferences, workshops and future strategy. Contact: [dan.hook@asvglobal.com](mailto:dan.hook@asvglobal.com)





Significant improvements have been made over the years. Designs have become inherently safer, training has developed, and risk analysis and project planning have removed some of the dangers at source.

#### Giant Leaps

In the 21st Century we now have the technology and understanding to make one of the largest ever steps forward in the maritime industry. That is the move to unmanned operations at sea where we can significantly cut the number of people exposed directly to dangers and place them in safe remote operations centres.

This will come with added advantages in operational efficiency, management, shift working and persistent accuracy that unmanned systems offer.

On top of this, the design freedom of reduced manning requirements will allow for smaller or more space efficient vessels, reducing fuel consumption and build costs.

In many roles it is now feasible, today, for the vessel to be completely unmanned, with nobody on board or at risk, and a remote operations centre running the vessel. Indeed there are some roles where this is unlikely to ever be the case and people will remain at the very centre of operations offshore.

This suggests there is also a 'middle ground' where some roles are completed remotely and the crew count onboard is reduced, along with the risk exposure.

#### Who Does What

The discussion topic of which role belongs in which category will always be a contentious one, especially with the added complexity of location, environment, regulation and operational details.

A list of examples of which L3 ASV has some experience or evidence for classifying is provided on the next page for discussion. A general observation from L3 ASV is that the left-hand column (feasible today) is growing fast and the right-hand column is shrinking as people open their minds to the potential offered by remote machinery, robotics and autonomy.

#### Whole System Safety Engineering

To ensure that the roles that are feasible today, and the lean manning opportunities are maximised, it is important that whole system safety engineering is rigorously applied. The latest in sensor processing, system monitoring, data analytics and digital world model development will need to be exploited.

L3 ASV Global has been working with BMT on a wide range of exploratory projects to see how we can combine our expertise in these areas to produce a world class capability in this rapidly developing market.

As well as business development opportunities these projects also include some InnovateUK partially funded R&D work;

- **The Synthetic Imagery training for Machine Vision in Extreme Environments (SIMVEE) project** will build upon L3 ASV's existing, COLREG cognisant, autonomous collision avoidance and path planning capability in its ASView® system.

The project will use BMT's REMBRANDT simulator to train and validate L3 ASV's vision algorithms to detect and classify objects at sea.

- **The Shared Waterspace Autonomous Navigation by Satellite (SWANS) project** will, for the first time, enable beyond line of sight, over the horizon, autonomous behaviour by unmanned surface vessels in areas of congested maritime traffic.

The project team will focus on four main objectives including: exploiting satellite sensing technology and enabling the delivery of a higher fidelity world model for vessel

operators/supervisors; simulating new scenarios for L3 ASV operations; combining, for the first time, L3 ASV's autonomous vessel control simulator and BMT's REMBRANDT ship manoeuvring simulator into a single suite capable of visualising different datasets in 3D and to evaluate new multi-vessel conflict scenarios in the real-world.

If any of the readers have interest in their businesses or sector for either completely unmanned or reduced manning opportunities, please contact the world class team at BMT / L3 ASV to discuss further.

## Examples:

**Feasible roles for complete unmanned operations today.**

Hydrographic Survey Launches  
 Small open ocean data gathering platforms  
 Acoustic positioning / communications vessels in Oil and Gas operations  
 Oil spill response / boom boats  
 Weapons training targets  
 MCM vessels (sweep, hunt, dispose)  
 ASW Barrier vessels  
 Small, dedicated ISR platforms

**'Middle Ground' roles that are suitable for lean or reduced manning through the application of remote or autonomous technologies.**

Warships  
 ROV ships  
 Deepwater survey vessels  
 Standby tug roles  
 Short sea freight  
 Short sea / inland water ferries  
 Offshore supply vessels

**Vessels / roles likely to have a high level of human involvement onboard for the foreseeable future.**

Large open sea RORO passenger ferries  
 Cruise Ships  
 Fishing vessels

*Note to reader: what else do you think will remain largely unchanged for a long time, with the same or more crew count?*



Contact:  
**Dan Hook**  
 dan.hook@asvglobal.com  
 Phil Thompson  
 phil.thompson@bmtglobal.com

# Sunny

SUNNY stands for **S**mart **U**nattended airborne sensor **N**etwork for detection of vessels used for cross border crime and irregular entry.

The European Union faces a major problem with control of its border, due to its length and because it is partially on land and partially over sea. Currently, the EU is trying to counter illegal incursions, border crossing and illegal entry, using legacy sensors and communications systems that were developed for military applications and which are not optimised for border monitoring, having limited interoperability with civil standards.



In the FOCUS edition of January 2017, we highlighted the SUNNY Programme, the development of a new intelligent aerial sensor network to monitor the external borders of the EU to combat cross-border crime and prevent the loss of migrant lives at sea.

The project has now been successfully completed, demonstrating an aerial sensor network with improved sensor and data transmission capacities and real-time data processing capabilities, to improve the effectiveness of the EU border monitoring compared to the legacy systems.

SUNNY demonstrated the integration of sensors, multiple UAV platforms, and a base station with interfaces with other border control systems. As part of the programme, performance and qualification tests were conducted on a range of different sensor technologies, including infrared, hyper-spectral and radar sensing. The data collected from these sensors was combined in a fusion module.

The solution included on-board data processing with an automated target identification module developed to effectively exploit information collected from the sensors.

Specialist aids were developed to assist the mission controller in selecting and reacting to threats, by combining information from UAV sensors, behavioural models of potential targets, environmental sources (including AIS, weather data and geometric queries), and confirmatory user interaction.

BMT successfully coordinated the project and oversaw the development of the SUNNY base station and the related data processing and visualisation. The base station brought all the information in the system together enabling it to be analysed and shown to a mission controller. It included data fusion and machine learning algorithms to process the information from multiple sensors and detect vessels and threats.

The system learned and improved over time taking feedback both from other sensors in the system and the user.

The base station offered the user with several visualisation options, including a 2D map based interface that provided the position of any assets and sensor information as well as 3D live representations of the UAVs and a full VR mission control station.

The system was fully trialed and demonstrated in the Spring of 2018, in Sao Jacinto Portugal. The trials saw 4 different UAVs in the air detecting vessels at sea. The trials proved the concept of SUNNY in an operational environment and gave the user team experience of the challenges of running and operating the SUNNY system in a real-world environment.

Contact: [richard.westgarth@bmtglobal.com](mailto:richard.westgarth@bmtglobal.com)

# MASSMO

## (Marine Autonomous Systems in Support of Marine Observations)

### Pushing the boundaries of new MAS technologies

MASSMO is a five-year programme of annual MAS demonstrator missions that brings together defence, industry and research partners to push the boundaries of new MAS technologies.

MASSMO is co-ordinated by the National Oceanography Centre (NOC), but also engages a wide range of 1) industry partners looking to trial novel MAS platforms and sensors (e.g. Autonaut, Seiche, ASV, ecoSUB, RS Aqua), 2) operational partners providing supporting remote sensing, model and oceanographic data (e.g. Met Office, Plymouth Marine Laboratory), and 3) research partners exploiting the data for scientific research (e.g. University of East Anglia, Scottish Association for Marine Science).

To date, the programme has focussed on defence applications, with Dstl being the primary sponsor, and Royal Navy and NATO-CMRE as key partners.

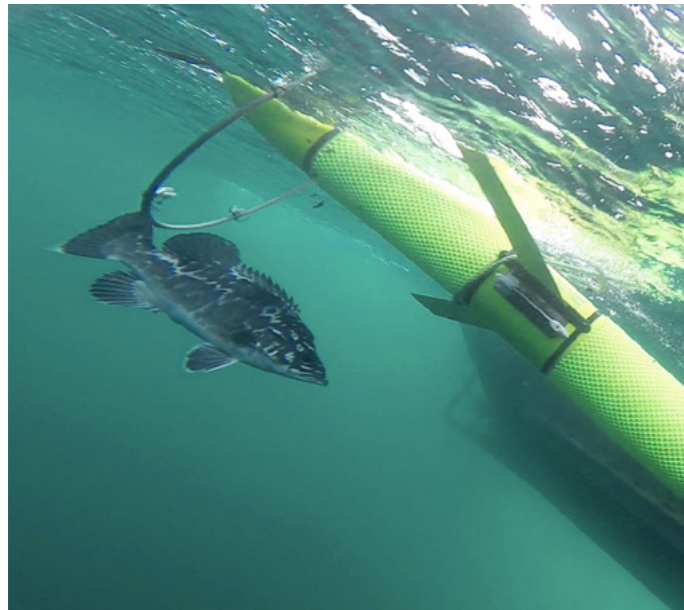


**Professor Russell Wynn**  
NOC Associate Director

Professor Russell Wynn is NOC Associate Director for Government, International and Public Engagement, and Chief Scientist for Marine Autonomous and Robotic Systems (MARS). He leads external engagement for the ongoing £30M of UK Government investment in the MARS fleet (including 'Boaty McBoatface'), and is co-ordinator of the annual 'MASSMO' series of demonstrator missions for UK Marine Autonomous Systems that are sponsored by Dstl and include CMRE, Royal Navy, UKHO, Met Office, and several industry and research organisations as partners; these missions have involved the largest mixed fleets of MAS to be deployed in UK waters. Russell was previously Head of NOC Marine Geoscience at NOC, and has published over 100 peer-reviewed science papers on topical marine matters, including novel use of MAS technologies. Russell is an Honorary Professor at University of Southampton, where he completed his PhD in marine geoscience in 2000.

Contact: [rbw1@noc.ac.uk](mailto:rbw1@noc.ac.uk)





The MASSMO missions are focussed on dynamic offshore environments in UK waters, targeting physical and biological features such as oceanic fronts, eddies, thermoclines, plankton blooms and vocalising marine mammals. A primary aim of the programme is to test mixed MAS fleets comprising unmanned surface vehicles (USVs), submarine gliders and micro-AUVs.

These vehicles carry standard oceanographic sensors to measure simple physical and biological properties such as temperature, salinity, oxygen and chlorophyll fluorescence, but also more advanced sensors such as passive acoustic monitors, meteorological sensors, onboard cameras, and acoustic doppler current profilers.

A key feature of MASSMO has been the generation of real-time and near-real-time data that are transmitted via satellite back to a central Operations Room based at the NOC, where partners can use it to assess progress and modify the mission plan.

An online mission portal allows vehicle locations and tracks to be compared with key environmental data layers, such as satellite images, seafloor bathymetry, tidal and geostrophic current vectors, and AIS vessel data; this ensures safe and efficient operation of the vehicles, and facilitates data fusion in order to generate the 'Best Composite Picture' of the studied area. All data are then archived at the British Oceanographic Data Centre, and made available for research applications.

MASSMO missions have featured on BBC TV News and various other media, and have therefore played an important role in promoting the environmental benefits of MAS to the public and the wider maritime community. Future MASSMO missions are due to target Arctic under-ice environments, and will see new platforms such as long-range AUVs being deployed.

The ultimate aim is to use these new technologies to better understand the rapidly changing Arctic environment, for the benefit of the UK science, industry and defence communities.



**Emma Parkin**

**Technical Sales Support Engineer, ASV Global**

Emma studied a masters of Chemical Engineering at the University of Sheffield and then spent 2 years on the QinetiQ graduate scheme. During her graduate scheme she spent time with the Maritime Autonomy Team, attending Unmanned Warrior and had secondments to the MHC team at DE&S, the Information Warfare team at NCHQ and the Modelling and Simulations team at CMRE (NATO). She now works for L3 ASV as a Technical Sales Support Engineer.

## Autonomy and the Fourth Industrial Revolution

### A young professional's perspective

As a young professional working in the autonomy field in the midst of the Fourth Industrial Revolution (4IR) I've been inspired, enthused and unsettled about what the future might hold. Why unsettled? It took millennia for the agricultural revolution to take hold, a century for the industrial revolution and only decades for the digital revolution. It is natural to feel unsettled about the speed at which the 4IR is taking hold and the changes this means for society.

However, being able to work at the front line of these technologies has removed any nervousness I might have had about the changes to come and replaced it with excitement. I have seen technologies I thought only existed in movies. The 4IR will see the physical, digital and biological sectors converge at an exponential rate which makes predicting even the near future a challenging task.

In this near future, we will see a world where a surgeon could carry out an operation from the other side of the world, drones which can guide cars to parking spots, reducing congestion by 30%. User manuals will become 'smart' so you can ask 'is this the right setting?' and then take it one step further by connecting to live data, adjusting the answer depending on the current situation such as environmental conditions.

But what does this mean for the maritime industry that I work in? We are seeing progression and innovation happen at an unprecedented pace, leaving many businesses, governments and industries behind.

With local remotely operated vehicles already in use across industry, it will not be long before fully autonomous ocean-going vessels are in operation. The 4IR is poised to transform the maritime sector into one we would not recognise today.

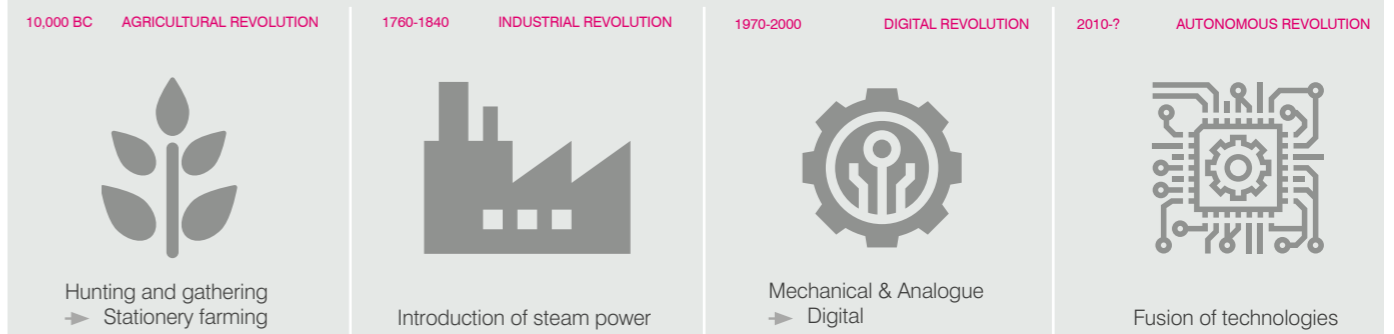
**Autonomous Surface Vehicles (ASVs)** are innovative solutions offering attractive economic advantages, improved safety conditions and environmental benefits. Combined with algorithms allowing autonomous optimised route designs, operating conditions and logistic chains, autonomy has the power to revolutionise the maritime sector.

**Autonomous boats** are already surveying the sea bed and coastal waters and being implemented successfully across a range of industries. Soon we will see autonomous systems dealing with oil leaks, or unmanned boats carrying out rescue missions.

They are able to work around the clock and remove the need to have people working in dangerous environments.

Working in the autonomy industry I have realised the constraints of the past are no longer relevant. We all have a part to play either as civilians, companies, consumers etc. We have the power to guide the 4IR through the decisions we make every day. Embrace the innovation and disruption brought by it. The future 10 years from now will be unrecognisable to the one we live in today, isn't that amazing?

Contact: [emma.parkin@asvglobal.com](mailto:emma.parkin@asvglobal.com)



# The Trust Paradox

## How much trust is enough?

As the adoption of autonomous systems, artificial intelligence and data-driven innovation to develop 'smart cities' accelerates, an emerging challenge is building trust - one of trust and public acceptance. These technological advancements are beginning to solve some of our most intractable problems and shaping nearly all aspects of our daily life.

### Polarised

Yet they are viewed as a double-edged sword. This duality is clearly reflected in the media, either the narrative is one of utopian optimism where technology is the silver bullet, or it heralds a nightmare future of unintended consequences and societal breakdown.

Neither of these polarised views are helpful, but they highlight the important role that perception plays in the development of these technologies and their ultimate impact on public acceptance.

They point to some fundamental questions that we should be exploring to understand how to develop 'trusted' systems and how to unlock the immense opportunities digital innovation could bring.

### The Trust Paradox

What I want to briefly explore is the emergence of a 'trust paradox'<sup>1</sup> associated with new, unfamiliar technologies and the implications for emerging technology.

A recent article noted that "people are both increasingly dependent on, and distrustful of, digital technology"<sup>1</sup>. Yet here is the paradox: despite our wariness we do not, for the most part, shun technology, quite the contrary we are embracing it.

To illustrate, take two voice-activated virtual assistants, Apple's Siri and Amazon's Alexa, as examples. Despite on-going, high-profile debates about privacy concerns and publicity about 'rogue' devices<sup>2</sup> we are, for the most part, still enthusiastically adopting these life aids. We appear to be consciously choosing to 'trust' these devices.

However, the concept of trust is a complex thing to unpick. It is inherently fluid, dependant on many contextual factors and innately personal.

### An Invasion of Privacy?

Returning to the story of the rogue digital assistant, the owner had accepted the manufacturer's claims that Alexa would not invade her privacy<sup>2</sup>. Was this trust a conscious choice? Probably not, we are more often weighing up how useful we think something is, tolerating less than perfect systems when the overall usefulness of the solution outweighs other considerations. This highlights how vital it is to understand what solutions people will value.

### When Trust is Lost

We stop trusting and start questioning when something triggers our distrust, such as when a private conversation is recorded then emailed to a contact without our explicit permission.

Often it is only then that we consciously weigh up perceived benefits against perceived risks and revise our original choices. Once lost, trust is fiendishly difficult to regain - as the owner of the misguided stated: "I felt invaded... I'm never plugging that device in again because I can't trust it."<sup>2</sup>

Contributing to this scenario is a common pattern of significantly overplaying the advantages of technology whilst understating the limitations. Unfortunately this can lead to a belief that technology is infallible, making us less forgiving when the inevitable happens.

It can be easy to overlook the importance of user-centred approaches in our race to implement new technology cost-effectively, but we risk jeopardizing our goals by doing so.

Ultimately the goal of digital innovation is to change people's behaviour and encourage new habits - be that in a team, an organisation, or a city. Therefore success is not simply about resolving technical challenges, but to address the social aspects associated with technological innovation.

For example, how to actively build trust through design, develop inclusive solutions to increase adoption, or address concerns around data use with transparent systems and what constitutes acceptable use.

### Understanding the Impact

Fundamental to this will be greater understanding of the public impact as well as a better understanding of what influences our willingness to engage with and trust new technologies.

User-centred design, with people at the heart of technology development process, is vital especially in a smart city context such as Bristol (where our focus is), where generating greater social value is set alongside economic benefits. The need to consider societal acceptance, especially during the early phases of design and development, whilst the technology is still 'novel', will require greater partnership and collaboration between all stakeholders involved in technological change - from innovators, technology providers and citizens, through to investors, regulators and policy makers.

Each brings diverse perspectives and know-how that can usefully inform the design, development and deployment of trusted digital solutions.

<sup>1</sup> Chakravorti, B. (2018). 'Trust in digital technology will be the internet's next frontier, for 2018 and beyond'. *The Conversation*, 4 January 2018, <https://theconversation.com/trust-in-digital-technology-will-be-the-internets-next-frontier-for-2018-and-beyond-87566>.

<sup>2</sup> Wolfson, S. (2018). 'Amazon's Alexa recorded private conversation and sent it to random contact'. *The Guardian*, 24 May 2018, <https://www.theguardian.com/technology/2018/may/24/amazon-alexa-recorded-conversation>.



### Freyja Lockwood

Freyja leads Bristol City Council's City Innovation Team. Along with city-wide partners, the team is exploring, developing and implementing 'smart', citizen-centred solutions to improve their city space. As a chartered Human Factors specialist and systems thinker, Freyja brings a people-centred approach to technology-driven change. In 2017, she co-authored the widely cited Global Marine Technology Trends 2030 Maritime Autonomous Systems that explored the potential impact of emerging technology on the maritime sector.

Contact: [freyja.lockwood@bristol.gov.uk](mailto:freyja.lockwood@bristol.gov.uk)



### Citizen-centred Digital Solutions

Here in Bristol, as a leading digital city, our focus is on using technology, data and civic innovation for public good. Trust-worthy, inclusive, citizen-centred digital solutions are central to our ethos.

Bristol City Council's City Innovation Team, along with our city-wide partners, are exploring, testing and implementing pragmatic 'smart' solutions to address issues relating to health and social care, waste management, highway maintenance, mobility, governance, inclusive growth and connectivity.



# Overcoming the Regulatory Challenges for MASS

## A UK Approach

### James Fanshawe



Chair, UK Maritime Autonomous Systems Regulatory Working Group

James Fanshawe retired from the Royal Navy in 2005. An Anti-Submarine warfare specialist, he commanded HMS HURWORTH, CLEOPATRA AND FEARLESS and was the Commander United Kingdom Task Group and Commander of the Devonport Flotilla. He held several senior appointments ashore including Director of Plans at the UK Permanent Joint Headquarters.

James works within a mixed commercial portfolio, chairing several companies and organisations. He chairs the UK's Maritime Autonomous Systems Regulatory Working Group on behalf of the Marine Industries Alliance. This group released a Code of Conduct for the safe operation of Maritime Autonomous Surface Ships (MASS) and has now published a Code of Practice for MASS, having prepared the proposal submitted by the UK to the International Maritime Organisation in February 2017 for a regulatory scoping exercise for Maritime Autonomous Surface Ships. He is a member of the UK Maritime Autonomous Systems (MAS) Steering Group and the MAS Council.

Contact: james.fanshawe@ukmarinealliance.co.uk

The UK has been at the van of progress for Autonomous vessels, no more so than addressing regulatory issues. Whilst there are challenges to be overcome, there should be no barriers to progress; there is very broad consensus that this must be achieved.

The UK Maritime Autonomous Systems Working Group has been meeting for the last four years and has produced Industry Codes of Conduct and Practice for Maritime Autonomous Surface Ships (MASS) which are available at <https://www.maritimeuk.org/mediacentre/publications>.

The UK produced the key submission to the International Maritime Organization which triggered the Scoping Exercise now underway at IMO, with its supporting Correspondence Group. The aim of the Scoping Exercise is to determine how safe, secure and environmentally sound MASS operations might be addressed in IMO instruments.

The objective is to assess the degree to which the existing regulatory framework, under the purview of the MSC, may be affected in order to address Maritime Autonomous Surface Ships (MASS) operations. The target completion year for the Scoping Exercise is 2020.

There is considerable work to be done; the IMO Scoping Exercise and other related work is the start of a process.

There is much debate about MASS around the world, notably on the complex subject of definitions. In reality, the development and operation of MASS is moving at a faster pace than the regulatory process; the advent of Yara Birkeland at sea in 2020 is a good example. This may present a degree of concern, not least if nations develop their own independent practices.

We should not assume that MASS will only operate within the jurisdiction of individual nations. Not only can they be found on the High Seas today, but they will increasingly transit between nations; short-sea operations will be the expected norm during the early years of the IMO work.

The key challenge is to dovetail the reality of MASS with regulatory outcomes, whilst not impeding progress. We must be patient whilst IMO do their work. Strong communication, flexibility, and acceptance of the full implications of equivalence will reap great benefits for the safety and efficiency of the maritime community.

The IMO preliminary definition of MASS is defined as a ship which, to a varying degree, can operate independent of human interaction. IMO have set four initial degrees of autonomy for their work:

1. Ship with automated processes and decision support - Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated.
2. Remotely controlled ship with seafarers on board - The ship is controlled and operated from another location, but seafarers are on board.
3. Remotely controlled ship without seafarers on board - The ship is controlled and operated from another location. There are no seafarers on board.
4. Fully autonomous ship - The operating system of the ship is able to make decisions and determine actions by itself.

It will be interesting to see how these definitions are adapted, as well as those of the Classification Societies.



# Upon Reflection

Richard Westgarth reflects on the Fourth Industrial Revolution

**In compiling the varied articles from our contributors, I have been struck by the breadth of the topics and thoughts that have emerged from a very loose brief. The diversity of thought that Sarah noted in her introduction is more than ever needed now.**

We have an enormous breadth and depth of capabilities within BMT that we are bringing together under our Collaborative Autonomous Intelligence Campaign. We want to be seen as the leading organisation delivering innovative ideas that deliver capability to the user, and market growth to industry and academia, by establishing methods and standards to deliver integrated capabilities.

The BMT Collaborative Autonomous Intelligence Campaign is identified in our BMT Strategy as one that requires to be managed across the breadth of BMT and provide significant opportunities in support of the growth targets.

Our vision for BMT in this field is to build an international capability to pursue high value opportunities as they emerge.

As the technology matures, BMT's independence will make us the natural choice to work on programmes, collaborating with the user, industry and academic enterprise to rapidly influence current and future challenges. We are establishing BMT as an influential and capable organisation through thought leadership and developing a clear presence in the market.

The Fourth Industrial Revolution will create opportunities that, as of now, are unimagined, it will change the nature of work, organisations and business models.

We must ask ourselves whether we are ready to take up the challenges that will transform our businesses.

Whilst the main topic has been on Collaborative Autonomous Intelligence, it must be remembered that this is only one area of technology that forms this 4IR. We could add advanced manufacturing, materials, quantum and the Internet of Things to select just a few.

Taken together we should expect to see increasing levels of innovation and disruption, today's young professionals such as Emma have an exciting future ahead.

As James's article on regulation demonstrates, here in the UK, we are in the van on addressing the challenges posed in the introduction of these systems, working with international partners to overcome the challenges in the maritime applications.

We have given significant thought on the future role of people in this new world. Dan's article talks about the difficulties of working at sea, Freyja's looks at issues of trust in the public acceptability of the autonomous systems and the need to adopt a people centred approach.

As business people engineers and scientists, we see the technology as the big opportunity. The business gains are to increase productivity, lower operating costs, drive up economic value. But we need to recognise that it is also seen by some as an existential threat to societies, communities and jobs.

We should ask ourselves, have we given enough thought to the impact upon our societies and people? We will need to look at new careers, training and development methods, new management science and organisational constructs, ensuring we create jobs and roles that meet people's expectations.

From a personal view, I believe we should expect to see a very rapid acceleration of the 4IR, whilst the first industrial revolution took over 150 years, we should expect the 4IR to last for a few decades characterised by the rapid exploitation of emergent technologies and business models.

Perhaps now is the time to start considering what a Fifth Industrial Revolution may be, perhaps created by developments in biological rather than physics based science?

Contact: [richard.westgarth@bmtglobal.com](mailto:richard.westgarth@bmtglobal.com)

## Richard Westgarth



Richard is Head of Campaigns at BMT, with a particular focus on Collaborative Autonomous Systems. A co-author of the Global Marine Technology Trends 2030, Richard is currently looking at the impact the fourth industrial revolution will have on the maritime sector. He is a Chartered Electronics Engineer, a Member of the IET, a Fellow of the Royal Institute of Naval Architects and a Fellow of the Royal Society for Arts, Manufacture and Commerce.

# News

## Aurora partnership to help transform defence engineering services

### AURORA ENGINEERING PARTNERSHIP

QinetiQ | Atkins | BMT

The Aurora Engineering Partnership (BMT, Atkins and QinetiQ) has been appointed by the Ministry of Defence (MOD) as their Engineering Delivery Partner for Defence Equipment & Support (DE&S).

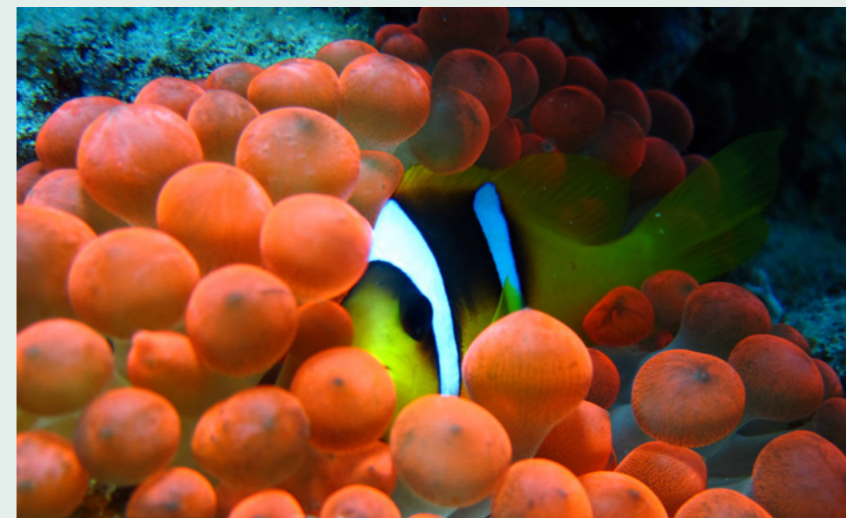
The partnership will help the MOD to reduce costs of their engineering services, while ensuring the UK's Armed Forces receive the best equipment and support. Another key element will be driving innovation from across industry and academia.



### BMT and Sonardyne to deliver subsea monitoring step-change

BMT and subsea technology company Sonardyne International Ltd. have signed an agreement to provide advanced integrated marine integrity monitoring solutions to the oil and gas industry.

The official Teaming Agreement will allow the two companies to collaboratively provide smarter, more efficient through-life solutions for monitoring and managing critical subsea assets, including drilling and production risers, moorings and wellheads.



### BMT and University of Queensland Team to Help Save Great Barrier Reef

BMT and the University of Queensland have secured funding to develop an approach that will help to boost coral abundance on the iconic Great Barrier Reef.

The \$2 million challenge funded by both the Queensland Government and the Australian Government through the Advance Queensland Small Business Innovation Research programme, was introduced to seek out novel solutions which will boost coral abundance and restore reefs exposed to the impacts of a changing climate.

### BMT Wins Prestigious Engineering Excellence Award

The Queensland Division of the Australian Engineering Excellence Awards 2018 has recognised BMT and Aurecon, with the prestigious RJ Hawken Award for their work on the Brisbane River Catchment Flood Study.



Phil Haines, Regional Managing Director, Environment at BMT, said: "The Brisbane River Catchment Flood Study is a global benchmark for contemporary hydrologic and hydraulic analysis, and is based on BMT's internationally recognised flood modelling software, TUFLOW."

### BMT Acquisition Strengthens Submarine Capability

BMT has purchased niche submarine design, engineering and assurance firm, Effectiva. Based in Australia and France, Effectiva employs some of the best submarine experts in the industry.

This acquisition is a statement of confidence by BMT in the continued development of Australia's sovereign shipbuilding industry, significantly boosting the company's local submarine expertise.



### BMT Acquires OBEG Fire Investigators

BMT is pleased to announce the acquisition of OBEG Fire Investigators. OBEG is the Netherlands' most recognised fire investigation group, founded and built by Erik Overtoom who has over 25 years' experience in forensic fire investigation of public property, industrial and marine fires. Erik is also head of the Dutch chapter of the US' most prestigious IAAI (International Association of Arson Investigators), and head lecturer at the Dutch Fire Academy. OBEG is often called as an expert witness in criminal and civil courts.



Credit: Sinot Yacht Architecture and Design



## Lateral Naval Architects launch new innovative projects

Lateral Naval Architects (a collaboration of BMT and Oceanco) has launched new and innovative naval architecture for two yacht designs to the market.

**Balance** is a 102-metre superyacht developed in collaboration with Sinot and Oceanco, Project "Balance" showcases technical innovation for real-world benefits: more space, increased efficiency and exceptional performance.

Explaining the engineering design philosophy behind the project, Lateral's Managing Director, James Roy, states that as the name implies, balance is, indeed, at the very heart of the vessel. "We do not live in a linear world," Roy explains.

"The world is in balance, our earth and its ecology act as a coordinated system to maintain the balance of nature and a state of equilibrium.

A small change in a seemingly benign parameter is balanced out by another to ensure the complex system remains in balance.

Balance, then, is the inspiration for our project. Project "Balance" is a yacht with a natural balance of proportion, form and space - achieved by taking inspiration from the laws of nature and asking new questions."

Credit: Tom van Oossanen



**Bravo** is Oceanco's first project built according to a new design and build philosophy called LIFE (Lengthened, Innovative, Fuel-efficient and Eco Friendly) Design. LIFE Design incorporates these fundamental aspects into an intelligent naval platform that together offers a balanced environment on board between technical and guest spaces.

Lateral Naval Architects' Director, James Roy explains: "The LIFE Design's use of advanced hybrid propulsion incorporating significant battery capability, combined with a single tier engine room allows novel use of space to deliver areas of outstanding luxury.

## First 'Futures Maritime' workshop with Keynote Speech from BMT



Richard Westgarth, BMT's Head of Campaigns, recently delivered a keynote speech at Maritime UK's first 'Futures' workshop, to discuss the likely skills implications of the rapidly changing technological landscape across the maritime sector, and the early futures focus on skills.

Richard Westgarth, Head of Campaigns at BMT and Maritime UK Futures Programme coordinator said:

"We have skills shortages, we see trade changing and we've seen the impact of the potential of Brexit starting to come through," he says. "I think there's a real energy now within the industry from academia, companies and the sector is really take control of this and drive it forward. The UK government's Maritime Growth Study and subsequent review paper have been key points driving that."



## BMT Wins Consulting Engineering Contract in Thailand to Support Royal Thai Navy Midget Submarine Programme

BMT, the leading international design, engineering and risk management consultancy, has been awarded a contract to support the Royal Thai Navy's (RTN) new midget submarine programme from its offices in Bath, UK.

BMT has been contracted to recommend submarine-specific engineering management best practice to help the RTN minimise risk during the design phase. BMT's UK defence businesses have supported the UK's in-service submarine fleet and submarine design programmes since 1993.

BMT has acted in a client advisory capacity to several overseas governments, and also supports domestic submarine acquisition and in-service support programmes from its offices in Australia and Canada.

## BMT's Maritime Simulator REMBRANDT Receives Full Mission DNV Certification for its Integrated Simulator Solutions

REMBRANDT, BMT's industry-leading integrated navigation and manoeuvring simulator suite, has been awarded Class A, B and C certification from DNV GL. The certification further builds on BMT REMBRANDT's 30-year history as one of the maritime industry's most recognised, advanced project engineering support tools, supporting marine pilotage, ship operations, port design and risk management associated with complex transportation infrastructure systems.

Dr Phil Thompson, Director of Simulation and Training Products at BMT comments: "The combined DNV GL Class A, B, C and existing S certifications reflect that our simulators provide the highest levels of physical and behavioural realism. Our new generation of fully-certified simulation technology is more versatile, hydrodynamically accurate, visually superior and all at a significantly lower cost, thus widening the support and benefit that we already provide to our existing customer base."



# Events



**Maritime Autonomous Systems Conference, London, UK**  
**17 - 18 January 2019**  
Keynote Speech to be presented by Sarah Kenny, BMT Chief Executive



**Society of Maritime Industries Annual Conference 2019, Portsmouth, UK**  
**The UK Maritime Enterprise: Implementing a National Shipbuilding Strategy**  
**20 - 21 February 2019**  
Sarah Kenny, BMT Chief Executive to deliver a talk on the importance of maintaining a sovereign design capability.

## On the move



**Sarah Kenny**  
Announced as Vice Chair of Maritime UK

Maritime UK is the sector's umbrella body, bringing together the shipping, ports, services, engineering and leisure marine industries to drive growth by promoting the sector, influencing government and fostering collaboration. The sector supports just under 1 million jobs and contributes around £40bn to GDP. Commenting on her appointment, Sarah Kenny said: "This is a hugely exciting time for the UK maritime sector, with the launch of the National Shipbuilding Strategy, green shipping initiatives, the emerging Maritime Sector Deal, and of course the forthcoming Maritime 2050 strategy. I am honoured and thrilled to take up the role of Vice-Chair at Maritime UK.



**Dr Mack Zhang**  
BMT Appoints New Transportation General Manager in China

BMT has appointed Dr Mack Zhang as General Manager of transportation who will be based in China. Mack has nearly 30 years' experience in the transportation market, taking the role of Technical Lead for several major rail projects in the region and working closely with key stakeholders helping them to address the globalisation of the industry.



**Anup Vittal**  
BMT Hires New MD in India

BMT has appointed Anup Vittal as Managing Director in India. An Aerospace and Defense industry veteran, Anup has over 28 years' experience working in both the private and government sectors. Anup joins BMT following his most recent role as an industry expert and external consultant with Ernst & Young and prior to this, as Managing Director and Member of the Board at Safran Engineering Services India.



**Doug Webb**  
BMT Appoints Doug Webb As Non-Executive Director

BMT has appointed Doug Webb as an Independent non-Executive Director. He joined the Board on 1 October 2018. Doug brings a wealth of relevant sector and corporate financial management experience, having served in Board roles for listed companies for more than twelve years. He is currently Chief Financial Officer of Meggitt Plc, a global engineering company operating in aerospace, defence and selected energy markets, with annual turnover of approximately [£2.03 billion].