



Ministry
of Defence

Defence Innovation Priorities

Accelerating commercial opportunities to solve Defence's most pressing challenges

Defence Innovation Directorate
September 2019



Foreword



Our Armed Forces face significant challenges with a strategic environment that is increasingly threatening including our adversaries investing heavily to erode our military advantage.

As the world changes, so must we. We are responding with a bold and ambitious innovation initiative - to embed innovation across our organisation and transform the way we think and operate.

With the civil sector driving rapid technological, social and cultural change, we are seeking new partnerships between civil and defence sectors. Bringing the best of our respective ideas, experiences and resources to deliver new outcomes, for our mutual benefit.

This document sets out our priorities for innovation. They are where our most pressing problems overlap with what can be addressed through collaboration with the civil sector. Not just technological innovation but also innovative policy, practice and process.

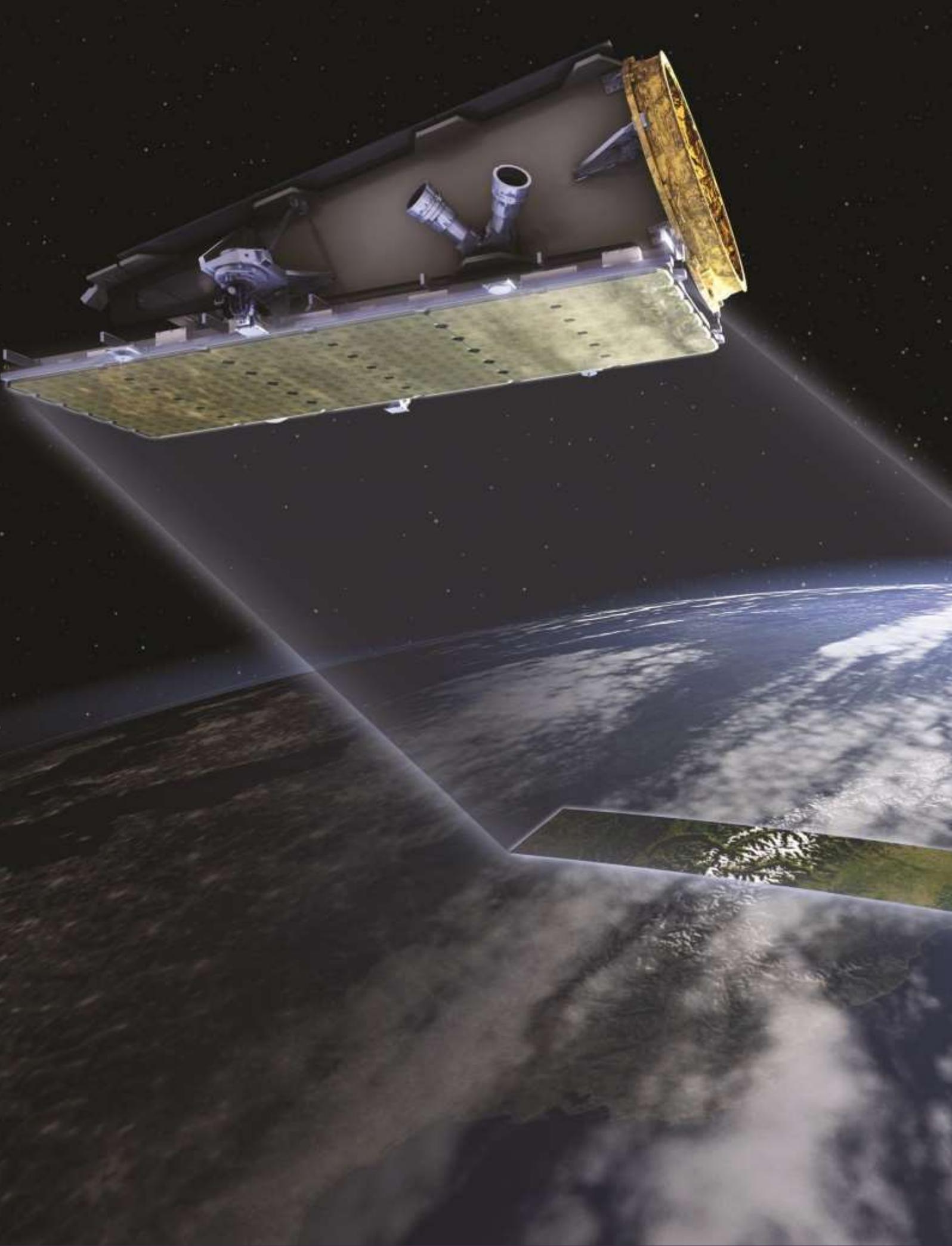
By publishing these Priorities, we want to establish a range of new relationships, harnessing ideas from outside our traditional boundaries - quickly and affordably - to mobilise, modernise and transform the MOD and the Armed Forces.

The Defence Innovation Priorities – along with the Defence Technology Framework, which we are publishing simultaneously – are central to our response to the threats facing Defence. They will be used to drive rapid change in the way we operate and the technology we use. This will be supported by changes to our acquisition and commercial processes, which will make it easier to do business with us and help us to develop and embed novel approaches to rapid capability development.

We are seeking the best of the civil and defence worlds, to pursue new possibilities and solve common problems.

A handwritten signature in black ink, appearing to read 'Ben Wallace', written in a cursive style.

The Rt Hon Ben Wallace MP
Secretary of State for Defence



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Introduction

Strategic context

“Innovating in not only what we are delivering but also how we are delivering.”

When we launched ‘Advantage through innovation: the Defence Innovation Initiative’ in 2016, we identified that we needed to develop:

- **a strategy-driven approach** that provides clear strategic direction to the Department, the component parts of which will remain primarily responsible for delivering innovation;
- **a broad and systematic approach** that seeks to embed innovation throughout the Department’s organisation, workforce, processes and culture. That includes better integration of military concepts, emerging technologies and capability development;
- **a culture that is ‘innovative by instinct’** by incentivising behaviours that we value. Such a culture emphasises the willingness – indeed expectation – to accept risk responsibility across the enterprise;
- **an open innovation ‘ecosystem’** that capitalises on innovative expertise in MOD and other national security departments. That builds effective, productive partnerships with innovators in industry and academia, as well as with important allies; and
- **the ability to accelerate promising innovations** from idea to solution, quickly and affordably.

In Defence, innovation means generating ideas and putting them into practice. Technology innovation is vital, but we also recognise that we need to be innovative in the way we do things. Our approach includes exploiting existing products, services, and processes from parallel sectors, and adapting ready-made solutions for Defence, for rapid impact.

Success so far

In 2016, we announced a new Defence Innovation Fund of around £800 million over ten years. It supports the Defence Innovation Initiative by incentivising changes in behaviours across the Defence enterprise, providing freedoms to pursue and deliver innovative solutions, and helping to overcome identified barriers to the realisation of the Initiative as a whole.

So far, we have invested over £100 million; from across the Defence Innovation Fund, the Chief Scientific Adviser's Research Programme and the Front Line Commands.

The majority has been invested through the Defence and Security Accelerator (DASA), via external themed and open innovation challenges primarily with small and medium-sized enterprises (SME) or academia.

These investments address some of our most pressing problems, with some funded projects now reaching maturity and getting new capability into the hands of users.

How we are building on this

We know that getting innovation right in large enterprises such as ours is hard – it requires a clear vision, strong leadership, and thoughtful organisational design.

However, across Defence there is now a vibrant innovation community. The Front Line Commands are embracing change and investing in innovation, setting up experimentation and trials units, conducting exercises with industry, establishing centres of expertise and engaging in internal ideas' schemes.

We are now on the journey towards creating a strong culture of innovation, placing innovation at the heart of our business and providing a powerful example to others. And we know we must continue to explore new avenues to achieve strategic advantage.

We must be clear about what our priorities are and why they are important. We must explain the particular problems that most need a rapid solution, and importantly those that the market and new partnerships can best help us with. These Defence Innovation Priorities set this out and explain how we are going to use them to engage with industry and academia. Particularly the parts of the civil sector we have not conventionally engaged with.

A Vision for Innovation in Defence:

A Defence enterprise, that is innovative by instinct, where ideas are readily generated and exploited to deliver innovative solutions to Defence's challenges.



How to use the Priorities

“We are looking for ideas and opportunities in unconventional places and in unanticipated relationships.”

The Priorities

- **Integrate Information and Physical Activity Across all Domains**
 - *How can we integrate information and physical activity across domains (particularly Space and Cyber), and synchronise with wider Government to increase understanding and operational tempo?*
- **Delivering Agile Command and Control**
 - *How can we deliver agile Command and Control, to make faster, better decisions and generate decisive advantage in complex operations?*
- **Operate and Deliver Effects in Contested Domains**
 - *How can we operate and deliver military outcomes in denied and contested domains?*
- **Defence People – Skills, Knowledge and Experience**
 - *How can we access people with the right skills, knowledge and experience?*
- **Simulating Future Battlespace Complexity**
 - *How do we represent future battlespace complexity and higher levels of integration in training, wargaming and experimentation?*

We have selected these Priorities by considering the intersection between our most pressing problems and where we think collaboration with the civil sector shows most promise. These are enduring problems for us that have a wide range of impacts. Whilst not explicitly captured in the Priorities themselves, affordability and efficiency will be major features of any resulting innovation collaborations.

Using the Priorities

We are adopting an open approach. We are looking for ideas and opportunities in unconventional places and in unanticipated relationships. We therefore want to engage with companies and organisations who are similarly willing to explore new ways of working.

To support this, we are:

- making it easier for businesses to work with us;
- working with industry in different ways;
- consulting with industry to identify lessons from the current innovation portfolio;
- exploring provision of access to finance and mentoring services; and
- piloting information sharing to give industry easier access to current and potential future innovation investment.

Within Defence, the Priorities will be used to:

- **inform policy, strategy and plans:** shaping how the Department understands and exploits innovation; and
- **focus innovation investment:** shaping how the Defence Innovation Fund is allocated.

Outside Defence, the Priorities should be used by:

- **organisations facing similar problems who are willing to share their solutions with us:** to recognise that your products, processes and practices might be applicable to Defence, and to work with us to learn from this and pilot similar solutions in Defence;
- **organisations facing similar problems who are willing to work with us to develop and test new solutions:** to recognise where your problems are also our problems, and to collaborate in developing innovative and mutually beneficial solutions;
- **organisations able to supply solutions to similar problems who are willing to work with us:** to recognise where the solutions you already have might address these problems, or where you have the capability to develop solutions to them, and to engage with us through DASA;
- **public sector partners:** to understand the problems we are focusing innovation resource on – and the outcomes we are seeking – and to work with us to find solutions applicable to wider public sector needs; and
- **international allies:** to understand the problems that we will be prioritising for international innovation collaboration and where there may be opportunities for co-development or to bolster existing bilateral and multilateral partnerships.

Focusing Innovation investment

The Defence Innovation Fund is allocated according to three themes, with the Defence Innovation Priorities determining the allocation to the strategic and cross-cutting activities theme.

- **Strategic and cross-cutting activities** – such as the current Spearhead Programmes and an upcoming thematic innovation challenge on Information Advantage run through DASA.
- **Opportunities and ideas** – being open to any opportunity and ideas from any source, including the DASA Open Call for Innovation and the internal ideas schemes for business units and staff.

- **Enabling** – activities and resources that enable a culture that is 'innovative by instinct', by overcoming barriers, supporting development of the innovation ecosystem and developing the practice of innovation.

How we would like you to respond

If you are an organisation that has similar problems to ours and is willing to work with us – then we want to talk to you. We aim to take a staged approach to developing new relationships, by:

- **Publicising the opportunity to collaborate:** Publishing this document is one way in which we are promoting the opportunity to work with us on innovation. We will also use existing news, publicity and social media channels;
- **Providing a forum to explore the long-term potential for collaboration:** The aim of this stage is to test and refine the case for collaboration and to confirm the continued commitment of parties. It will also define the goals of any innovation activity. This may be through a conventional process of face-to-face meetings, but it will also employ digital collaboration spaces; and
- **Conducting innovation activity:** The activities we undertake together may be as simple as capturing the instances of how problems have already been solved and working out how we can apply them for mutual benefit. Or it might be we jointly sponsor innovation challenges to bring fundamentally different solutions into the market to address our shared problems. Or it might be exploring a strategic arrangement that enables a joint portfolio of projects to be established.

If you are an organisation that has similar problems to ours, then we want to talk to you. Please contact us via the following email address – info@innovation.mod.gov.uk. Please provide details of how you want to collaborate, and we will respond to you.

If you are an organisation that can supply us with solutions to the problems we have detailed in this document, please monitor the DASA website, which will provide information about innovation challenges as we launch them. DASA operates an Open Call for Innovation which welcomes ideas on any subject and is reviewed on a regular cycle. For focused engagement; Themed Competitions offer suppliers the opportunity to submit proposals around specific government areas of interest. More information can be found at: <https://www.gov.uk/government/organisations/defence-and-security-accelerator>



[MIXED REALITY]

Defence Innovation Priorities

Integrate Information and Physical Activity Across all Domains

“Achieving a step change in how we exploit information will unlock a step change in military capability.”

Priority Overview

The world is changing. Success against complex and diverse threats that exploit pervasive information requires us to do things differently. Our Armed Forces need to exploit information to a much greater extent. Their many different units need to be better integrated: with each other, with other government departments, and new and existing international allies and partners.

By integration we mean enabling fighting or supporting units to work harmoniously together to deliver winning impact, and particularly to work together across the five different domains – on or under the sea, on or over the land, in the air, or in space, or in the information realm of cyber.

Integrating military units physically will continue to be important, for example integrating joint activity between units in the air with units on the land. We particularly need to increase integration with operations in space and cyber domains. Information will be important to achieving this integration. Achieving a step change in how we exploit information will unlock a step change in our military capability, achieving what we call Information Advantage. The effect of exploiting information is to increase our ability to orchestrate activity, provide protection to military personnel and their equipment, and by doing so deter hostile action by our adversaries. The Innovation Priority: Delivering Agile Command and Control, provides a greater focus on planning and the orchestration of military activities.

We must also be better at integrating with the Armed Forces of our allies and at synchronising military activities with the activities of other government departments. Again, better use of information will be important to achieving this.



Illustrative Defence uses

The following has been derived from the Resilient Communications application area of the Defence Technology Framework.

All communications are ultimately vulnerable to adversary disruption, introducing significant operational risk. Therefore, to enable highly mobile forces to be successful, we need to field communications capabilities that are resistant to attack, but continue to perform if degraded, and are secure. They need to be effective in using limited portions of an electro-magnetic spectrum, which is also in high demand by multiple operators. They also need to be affordable.

Communications capabilities underpin all aspects of modern military operations. They enable multiple operators to coordinate in order to maximise their combined effectiveness. They also enable command and control, logistics planning, the operation of unmanned systems, and the exchange of personnel and welfare information, among many other activities.

Challenges

Defence faces a number of challenges in this area. These include:

- managing significant volumes of data, such as from remote or autonomous systems or distributed sensing architectures;
- designing information services that integrate diversely formatted and unformatted data from different domains and bespoke systems;
- approaches to the training of personnel and to learning from experience in the use of control systems for managing complex operations; and
- the security challenge of collaborative data sharing, particularly with national and international partner organisations, addressing the differing security classifications, governance and policy processes applied by each partner.

Delivering Agile Command and Control

“We must maintain our ability to understand the world around us, and plan and orchestrate our Armed Forces effectively.”

Priority Overview

The world in which we are seeking to protect the people of the UK, prevent conflict, and be ready to fight our adversaries is increasingly complex and contested. The distinction between war and peace has blurred and adversaries, both state and non-state, will threaten the stability of the rules-based international order. Anticipating and adapting to that complexity, and not seeking to control it, is essential to our success.

To be successful we must maintain our ability to understand the world around us, and plan and orchestrate our Armed Forces effectively to achieve desired outcomes. We call this Command and Control. Other considerations for operating in the face of persistent and effective competition are the focus of the Innovation Priority: Operate and Deliver Effects in Contested Domains.

A style of command that the UK Armed Forces have historically used is Mission Command, which is essential to achieving the adaptability we need to respond quickly to the complexity of our world. In Mission Command, subordinates are enabled to understand the intentions of their senior officers and their place within their plans. They are delegated appropriate resources, enabling them to carry out missions with the maximum freedom of action.

To achieve the extent of adaptability needed, the ability to collaborate easily and the use of Mission Command must be maximised. A shift from traditional chains of command to more dynamic, lateral networks, with greater delegation of authority will allow decision-making to be pushed to the edges of an organisation and allow the exploitation of the most relevant information at speed (i.e. agile Command and Control).

To do this, we will need to change our approach to Command and Control throughout the system – people, processes, structures and technology. This will also require cultural and behavioural change and changes to our approach to training. This is a feature of the Innovation Priority: Simulating Future Battlespace Complexity.

To achieve the levels of Command and Control we need, we must transform our military capabilities so that they are information rather than platform-centric. That is, designing future forces and future platforms around an information architecture – a



robust network of integrated Command and Control hubs, enabling widespread access to and sharing of information. The architecture must allow components to be added, upgraded, and swapped easily and allow networks to be connected or reconfigured between missions.

Illustrative Defence uses

The following has been derived from the Comprehensive Intelligence, Surveillance and Reconnaissance (ISR) application area of the Defence Technology Framework.

ISR is both the co-ordinated tasking of the platforms and systems that conduct surveillance and collection intelligence and the processing and communication of the resulting information. ISR includes the automated tools to minimise the burden on the operator and to provide timely insight and understanding.

The understanding of operational situations that is provided by ISR underpins all military operations. It allows informed decisions to be made, targets to be effectively prosecuted and outcomes to be understood. It is a critical contributor to our strategic and operational advantage.

Challenges

Defence faces a number of challenges in this area. These include:

- technology based data analysis (such as the use of machine learning), including; risk assessment and event prediction that appropriately respects confidence assessments and data provenance, and integration of new data with current data to enhance decision making;
- effective collaboration between human and technology-based decision making processes;
- designing systems and processes for the analysis and visualisation of real-time data from complex and remote systems to enable rapid, sometimes in-flight, decision making;
- incorporating synthetic and predictive models into the planning of operations to allow assumptions to be tested and to improve the prediction of outcomes; and
- merging in-house and commercially available information services to establish situational awareness of space and cyber domains, in support of operational and tactical decision making.

Operate and Deliver Effects in Contested Domains

“Retaining the freedom to use our information networks and the electromagnetic spectrum is essential.”

Priority Overview

Our Armed Forces will always have to survive and operate in hostile environments. They will experience persistent and multi-faceted state-on-state and non-state competition. Access to and control of each of the five domains will be heavily contested. This is particularly true for the cyber and space domains. We expect significant and growing threats to our information. In more advanced cases, offensive anti-satellite systems could disrupt our ability to use our space-based capabilities.

Retaining the freedom to use our information networks and the electromagnetic spectrum is essential. We use our networks to enable Command and Control. We use the electromagnetic spectrum for communications with and between our forces operating on the battlefield. It is the medium for many of our most effective sensors, such as radars. All these can be a source of intelligence to our adversaries and disrupting or disabling them can undermine our ability to fight effectively. Electronic components are also critical parts of almost every system, and a potential cause of vulnerability if they are not robustly protected. We need to be sure that we are robust and resilient; able to fall back on redundancy and on reversionary modes. But we must also degrade our adversaries' abilities in all these areas, ideally at a time and in a manner of our choosing.

To survive and deliver military missions against such opposition, military forces must be able to operate despite the performance of the systems being degraded due to hostile action. This also applies to our remote and autonomous systems. We must be able to quickly adapt our tactics and processes to unexpected or evolving adversary tactics and systems. And we will also need our military personnel to think creatively, to respond to the unpredictable.



Illustrative Defence uses

The following has been derived from the Enhanced Cyber and Electronic Warfare application area of the Defence Technology Framework.

MOD's cyber infrastructure is significant and comprises commercial Information Communication Technologies alongside bespoke weapon and platform systems operating far from the UK.

This single information environment blurs traditional boundaries between wired and wireless systems. Commercial cyber-security solutions do not cover the breadth of the architecture and expected use cases. Our need to operate remotely through the electromagnetic spectrum means that cyber and electronic warfare capabilities are converging into a common information operating environment. In turn this leads to a convergence in the technologies used.

Challenges

Defence faces a number of challenges in this area. These include:

- the ability to communicate and synchronise activities in contested environments, and more realistically evaluate strategies for such operations;
- monitoring contested environments and rapidly evolving and testing new processes for teams and systems operating in those environments;
- manufacturing methods and design concepts to deliver alternative explosive or electromagnetic or chemical effects, or the protection from such effects, and their testing and evaluation;
- exploring options to enable Defence to operate in areas where the ability to navigate is denied to conventional means;
- managing fleets of remote or autonomous systems, or using such systems to undertake roles normally undertaken by human operators, such as evaluating and repairing remote systems;
- learning from experiences in using remote and autonomous systems for civil purposes;
- learning from data on cyber vulnerabilities encountered in civil infrastructure; and
- exploring the application of cognitive approaches, such as the use of cognitive radio, spread spectrum techniques and other related methods.

Defence People – Skills, Knowledge and Experience

“In a competitive and changing labour market, securing access to expertise ... will require a more collaborative approach.”

Priority Overview

To successfully meet our challenges, we know we must aggressively adopt cutting-edge technologies and exploit information to a greater extent. Our ability to do this requires us to have access to people with the appropriate skills, knowledge and experience. In a competitive and changing labour market, securing access to expertise in important sectors such as science, technology, engineering and mathematics (STEM) will require a more collaborative approach – whether with other government departments and international allies and partners, or with industry and academia. We will need to broaden our knowledge, skills and experience through increased opportunity to gain external experience and direct entry into a wider range of grades and ranks.

Exploiting novel contracts and employment models, including portfolio careers and flexible working practices, will become more important if we are to attract a more diverse pool of talent to Defence. The complexity and uncertainty of the environment our people will operate in also demands intellectual rigour. And the pace of change of that environment means that individuals may need to learn new skills many times in their careers. Lifelong education and training will be vital if we are to maximise the potential of our people.

We must also fully use the opportunities and benefits of simulation to personalise training, maximise human potential and create realistic operational environments. This is a feature of the Innovation Priority: Simulating Future Battlespace Complexity.

Illustrative Defence uses

We have a requirement for a comprehensive people analysis capability to allow us to harness and maximise the potential of multiple Human Resources (HR) and other data sources. This capability would enable the systematic inquiry, insight generation and evidence collation to support better interventions in the management of our people. For example, for optimal allocation of correctly skilled people to roles.



Challenges

Defence faces a number of challenges in this area. These include:

- effective approaches to attract and retain Suitably Qualified and Experienced Personnel (SQEP) with niche specialities and technical skills. Of particular interest are: Signals and Communication Specialists, Engineers, Cyber Specialists – and even Chefs;
- effective tracking and management of important skillsets across the workforce to enable their effective application to business needs;
- alternative approaches to contracting or seconding specialist staff appointments, in organisations with high security considerations and rank-like structures, including partnering with such organisations;
- technologies, services and other opportunities to improve standards of welfare, workforce health and wellbeing for Defence personnel; and
- identifying and collaborating with organisations that have experience in the development of programmes that improve the safety of critical infrastructure, through education, research and engagement that advocates scientific excellence and supports engineering-related research, training and education.

Simulating Future Battlespace Complexity

“Modern offensive and defensive systems and the anticipated battlefield complexity cannot be reflected in current live exercises.”

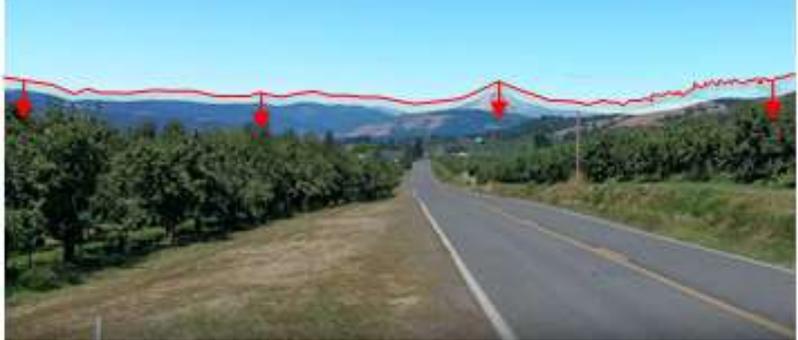
Priority Overview

We expect our Armed Forces to operate in a context that is becoming increasingly complex and uncertain. We also expect them to be integrated across Government and with our international allies and partners. We forge fighting power and fighting spirit in training and experimentation. So, we must improve this capability to meet this increased complexity.

Many modern offensive and defensive systems and the anticipated complexity of the battlefield cannot be represented in current live exercises. Using live platforms also places a demand on scarce resources, and their use also brings a financial and environmental cost, through the use of fuel and other consumables. It is essential therefore that we create more effective training environments, which exploit technology – such as the addition of a synthetic element into live training – to offer greater challenge, greater availability and greater frequency of training to our people and teams. Targeted and responsive – even personalised – training should enhance individual and collective capability, and the ability to adapt to unforeseen events.

Our training environment must provide the opportunity to experiment, to push the boundaries and be ‘safe to fail.’ It must enable the faster insertion of new capability and must inform and be informed by wargames and simulations investigating emerging threats.

In addition to this, we need joint education, routine experimentation, wargaming and training at the strategic level, linking with cross-Government partners.



Illustrative Defence uses

We have recognised the need to work with civil partners to identify and pursue pioneering technologies and approaches, to better reflect the complex challenges of modern warfare in our training. Simulation, including mixing with live action, offers training opportunities to link across the five domains. It is also compatible with the constraints of our budgets, our training facilities and legislation.

Simulation offers other benefits: the delivery of complex scenarios across a broad catalogue of platforms and systems; and more effective and frequent collective training. It also supports the testing and experimentation needed to integrate remote and autonomous systems, as well as other new capabilities as they emerge.

Challenges

Defence faces a number of challenges in this area. These challenges include:

- the application of procedures and solutions that provide effective training and evaluation of both the operator and the systems being operated;
- integrating and fusing data from, and collaborating between, diverse and geographically distributed training and experimentation systems;
- training operators to perform in complex or high stress, sometimes remote, environments;
- adoption of Virtual Reality (VR), Augmented Reality (AR) or other novel technology into our approaches to training field operators; and
- effective capture and exploitation of performance information collected during training, to understand the impact and effectiveness of training regimes.

How to engage with MOD

How to engage

If you are an organisation that has similar problems to ours, then we want to talk to you. Please contact us through the following email address – info@innovation.mod.gov.uk. Please provide details of how you want to collaborate, and we will respond to you.

If you are an organisation that can supply us with solutions to the problems we have detailed in this document, please monitor the DASA website, which will provide information about innovation challenges as we launch them.

Defence and Security Accelerator (DASA): DASA finds and funds exploitable innovation to support UK defence and security quickly and effectively, and support UK prosperity. To do this DASA operates an Open Call for Innovation which welcomes ideas on any subject and is reviewed on a regular cycle. For focused engagement; Themed Competitions offer suppliers the opportunity to submit proposals around specific government areas of interest. More information including contact details can be found at:

<https://www.gov.uk/government/organisations/defence-and-security-accelerator>

Engaging with the wider MOD innovation ecosystem

Innovation Hubs in Defence: Innovation Hubs have been established in all Front-Line Commands and for the Chief Information Officer, to act as catalysts for innovation. These include: the Royal Navy's Discovery, Assessment, and Rapid Exploitation (DARE) team; the Army Innovation team; the RAF Innovation Exchange (RIX), the Joint Forces Command's jHub and the Information Systems & Services (ISS) Innovation team. Please contact these hubs through the following email address – info@innovation.mod.gov.uk.

Defence Science and Technology Laboratory (Dstl): If your idea requires further research or you are an innovative research company, please contact the Dstl SME Searchlight. This initiative aims to attract non-traditional Defence suppliers and SMEs to help deliver a projected £40-45 million increase in Dstl research spending with external companies, in line with the Government's intent to increase external spending with SMEs to 33% by 2022. Please contact searchlight@dstl.gov.uk.

Acquisition organisations: Alternatively, if your innovation is well developed, you may wish to contact the Defence Equipment and Support (DE&S) or the Defence Suppliers' Service (DSS), the Department's focal point for the provision of advice and guidance to companies interested in supplying to the MOD.

Their contact details are: 030 679 32843, dessrt-dsshelpdesk@mod.uk

Furthermore, you may be interested in www.contracts.mod.uk, where you can read about MOD defence contracts. Defence Contracts Online (DCO) is the official source of UK MOD contracts – giving you instant access to all of MOD's contract opportunities, of all values, in one place.

