

Growing the Contribution of Defence to UK Prosperity

A report for the Secretary of State for Defence

Philip Dunne MP
July 2018



Front cover: Flexible Manufacturing Systems at the BAE Systems F-35 machining facility at Samlesbury, Lancashire. The systems help machine complex titanium and aluminium components with unparalleled precision. Copyright BAE Systems plc.

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Foreword by Philip Dunne MP





I am pleased to have been asked by the Secretary of State for Defence to undertake this Review of the contribution of Defence to the prosperity of the United Kingdom.

As part of the Defence and Security Review 2015, when

I was Minister of State for Defence Procurement, the Ministry of Defence was tasked for the first time to include within its formal objectives the promotion of prosperity, in line with National Security Objective three: ***'Promote our prosperity'– seizing opportunities, harnessing innovation to strengthen our national security, and working with industry to ensure we have the capabilities and equipment that we need. Our economic and national security go hand-in-hand.'***

It did so, adopting the objective:

'We will contribute to the UK's economic security, support our industry including through innovation and exports, continue to invest in science and technology and contribute to wider skills and citizenship development that supports British society, through Cadet Forces, University Units and investment in skills, including through apprenticeships.'

No definition of 'prosperity' was made in 2015. The latest edition of the Treasury's 'Green Book'² has now produced a definition, but not one that yet provides clarity across Defence. The definition refers to 'social value' and in turn to 'social welfare or wellbeing'. For the purposes of this review I take that to mean the broad economic wellbeing of the United Kingdom and its people.

As the Government looks at modernising Defence in response to a new international situation, it is right to consider how the role of Defence should be adapted - not just to reflect the rapidly evolving threats and capabilities of those who would do us harm, but also how the capabilities of our Armed Forces and the defence industry and infrastructure that supports them should be positioned to meet future requirements.

In addition, we have a unique opportunity as a result of the historic decision by the British people to leave the European Union from March 2019, to reconsider what impacts this may have for the role of Defence in the UK economy.

I have been asked in the Terms of Reference for the Dunne Review, set out in Annex C, to undertake this work within an initial tight two-month timeframe, to inform the Modernising Defence Programme work this summer. I have therefore not had the opportunity to commission new research, but have relied on existing sources of information available and am grateful to all those with whom I have engaged over the past few months and who have been generous in providing information, a selection of which I have included in this Review, duly attributed. A list of organisations and people with whom I have engaged, including in each of the Devolved Nations, is set out in Annex D.

This Review seeks to highlight the principal contributions made by Defence across the four nations of the UK to the five main elements identified in the Industrial Strategy published in December 2017, namely the contribution to UK national life, economic growth, people, ideas and place. In addition, I have made a number of recommendations for the Secretary of State to improve the agility of Defence to procure the capability it needs, and for his Department and defence industry more widely in meeting the challenges of the future.

I am grateful to the team who have supported my work. We have endeavoured to minimise the jargon for which the Ministry of Defence and Armed Forces are renowned. It is important that these issues are accessible to and understood by non-Defence policymakers and the public alike. I have however adopted one house term for ease of writing: the use of the term 'Defence' to capture the whole effort from the Ministry, Armed Forces and industry.

A handwritten signature in black ink that reads "Philip Dunne". The signature is written in a cursive, slightly slanted style.

Philip Dunne MP

¹See for example <https://www.gov.uk/government/publications/ministry-of-defence-annual-report-and-accounts-2016-to-2017>, p51

²Central Government Guidance On Appraisal And Evaluation dated 18 April 2018

Executive Summary



This report provides the opportunity, for the first time in recent years, to scan the contribution of Defence in its entirety (MOD³, Armed Forces and industry) to the economic prosperity of the United Kingdom. This input is considerable and has significant potential to grow the UK's prosperity further still. But it is generally unrecognised or taken for granted.

Defence makes possible our secure domestic environment and rules-based international order so that we can live and prosper, protected from the devastation of war and the impact of terrorism. It also enables many of the benefits we rely on to conduct our daily lives. It protects the trade routes that carry the goods we consume. It guards the underwater cables and satellites that convey the communications which connect us with other nations. It counters the cyber-attacks that could bring our technologically-dependent lives to a standstill. Virtually invisible, this protection underpins our economic growth.

Defence's direct contribution to GDP includes over £7bn of exports generated on average each year in addition to the MOD budget of £37bn. Defence's role as a customer and industrial partner with high growth sectors in the economy generates more growth, notably in the aerospace, engineering, space, cyber, and now the knowledge and creative sectors. It is hard to quantify. But it is very valuable, both to the ability of the Armed Forces to deploy successfully and to keep the UK ahead of its competitors and adversaries in the future.

The recommendations of this review boil down into a few key themes.

The first is what MOD can do to embed prosperity as an explicit objective into its decisions. It needs to take account of prosperity in all major procurements, in the way that it has started with the new Type 31e frigate. MOD also needs to prioritise and incentivise export promotion work.

The second is around increased agility in procurement. The current approach is quite properly driven by the need to spend public money wisely and the correct view that competition drives value for money. But alongside the EU competition rules, the result has been process-heavy, not just for major platforms but for smaller items, focused more on upfront capital cost than driving value through life of the capability. More agility will help bring innovation to the frontline and meet rapidly evolving threats from advancing technologies.

Removing excessive process and establishing the ability to consider impact on the UK economy - jobs, skills and productivity - can, if the MOD grasps the opportunity, help change for the better how Defence does things. That could not only drive faster procurement for the MOD, but also sustain a stronger more diverse defence industry with more chance of export success.

Thirdly is the relationship between the defence industry and the rest of the economy. Historically there has been a strong correlation between defence research and technological advances across society. That can still happen - as the recent defence-funded discovery of a new way of working titanium bears witness. But Defence now needs to be able to absorb the huge technological change - particularly around data - that is taking place across the economy. It needs to work with the innovative, often smaller companies generating some of the most interesting digital advances; and to get new technology into service while it can still provide a technical - or information - edge.

The Armed Forces' senior leadership understand this, but there is still much to be done to implement and embed the required agility.

The report also covers people and skills as a shared challenge, especially the shortage of technically qualified staff. The MOD and Armed Forces have an impressive record in training staff and providing them mid-career to the economy. The report recommends that as the Government implements its Industrial Strategy it needs to include the defence industry - which can both contribute and benefit.

Finally, the report recommends greater investment in defence innovation to produce a dividend for the economy, though such investment reaps rewards over a longer timeframe than the parliamentary cycle. Defence R&D has suffered as resources have tightened. There will be many demands on future resources. But a focus on innovation will be essential to drive military advantage and secure the nation's future prosperity.

A full list of the 41 specific recommendations identified in the body of this Review is set out at Annex A.

³Ministry of Defence

Chapter 1: National life



Key observations:

Defence makes a huge contribution to the fabric of the United Kingdom: it underpins the secure domestic environment and rules-based international order that allows us to live and prosper as individuals and as a Nation. Defence must continue at sufficient scale to secure British values and way of life, using five operational domains: Land, Sea, Air, Space and Cyber, and our international partnerships, both multilateral and bilateral. It has two different but related tasks:

- Our Armed Forces defend the sovereignty of the UK across all five operational domains and keep essential trade routes open.
- The Ministry of Defence projects the UK's power and influence overseas, through bilateral and multilateral relationships, underpinning our nation's status and helping the UK to enjoy relative economic growth and prosperity.

Together these roles create a stable and secure environment, providing the basis for further inward investment and prosperity, making the UK a great place to live and do business.

Introduction

Defending its people is the first and undisputable role of government. Both life itself and ways of life must be protected. Defence and security underpin the values and way of life we enjoy in this country, as well as being critical to how it operates and our economy. These ways of life are changing though: technology is increasingly an integral part of people's lives and the defence of the country. The strategic role of the MOD has been periodically reviewed, often by incoming Governments at the outset of their period in office. In recent decades, strategic reviews were undertaken in 1998, 2010 and 2015. The threat picture has changed markedly over this period.

The recent National Security and Capability Review (NSCR) noted how the world has become more uncertain and more volatile since 2015. These growing risks mean that Defence must continue to innovate in order to maintain a winning edge and modern deterrent. It must also do so across a much wider range of operational domains than in the past. As the Defence Secretary has recently noted, these now include not only Land, Sea and Air, but also Space and Cyber.

The task of defending the UK requires developing and purchasing high quality equipment and services. The MODs plan to spend £180bn on equipment and support over the decade out to 2026-27.⁴ It is of vital importance that the MOD works with Industry, international partners and across government to address defensive and offensive capabilities in all of these operational domains. That is a given. But the MOD should also fully consider and maximise, where possible, the impact this taxpayer funded spending can have on the prosperity of citizens across the UK.

This chapter will briefly consider the long-standing role the MOD plays nationally and internationally and why it is still relevant; how a secure and stable environment provides economic benefit; and finally, how the MOD enhances UK national life (including the newer operational domains of Space and Cyber).

⁴The Defence Equipment Plan 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/677999/20180125-EP17_Final.pdf

Defence and Security of the UK

During the two World Wars we saw the nation mobilised in the defence of our country. The Armed Forces of today must continue to develop to protect the nation successfully from the state-on-state threats of tomorrow. We have witnessed determined Russian resurgence over recent years and if we wish to maintain our ability to deter, we cannot afford to stand still while others progress their national military capabilities.

But the UK has also experienced five terror attacks in 2017 alone, as well as a number of foiled attacks. The MOD works in support of other security agencies to prevent these attacks from taking place and to minimise the impact they have. Nearly 1,000 armed military personnel were deployed in support of the police following the Manchester Arena terror attacks in which 22 people lost their lives in May 2017. Over 700 were deployed in support following the incident at Parsons Green underground station in September 2017. This MOD support freed up armed police for patrolling and other tasks.

CHEMICAL WEAPON USE ON BRITISH SOIL

The attack on Sergei and Yulia Skripal in Salisbury in March 2018, was the first time a nerve agent has been deployed in Europe since the Second World War. Defence responded to emergency demands for chemical, biological, radiological and nuclear equipment in the wake of a suspected nerve agent attack in support of the police. Defence issued individual protective equipment, decontamination equipment and medical countermeasures to military units, as well as to the Police and Fire Service. These included: decontamination suits, protective gloves, overboots and suits; respirators, medical countermeasures and pre-treatment sets; disclosure pens; and sprays. Authority to provide this equipment was made within hours of the request.

Defence continued supporting civil authorities after the initial event. This included transporting potentially contaminated vehicles and objects to secure locations, continuing to provide protective equipment and training to support the police and ambulance services, and providing vital expertise and advice to assist in the decontamination efforts from the Defence Science and Technology Laboratory in Porton Down (Dstl).



Military personnel from the Army and the Royal Air Force working in support of DEFRA and the civil authorities on the recovery operation in Salisbury in the aftermath of the nerve agent attack in March 2018

In addition to supporting major incidents the MOD maintains forces at readiness to provide resilience and support to civil authorities across the UK, for which it receives wide ranging requests every year. These have included building flood defences during the widespread floods of 2016 (and previous years) and more recently, during the winter storms in February 2018, helping some of the worst-affected parts of the UK ranging from Scotland to Devon. Over 300 Regular and Reserve Service personnel were deployed, along with 124 4x4 vehicles and a Royal Air Force (RAF) Chinook helicopter, to support wider Government efforts.

The MOD has three Army battalions totalling up to 1,200 soldiers on 24-hour standby on an enduring basis. These soldiers can be called upon by Government departments to support events of national importance requiring an urgent response across the country.



A RAF Typhoon of 1 (Fighter) Squadron from RAF Lossiemouth overflies the RAF's newly installed Air Defence Radar at Saxa Vord, on the Island of Unst, Shetland

The RAF is on standby 24/7, 365 days a year, to defend UK airspace with an integrated Air Defence system that includes Typhoon aircraft providing Quick Reaction Alert (QRA), and Voyager tankers, air surveillance and control facilities in support. QRA has deployed 38 times to monitor Russian aircraft since 2012.⁵ Since 11 September 2001, the UK has been alert to the broad potential threat to its airspace from terrorists. The same capabilities are also used in support of NATO to intercept and escort long-range aircraft from non-NATO countries that enter the NATO air policing areas surrounding the UK. These are often from Russia, such as the Tu-95 Bear. The quick reaction aircraft also provide support for commercial and light aircraft that have lost communications or have other emergencies requiring airborne assistance.

The Royal Navy maintains a standing defence task of protecting our sea-lanes and coast. This extends to monitoring passage of warships by non-NATO members near our territorial waters, 33 times in 2017,⁶ as well as patrolling the UK's Exclusive Economic Zone - an area that covers over 80,000 square miles of sea and stretches up to 200 miles from the coastlines of England, Scotland and Northern Ireland. The Fishery Protections Squadron operations also include offshore installation protection, escort duties and wider maritime security tasks. In 2017-2018 the Squadron completed 4,235 patrol hours, boarding 257 fishing vessels. Working alongside other Government departments such as the Department for Environment, Food & Rural Affairs (DEFRA), the Royal Navy safeguards the nation's coastal waters and key offshore-installations.

Our Armed Forces also play a critical role in ensuring security at large national events. Most recently, at the wedding of TRH The Duke and Duchess of Sussex in May 2018, the MOD provided military support to the police, in line with Military Aid to the Civil Authorities principles. This included Explosive Ordnance Disposal assets, logistical support and 250 military personnel who performed ceremonial duties. At the London Olympics and Paralympics in 2012 17,000 personnel were deployed and at the Commonwealth Games in Glasgow in 2014 more than 2,000 personnel deployed to assist in ensuring security.

These events not only directly benefit our economy through tourism, they project our global influence, helping to support the global rules-based international system that enables the economy to grow. The UK topped Forbes 'Best Countries to do Business in 2018',⁷ with our \$2.6 trillion economy the fifth largest in the world. Quality of life, personal freedom and freedom of trade are three of the fifteen factors considered in this assessment and this chapter outlines how Defence provides a critical contribution to them. Further chapters of this report highlight how Defence also contributes to other factors assessed by Forbes, such as innovation and technology.



The Armed Forces providing ceremonial support to mark the occasion of the wedding of TRH the Duke and Duchess of Sussex in May 2018

⁵Hansard, Defence Secretary in House of Commons, 20 June 2018

⁶<https://www.gov.uk/government/speeches/rusi-sea-power-conference-speech>

⁷<https://forbes.com/sites/kurtbadenhausen/2017/12/19/the-u-k-tops-forbes-best-countries-for-business-2018/#6f01f30226de>

British Overseas Territories



The UK's international role

It is clear that our Armed Forces must operate in a wide range of roles at home. But alone, this is not sufficient. The MOD provides a potent force for projection of both hard and soft power overseas. Protecting our Overseas Territories and projecting our influence abroad is a key part of the UK's strategy, without which we will not continue to enjoy the freedoms and relative economic prosperity that we do.

The Armed Forces help ensure this influence and stability of the world order routinely through Defence engagement activities, and when the occasion demands it, by providing humanitarian and disaster relief, or conducting counter terrorism and stabilisation operations. These bilateral activities reduce the likelihood of threats materialising and affecting the UK, our interests, and those of our allies and partners.



View of Khawr Al Ameyya oil terminal in the Gulf, from the back of a Royal Navy jet pack as it returned to HMS Cornwall

HUMANITARIAN

The UK Overseas Territories and Caribbean Islands were hit hard by Hurricane Irma, in September 2017. In response some 500 personnel were deployed with RFA Mounts Bay, HMS Ocean and C-17, Voyager and A400M aircraft. The MOD provided and distributed medical supplies, restored critical power supplies and cleared essential logistic routes.

COUNTER TERRORISM: TUNISIA

Defence provides Counter-Improvised Explosive Devices (C-IED) expertise to the Tunisian Military. Tunisia has been a frontline state in the fight against Daesh, as the Sousse attacks in June 2015 showed when 38 people were killed including 30 Britons. The capability Defence is helping to develop assists the Tunisian Military's ability to defeat Daesh and other counter terrorism threats within the country.

GULF

Defence has long been a central element in the UK's important strategic relationship with the oil-producing countries of the Gulf. Gulf Co-operation Council countries have long provided operational basing and exercise facilities to the UK, such as the basing facilities Bahrain has provided to the Royal Navy in the Gulf, and the exercises that Oman and UAE have hosted. These relationships also include long-standing arrangements covering the loan of expert personnel and the supply of equipment and support services to Saudi Arabia for over 50 years. The UK also has a long-standing relationship with Kuwait, including through the British Military Mission Kuwait, with UK forces embedded across the Kuwaiti Armed Forces; and Qatar which hosts 83 Expeditionary Air Group, the UK's operational Headquarters in the Middle East.

The UK has a unique position in the world given our responsibility to protect fourteen Overseas Territories. Their disposition around the globe is often in strategic, but isolated locations. These territories are also a strategic asset for global communications, with both MOD and commercial applications. It also comes with a defence responsibility, notably discharged in the Falkland Islands in 1982, but also today with routine support from our Armed Forces.

Defence Engagement activity plays a central role at the heart of many bilateral relationships with allies and partner nations. This takes many forms, including diplomatic relations through the Defence Attaché network, militarily through joint training exercises and more directly, contributing to the UK's prosperity through defence exports as discussed in Chapter Two. The UK cannot and does not work in isolation internationally. To be effective, we work with and alongside international partners to complement activity and form a cohesive strategy, in line with the UK's interests and priorities. The UK's position as a permanent member of the United Nations Security Council is underpinned by our continuous-at-sea strategic nuclear deterrent.

The UK's leading role in NATO is vital in projecting our influence and maintaining world order and thereby supporting our nation's well-being and prosperity. In 2017, the UK led the Very High Readiness Joint Task Force, formed in response to Russia's actions in Ukraine, provided Typhoon aircraft to NATO's Baltic Air Policing mission, and ships and Army units to NATO exercises to reassure our allies against the threat from Russia. The UK must remain NATO's strongest military power in Europe in order to continue to lead and influence key strategic interests where only multilateral action will have meaningful impact.

The UK's security and prosperity is reinforced through our multilateral defence and security relationships, such as in South East Asia through the Five Powers Defence Arrangement. Of particular importance is our cooperation with Australia, Canada, New Zealand and the United States through: the Five Eyes intelligence-sharing partnership; the Five Eyes Law Enforcement Group on reducing the international threat and impact of organised crime; and the Consular Colloque⁸, which allow us to support each other in protecting our respective nationals overseas. In Libya in 2014 the UK worked closely with other nations to evacuate personnel from Tripoli. The UK evacuated French, Irish and other nationals, and French and Greek ships offered places for UK evacuees. Close international collaboration such as this is critical in ensuring the safety of UK citizens.

Some of our closest bilateral Defence relationships are with EU partners, notably France through the Lancaster House Agreement of 2010, but also with other partner nations in equipment collaborations, such as Germany, Italy and Spain on Eurofighter Typhoon, and with Germany, Italy, Spain and Turkey, in addition to France, on A400M transport aircraft. As part of our Brexit negotiations it was right for the UK to make a generous offer to reassure our EU partners that the UK intends to maintain its military commitments and equipment collaborations once it has left the EU. This will help us maintain close working with our defence partners, both bilaterally and through multilateral forums, which will in turn maintain our ability to project influence and stability to the world order and protect the UK's relative economic prosperity. In the same spirit, we should expect such defence cooperation to work both ways.

VALUED DEFENCE COLLABORATION

France: UK and French Armed Forces work together across the world to deliver security and stability, including to counter terrorism in Syria and Iraq, and the use of chemical weapons in Syria; on hurricane disaster relief in the Caribbean; on coordinated counter-piracy engagement off the coasts of East and West Africa; through provision of UK air transport aircraft and Chinook helicopters to support French-led stabilisation operations in Africa; and French participation in the UK-led NATO enhanced Forward Protection Force in Estonia.

United States: The UK and the US have a rich history of defence cooperation across the domains. This was extended in 2014 in to a formal US/UK Science and Technology Communiqué. This was the first such agreement the US entered with an ally, it covers priority areas such as space, data analytics, operational energy and cyber. The UK and the US also agreed to collaborate on next-generation aircraft.

The F-35 Lightning II fighter jet programme is the world's biggest and most advanced defence project. The UK is the only Tier One Partner of the US in the project. The UK is also hosting the European avionic support facility for F-35.

⁸Consular co-operation forum, made up of the UK, US, Australia, New Zealand and Canada. It meets annually at Director level and runs a number of joint working groups to develop policy, share best practice and co-ordinate efforts in lobbying third countries over their approach to consular issues.

A secure and stable environment – economic benefits

The security that Defence brings to an economy becomes most evident to the public when it is at risk or is lost. War has a devastating effect on people's lives, tearing families apart, causing the wholesale destruction of cities and countries and shattering economies. We have seen this in the horrific devastation that has occurred most recently through civil wars in Syria and Yemen. The direct and tragic human element of war is well understood; the economic impact less so. The World Bank estimated this loss to be over \$200bn in Syria for the period between 2011 and 2016, about four times Syrian GDP of 2010.⁹ The economic impact comes from:

- The direct impact of disrupted and destroyed assets based in the conflict zone.
- Lost welfare and wellbeing for individuals, from mass displacement, as well as shifts in the economy from production of consumer goods and services to the production of military equipment.
- The indirect impact on trade, tourism and general business activity caused by the conflict, as people are deterred from entering the conflict zone.

The foundation for a nation's economic growth and prosperity is a secure and stable environment; this is what Defence endeavours to ensure. This contributes directly to the UK being seen as an attractive place to invest, as noted already by the Forbes 2018 assessment. A fundamental element of this is freedom of trade.

Trade

The UK economy is heavily dependent on international trade and has been since before the industrial revolution. Trade routes provide many of the goods and services we all use every day; in 2017 Britain traded around £820bn worth of goods.¹⁰ In addition, undersea cables carry 97% of the world's communications and financial transactions totaling approximately \$10 trillion every day.¹¹ The MOD protects sea, air and land trading routes to and from the UK. 95% of Britain's trade (by volume) depends on passage of trade across the sea¹², and there are a handful of global chokepoints through which the majority of this trade passes.¹³



HMS Sutherland escorting the Russian ship Yaroslav Mudry

Around £149bn worth of cargo passes through the Suez Canal to the UK every year alone. Approximately 20% of internationally traded oil and 33% of global liquefied natural gas passes through the Straits of Hormuz, another vital trade route for the UK. Iran has publicly threatened to close the Straits twice in the last 10 years.¹⁴ Without the UK and other international navies routinely patrolling these waters, Iran may feel they can carry out these threats. The MOD has four minehunter vessels permanently patrolling the area around the Gulf. While on patrol, the vessels carry out routine surveys, sea bed clearance and mine clearance operations, thereby safeguarding the waterways.¹⁵

Tourism

The UK's tourist industry is estimated by Visit Britain to be worth 9% of GDP.¹⁶ It is evident how insecurity in other countries has affected their respective tourist economies. Overseas visitors to Tunisia fell by about 25%¹⁷ in 2015 following the Tunis and Sousse attacks earlier that year, and in 2017 tourist revenues were still nearly US \$1bn lower than in 2014.¹⁸ In Egypt, tourist receipts are estimated to have fallen by several billion dollars following international reaction to a Russian airliner being brought down over northern Sinai in 2015.¹⁹ Without the capability of our defence and security agencies, we could expect attacks in the UK to have a similar consequence.

⁹ <http://www.worldbank.org/en/country/syria/publication/the-toll-of-war-the-economic-and-social-consequences-of-the-conflict-in-syria>

¹⁰ <https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/bulletins/uktrade/march2018>

¹¹ Rishi Sunak MP, Policy Exchange, Undersea Cables: Indispensable, insecure, December 2017

¹² https://assets.publishing.service.gov.uk/_/port-freight-statistics-2016-revised.pdf

¹³ <https://www.royalnavy.mod.uk/what-we-do/protecting-our-economy>

¹⁴ <https://www.eia.gov/beta/international/regions-topics.cfm?RegionTopicID=WOTC>

¹⁵ <https://www.royalnavy.mod.uk/news-and-latest-activity/news/2018/march/26/180326-mine-hunter-puts-international-trainees-to-the-test-during-sea-training>

¹⁶ <https://www.visitbritain.org/visitor-economy-facts>

¹⁷ <https://www.reuters.com/article/tunisia-economy-tourism/tunisia-sees-record-tourist-numbers-in-2018-as-attack-effect-fades-idUSL8N1QB1TX>

¹⁸ <https://www.ft.com/content/081d7132-10c9-11e8-940e-08320fc2a277>

¹⁹ www.imf.org/~media/Files/Publications/CR/2018/cr1814.aspx

The Armed Forces have a secondary impact on the UK's tourist economy through helping attract visitors to the UK. State Ceremonial activities and guarding duties are conducted by military units such as the Household Cavalry. The events range from the daily Changing of the Guard at Buckingham Palace, on the itinerary of many visitors to London, to major events such as the State Opening of Parliament and the Queen's Birthday Parade that attract tourists in their own right. Historic military museums and air shows around the country fascinate hundreds of thousands of visitors each year, many of which are supported by Defence.

ROYAL EDINBURGH MILITARY TATTOO



Edinburgh Castle is the backdrop for the Royal Edinburgh Military Tattoo¹ – a month long event each August of music, ceremony, theatre and dance. Performers from over 48 countries have taken part in the Tattoo, and around 30 per cent of the 220,000 audience each year are from overseas.

A study by EKOS showed the event generated net additional expenditure of £64.1 million in Edinburgh, and supported the equivalent of 1,282 full time-equivalent jobs.¹

The Tattoo is a registered charity, to which Defence provides support in planning and performing.

¹ Royal Edinburgh Military Tattoo: Report for Progressive Partnership, EKOS 2012

Defence enhancing UK national life

In the past Defence has been responsible for many innovations that we take for granted today. Much of what we as consumers regard as progress through technological innovation has arisen through initial development of military capability. The internet was originally developed for secure military communications (by the US). ATM machines from which most of us receive cash rely on the Global Positioning System (GPS), also originally used for US military communication. Flat screen televisions, laptop and tablet computers and touch-screen mobile phones use liquid crystal displays originally developed in the UK by the predecessor to QinetiQ (then the Royal Signals and Radar Establishment) for military purposes. A more recent example of technology crossing-over between military and civil use is thermal imagery.

THERMAL IMAGING: MAKING EXTRAORDINARY TELEVISION



Image from BBC's Planet Earth

Infra-red detectors and thermal imaging sensors, play a crucial role in supporting military and security personnel operating in very challenging environments. Such sensors equip the Challenger 2 tank and the Chinook helicopter, and are on the flight path monitoring system for the HMS Queen Elizabeth aircraft carrier.

The BBC is just one of the media organisations to have discovered the wide capability of thermal imaging cameras, adapting them for use in wildlife documentaries. BBC production teams on "Autumn Watch" and "The Great British Year" have captured previously unseen nocturnal animal behaviour around the UK. With its all-weather capability, the technology delivered high quality images regardless of weather conditions or time of day. Thermal imaging cameras were also used for award-winning footage of leopards hunting in Mumbai in "Planet Earth 2".

Space

Satellites support our everyday lives, from smartphones and financial transactions to complex military equipment. The space industry is growing rapidly, contributing directly to our prosperity. The UK space sector has trebled in size in real terms since 2000, and the UK captures between 6.3% and 7.7% of the global market²⁰. The space sector was initially entirely government supported, based on defence objectives. It has now evolved into a rapidly expanding commercial sector as the wider benefits of space technologies and services have taken hold, with increasing reliance on space for telecoms and broadcast²¹. This is also an example where the MOD initially spawned a thriving sector, which is now offering significant innovation back to Defence.

CARBONITE-2 - AFFORDABLE SPACE TECHNOLOGY



Carbonite-2 satellite, pictured at Surrey Satellite Technology Ltd

Surrey Satellite Technology in Guildford built Carbonite-2 and launched it in January 2018. This collaboration between Industry, Defence and UK Space Agency has demonstrated that the UK can lead the way in new affordable space technologies and small satellite manufacturing.

The satellite is capable of colour imagery and full HD video; short clips have been released demonstrating the first high-definition, full-colour videos to be delivered from orbit by a commercial satellite on a regular basis. The satellite was fielded within 8 months at a fraction of the cost of other international capabilities.

Carbonite-2 is one element of an Operational Capability Programme being led by the RAF that aims to inform Defence's ambition for a future small-satellite constellation that will provide intelligence, surveillance and reconnaissance information and support the Armed Forces.

Space is increasingly congested, with risks from collision and from other nations' space activities. In addition, some nations have the ability to disrupt and destroy satellites. China has demonstrated that capability on several occasions. Space is now an operational domain for Defence. Reflecting that satellite technology is not just a crucial tool for our Armed Forces but vital to our way of life, the Defence Secretary launched the UK's first Defence Space Strategy on 21 May 2018. The strategy will examine how Defence can work with allies across NATO and the Five-Eyes partnership to protect and defend our mutual space interests.²²

The global reach of our Armed Forces depends on resilient satellite communications, currently provided by the Skynet 5 constellation. In 2003 the MOD invested £600m in resilient satellite technology, in which the UK is now a world leader, winning exports worth £1.25bn²³. The MOD was also an initial developer of some patented technologies included within the Galileo satellite constellation, being established by the EU for a European global navigation satellite system, in which continued UK participation is currently subject to Brexit negotiations. Space capabilities are evolving rapidly. Defence's space capability needs to develop to continue to secure the ability of our Armed Forces to operate. The MOD can now co-invest with industry to achieve this, as well as to attract investment and export potential. Carbonite-2 demonstrates positive early potential for this strategy.

Cyber

We all rely increasingly on networked technology in many areas of our lives: socially, at work and as part of the workings of government. This is bringing enormous and rapidly evolving changes to us all, but also creates a significant vulnerability to attack on parts of networks that are essential for the day-to-day running of the country and the economy.

International actors are increasingly exploiting those vulnerabilities. This can take a broad spectrum of forms from attempts to influence government policy or voter behaviour at elections through misinformation campaigns on social media, to compromising Critical National Infrastructure and stealing commercial secrets. The growing ability to exploit this domain has been demonstrated recently by Daesh's strategic communications campaign.

²⁰ London Economics (2016), Size & Health of the UK Space Industry 2016

²¹ <https://www.parliament.uk/documents/commons-committees/Exiting-the-European-Union/17-19/Sectoral%20Analyses/34-Space-Report.pdf>

²² <https://www.gov.uk/government/news/uk-poised-for-take-off-on-ambitious-defence-space-strategy-with-personnel-boost>

²³ MOD figure.

COMBATting DAESH ONLINE

In April 2018, the Director of GCHQ noted how Daesh understood the value of strategic communications, the power of social media, of messaging apps to radicalise and scare, and how they have done this better than any previous terrorist group.¹ He stated that Daesh understand their audience; they know potential sympathisers react well to slickly produced, unfiltered videos and magazines that can be downloaded and watched on smartphones; and, they know which platforms to use to reach them. Daesh's ability to inspire, direct and enable attacks, and the simple tactics they use make stopping attacks much harder.

Defence has worked with GCHQ in recent years to increase capabilities at pace and create robust responses to Daesh's cyber threat; conducting a major offensive cyber campaign against them. These operations have made a significant contribution to Coalition suppression of Daesh propaganda, hindered their ability to coordinate attacks, and protected UK and Coalition armed forces, operating in support of local forces on the ground in Iraq and Syria. This is the first time the UK has systematically and persistently degraded an adversary's online efforts as part of a wider military campaign.

¹ Director GCHQ, Speech at CyberUK 18, 12 April 2018

The number and complexity of cyber-attacks against us is rising sharply, as are the costs to business; the average total cost of a data breach in the UK was estimated to be £2.5 million in 2017. The average per capita cost has increased over the past years from £47 in 2008 rising to a high of £104 in 2015 and reducing to £98 in 2017.²⁴ On 12 May 2017, a global ransomware attack, known as WannaCry, hit a wide range of countries and sectors, including the NHS, where it affected 80 of the 236 hospital trusts across England.²⁵ This is despite the UK being a world leader in cyber security. Defence must continue to innovate, as it is through the National Offensive Cyber Programme (a partnership run between the MOD and GCHQ) to protect us as individuals, as well as our collective prosperity.

Cyber and Space, and Defence's ability to be agile to emerging requirements, is considered further in Chapter 5 which looks at 'Ideas and Innovation'. Chapter 6 looks at the new environment for defence procurement as we leave the EU. The direct contribution of Defence to UK prosperity though economic growth is considered in the next chapter.



A student at the Defence Cyber School in the Defence Academy, Shrivenham, at its opening in March 2018. The result of a joint investment by the MOD and the National Cyber Security Programme, the School addresses specialist skills and wider education in line with National Cyber Security Strategy objectives.

²⁴ Ponemon Institute LLC, 2017 Cost of Data Breach Study United Kingdom, June 2017

²⁵ Lessons learned review of the WannaCry Ransomware Cyber Attack, February 2018. <https://www.england.nhs.uk/wp-content/uploads/2018/02/lessons-learned-review-wannacry-ransomware-cyber-attack-cio-review.pdf>

Chapter 2: Economic growth



Key observations:

- The UK defence industrial sector is one of the world's strongest, with an annual turnover of £22 billion and supports 260,000 jobs, many of which are highly skilled and well paid. The UK is also one of the world's leading, responsible exporters of defence capability, securing export orders worth £5.9 billion in 2016.
- The difficulty in measuring the economic benefit of Defence brings a risk that its true value and importance to the economy is overlooked. In procurement decisions, it means that MOD tends to focus on relative measures of cost and capability, without a clear understanding of, or any real ability to measure, broader value to the economy.
- In its Defence Industrial Policy, and in the approach adopted in the National Shipbuilding Strategy and developing Combat Air Strategy, MOD has made progress towards considering wider economic factors early in business case development.
- There is now a need for more concerted focus by government and industry to realise the export opportunities we know exist: to improve supply chain security and competitiveness; reach out more effectively to other adjacent sectors in the economy; draw more co-investment into defence; and to explore different ways of building agility in defence procurement.

Key recommendations:

- Commission independent academic research into assessing and measuring the net economic benefit from Defence, consistent with HM Treasury's Green Book.
- Develop incentives for the Armed Forces to provide support for defence exports.
- Set clearer, practical guidance on the prosperity factors MOD is most likely to consider, the reasons for their importance and the primary metrics for assessing their value and relevance.
- Develop a common MOD-industry approach and format for collecting data around the defence supply chain, to underpin new guidance and metrics on key prosperity factors as well as to cover cyber-assurance and ownership.
- Review and align MOD resource, alongside that in wider government and industry, to promote prosperity effectively.
- Make a determined effort to increase agility and pace in defence procurement, adopting a culture more focused on finding the right procurement solutions and less on defining and avoiding obstacles at the outset.

The wider defence contribution to prosperity

The MOD budget for 2018/19 is £36.9 billion. This is due to increase in real terms by 0.5% per year during this Parliament. As already note, the primary contribution of Defence to UK prosperity is the protection it provides from external threats and aggression, which allows the economy to function peacefully. Defence also supports the international rules-based system in which growth in the world economy can take place and from which the UK benefits.

It is reasonable to assume that the benefits provided by Defence outweigh the opportunity costs of the people, capital and land employed in the public and private sectors for defence purposes. Erosion of confidence in our defence and its deterrent effect would raise the risk and cost of doing business for and with the United Kingdom. Our influence in the world would be less and the pressure that hostile actors might exert over us would be greater. For a highly connected trading nation, a drop in confidence in our defence can have disproportionate effect on everyday lives – jobs, prices, livelihoods, staying connected with the world and managing the reality or fear of scarcity. However, there remains a fundamental problem in quantifying the prosperity benefits of Defence.

The challenge of defence inflation

Defence spending rose between 2006/07 and 2009/10, but has now fallen back in real terms to around 2006/07 levels. During this time defence inflation has been positive each year, indicating that prices for defence goods and services have continued to rise. In 2015/16 defence spending increased by 2.1% while MOD's estimate of defence inflation was higher at 3.9%.¹ Defence inflation was much higher than inflation in the general economy in 2015/16: the GDP Deflator (a measure of general inflation) was 0.7% and the Consumer Prices Index was lower still at 0.1%. This illustrates that the average price paid by MOD for goods and services can often increase at a higher rate than for the general economy, resulting in a reduction in defence spending power.

¹ <https://www.gov.uk/government/collections/defence-inflation-estimates-index>

Tighter defence budgets in recent years have coincided with, and probably fueled, a growing cross-government interest in maximising the impact of defence procurement as a lever for prosperity – in addition to the core economic role that defence plays in underpinning all other activity in the economy. The 2015 Strategic Defence and Security Review (SDSR) made 'Promoting our Prosperity' a National Security Objective. MOD has met its SDRS commitments²⁶ to support innovation, refresh its Defence Industrial Policy, publish a national shipbuilding strategy, make it easier for smaller companies to do business with Defence, enhance support for exports and invest in skills and people.

The recently revised Treasury Green Book²⁷ defines and measures prosperity as 'social value'. This review illustrates examples of Defence spending leveraging value elsewhere in the economy. Many defence companies and consultants have sought to do the same through reports detailing economic impacts to the UK economy. However, Defence still faces a considerable challenge in demonstrating its total prosperity benefits given the inter-related nature of much of its supply chain with the aerospace, automotive, engineering, security and space sectors.

The problem of defence statistics

The Office of National Statistics (ONS) no longer maintains a standard industrial classification (SIC) code for Defence, primarily because of the disparate nature of defence goods and services, many of which have civil and defence uses. There have been a number of alternative proposals for defining and collecting data on the defence sector, but none has been formalised. The ONS conducts an Annual Business Survey and UK Business Register and Employment Survey. It would be of great benefit to Defence if these data sets could be developed to improve the evidence base around the sector from which broader assessments of its comparative performance and prosperity impacts might be drawn.

²⁶ National Security Strategy and Strategic Defence Review, Chapter 6 – Promote our Prosperity, Cm 9161, November 2015

²⁷ The Green Book (April 2018) is guidance issued by HM Treasury on how to provide objective evidence-based decision support information for government spending proposals. It explains how to appraise policies, programmes and projects. It also provides guidance on the design and use of monitoring and evaluation before, during and after implementation. The Green Book (p.119) defines social value as "the net measure of total welfare resulting from an option or intervention. Alternatively, it is the sum of total benefits and total costs of an intervention, including private and social costs and benefits." https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_BookGreen_book.pdf.

MOD should discuss with ONS whether existing surveys could be expanded to capture more information about spend with supply chains and prosperity, and how defence activity in the economy can be more easily identified. (Recommendation 2.1)

The MOD should commission independent academic research into assessing and measuring the total economic benefit that Defence gives to the economy, consistent with the Treasury Green Book. This research might also attempt to highlight where MOD has already generated a prosperity premium to the wider economy. (Recommendation 2.2)

The economic strength and growth potential of the UK defence sector

While there is uncertainty about how best to measure the overall value of Defence, ADS Group, the trade association, estimates that the UK defence sector has an annual turnover of £22bn and supports 260,000 jobs (140,000 directly and 120,000 indirectly), many of which are highly skilled and well paid.²⁸ The defence industrial footprint spans the whole of the United Kingdom, underpinned by an innovative supply chain, making a strong contribution to the manufacturing sector.

A significant proportion of the UK's civil aerospace suppliers also work for the defence sector.²⁹ This reinforces important, mutually supporting links and interdependencies in design and engineering. It gives critical mass to high value manufacturing in the UK, including at local and regional level.

Support for exports

The UK is one of the world's leading, responsible exporters of defence capability, securing export orders worth £5.9bn in 2016 and averaging £7.3 billion over the past ten years.³⁰ Defence exports:

- Build interoperability of equipment and doctrine with Allies and partners.
- Develop supply chains which are more robust than can be sustained by MOD alone.
- Sustain capability in a way which drives lower through-life cost of maintaining equipment in service.

Support for defence exports is led by the Defence and Security Organisation (DSO) in the Department for International Trade (DIT). The SDSR (2015) assigned responsibility to MOD for major export campaigns for Eurofighter Typhoon, complex weapons and F-35 sustainment, on the basis MOD holds the critical levers of success, including training and military assets. The Government has also committed to support the defence sector through the Defence Growth Partnership (DGP), led by the Department for Business Energy and Industrial Strategy (BEIS) but also involving DIT-DSO and MOD.

A key strand of the DGP is the Defence Solutions Centre, in Farnborough, which has now identified strategic market opportunities in 24 non-NATO partner countries over the next five to fifteen years, worth some US\$88 billion.³¹ This suggests that the UK should be able to sustain its current success in defence exports in a competitive and changing market. Through the DGP, the Defence community is working on a more strategic approach to identifying and winning export orders, including through a more concerted 'Team UK' approach.

Achieving success will require concerted effort. This requires committed senior leadership for DSO to engage at appropriately senior level with allies and partner nations. The Secretary of State for International Trade is reforming the DSO, ensuring that it has the necessary skills and structure to engage industry at appropriate levels, and balances its focus between defence and security.

The MOD should support DIT plans to strengthen DSO. (Recommendation 2.3).

Building and maintaining strong, collaborative relationships will be important. This applies across defence, but is especially the case in major defence procurements where Government-to-Government support needs to be fully aligned, as was the case in the recent successful contract award by Australia for nine SEA 5000 Future Frigates based on the T-26 Global Combat Ship design.

A good example of how this has worked is MOD's role in encouraging industry to come together through the DGP, under an independent chair, to prepare an integrated UK training offer to international partners.

MBDA are leading the Defence Enterprise Export Programme as a DGP initiative. This excellent initiative is an opportunity for industry, DSO and MOD to develop a broader pool of project management and business development skills to support strategic export campaigns.

Industry need to show more leadership in driving the 'Team UK' approach, which also needs more encouragement from MOD. (Recommendation 2.4).

²⁸ ADS Defence Outlook 2017, www.adsgroup.org.uk

²⁹ UK Aerospace Supply Chain Study, July 2016 (BIS Research Paper 294), p.26. Fig 12.

³⁰ <https://www.gov.uk/government/statistics/uk-defence-and-security-export-figures-2016>

³¹ UK Defence Solutions Centre - market projection, 2021-30 (August 2017).

Our Armed Forces remain a vital reference customer for UK defence exports, provide much-valued support in export campaigns and are instrumental in guiding how and where the capabilities they need to develop can also be made exportable. If promotion of exports is to be adopted broadly and successfully as an objective across defence, it needs to be more widely reflected in defence leadership objectives, and the benefits accruing to defence need to be shared with those units and establishments who deliver them.

Incentives should be developed for the Armed Forces (and others with a role) to provide strategic support for defence exports (Recommendation 2.5).

Access to training alongside the UK Armed Forces, as well as to UK test and evaluation expertise, can be a critical enabler for success in defence export campaigns. However, the MOD and Armed Forces’ ability to support such access can be constrained by policy in Managing Public Money on the commercial exploitation of spare capacity (often referred to as ‘irreducible spare capacity’). There is room for greater clarity around what is possible within existing policy, and potentially for additional flexibility (as with the model recently adopted for Typhoon training).

Engagement between MOD and Treasury would be desirable to improve access to training and other critical enablers for defence exports. (Recommendation 2.6)

MOD and industry should additionally bring forward proposals to improve how industry can access UK test and evaluation to support export of capability, whether in service, in development or not currently in service with the Armed Forces. (Recommendation 2.7)

It will continue to be important to avoid undue risk to MOD from any expectation that UK Armed Forces’ use or evaluation implies any performance-underwriting of an export product.

There are a number of different ways in which MOD is already working with industry to support and promote exports, and broader economic benefit to the UK economy, including two complementary models in the complex weapons sector.

MBDA AND THE COMPLEX WEAPONS PORTFOLIO MANAGEMENT AGREEMENT

MOD and MBDA signed a Portfolio Management Agreement in 2010, under which MBDA is MOD’s sole supplier for a significant proportion of its complex weapons acquisition. This approach delivers military capability matching evolving requirements of the UK’s Armed Forces and underpinning defence requirements for freedom of action and operational advantage. MOD has set a 10-year net savings target from the complex weapons pipeline (compared with estimated ad hoc procurement costs in a non-portfolio approach) of £1.2 billion¹. The agreement has been structured to contribute to the UK’s prosperity by:

- Extending the partnership between government and MBDA to cover defence exports, reinforcing the UK’s international strategic defence and industrial relationships. MBDA and Defence Equipment & Support (DE&S) assess it has delivered £600 million of gross export benefits since 2010, and that the strength of the product portfolio makes future export prospects still more promising.
- Sustaining broader industrial capability which MBDA estimates as comprising more than 3,500 skilled employees, a UK supply chain spanning 1,000 companies including 700 SMEs, and a jointly-funded international technology and innovation programme.
- Giving MBDA the long-term confidence to invest £50m in a new factory in north-west England and in a nationally-recognised early career programme for over 200 apprentices and graduates.



ASRAAM in the Environmental Laboratory.
© MBDA UK Limited

¹ Defence Equipment Plan 2017, para 24c.

RAYTHEON UK: PAVEWAY IV

- Following a contract to design and develop the Paveway IV precision weapon, Paveway IV has generated over £1 bn in UK export sales to Typhoon international customers and through Raytheon UK's broader participation in US Paveway programmes.
- The Paveway IV programme is managed by Raytheon UK's weapons team in Harlow, which the company has assessed generates over 60% UK work-share - including in-service support and the design and development of sub-systems such as Thales UK's electronic fuse.
- Raytheon UK's facility at Glenrothes in Fife is now the sole manufacturer of all Paveway GPS-aided guidance and navigation electronics, including those sold to US Department of Defense and to international customers by Raytheon Corporation. Raytheon also promotes Paveway IV export sales from the UK for Typhoon aircraft.
- Raytheon UK continues to develop Paveway IV for MOD and export customers and is funding research and development into targeting flexibility and GPS jamming protection. Raytheon UK's weapons team is also supporting the integration of Paveway IV onto the F-35.
- This accumulated investment and innovation has delivered financial and operational advantages to MOD, including exports, without imposing the full costs of developing the technology from scratch.



RAF Typhoon releases Paveway IV. Photo by Jamie Hunter

Developing and securing the supply chain

The UK defence supply chain is a vital source of innovation, expertise and competitive advantage in the UK's advanced manufacturing, new technology and service sectors. Smaller and medium-sized enterprises (SME) are key to this capability, and the Government has set ambitious targets for smaller businesses to win government procurement contracts.

The aspiration that 25% of defence spending with industry should be with small and medium-sized enterprises is challenging, given the scale of procurement through large programmes with prime contractors. It can only be achieved by taking into account indirect spending through the supply chains of prime defence contractors. This requires a greater depth of understanding about defence supply chains than is generally available to government or industry, although single source contractors are now generating this data for the Single Source Regulations Office.

The need for a better view of how defence spending flows through the supply chain coincides with heightened concern about supply chain vulnerabilities. Some specialist defence suppliers have experienced financial challenges which could adversely impact on the UK's freedom of action and operational advantage. This security risk is exacerbated by activities orchestrated by some foreign countries to obtain intellectual property from UK defence and security suppliers. These activities are often conducted through changes of company ownership and cyber targeting.

Defence needs to take a more strategic view of managing risks in its supply chain, both in understanding key UK requirements for freedom of action and operational advantage, and in how it goes about assuring the underpinning intellectual property in the supply chain. This should include stronger levels of cyber assurance and closer scrutiny of the security implications of changes in company ownership. (Recommendation 2.8)

STRATEGIC PARTNERING IN INDUSTRY

BAE Systems started a long-term strategic partnering approach in 2017 with Leonardo (UK), MBDA and Rolls-Royce, as key sub-system suppliers. The aim is to give the four companies a more holistic vantage point from which to understand and protect UK freedom of action and operational advantage, while improving value for money and competitive advantage. The approach identifies areas of alignment and considers where the companies can jointly deliver solutions for near and long-term challenges. The areas of focus are:

- Future Air sector
- Export alignment/ global presence
- Technical processes/ integration
- Operational mission support and training
- Business and commercial relationship

The partnering approach is intended to help position UK industry to respond constructively to the Combat Air Strategy due to be published soon.

Government and industry, including through the DGP and other growth partnerships, have recognised the potential to encourage defence companies (to use supply chain development schemes (including those funded by BEIS) to improve their productivity and competitiveness. This particularly applies at the mid-tier or SME level. There are good examples of this working in the civil aerospace and automotive sectors. Supply Chains for the 21st Century (SC21) is a programme overseen by the Aerospace Growth Partnership to improve competitiveness in the aerospace and defence industry by raising the performance of its supply chains. Participants achieving and maintaining criteria for delivery, quality, sustainable improvement and the associated improvement frameworks (business, manufacturing and relationship excellence) receive national recognition in the form of a Bronze, Silver or Gold performance standard award.

Defence has a close and constantly evolving association with other key sectors of the economy, to which it can offer technology and critical mass, including at local and regional level. The Industrial Strategy represents a very significant opportunity for defence and for adjacent sectors to work more closely together on supply chain

development and to build stronger relationships in ways which may not have been sufficiently well explored or exploited in the past. This is relevant to a number of areas where sector deals have already been announced or are proposed, including in aerospace, artificial intelligence, creative industries and life sciences. Many of these sectors generate innovation which is or can be adapted to defence use, which can also support the Defence Sector Deal now under consideration by BEIS.

Taking more systematic account of prosperity in defence procurement

There is a very welcome and important commitment in the refreshed Defence Industrial Policy, *Industry for Defence and a Prosperous Britain*, published in December 2017,³² to develop an early strategic outline vision for the prosperity benefits which might accrue from significant defence procurement decisions, to the benefit of the UK economy as a whole. This new approach also recognises the importance of taking account, at a similarly early stage, of wider strategic defence or international relationships, and of UK defence infrastructure and supply chain resilience needs where they are of direct importance to national security.

There is already good emerging evidence that the military requirement-setting community in defence is driving better value by engaging earlier with defence industry, potential challengers and new entrants when considering capabilities. Three developments are especially worth highlighting:

- In taking forward the **National Shipbuilding Strategy** and, in particular, the new value management approach to the Type-31e frigate competitive design phase, the MOD has introduced - for the first time in a major defence procurement - assessment criteria for broader prosperity objectives, drawing on the revised Treasury Green Book and the need to maintain critical shipbuilding skills and the UK maritime supply chain.
- The initial work in MOD on a new **Combat Air Strategy** will take this approach further, to ensure MOD's capability choices take account of prosperity, industrial capability and international influence as projects are initiated and rather than as an afterthought.
- MOD has very recently reviewed the culture, behaviour and processes in its **investment approvals**. It has recognised opportunities to improve the way it drives earlier engagement, take a risk-based approach and clarify roles and responsibilities. MOD will now move to a three-stage approvals process, adding an early "strategic outline" approval point.

³² Industry for Defence and a Prosperous Britain: Refreshing Defence Industrial Policy, December 2017.

This will help the Department identify projects early, where embracing wider strategic and policy needs (including prosperity, international, commercial and security interests) will be of particular significance, and provide for any overarching parameters/constraints to be taken into account in developing the case.



Queen Elizabeth Class project courtesy Aircraft Carrier Alliance

This new direction of travel is very welcome, not least given the widespread concerns held across Defence, including at very senior levels, about the burdens and delays inherent in the current process.

But there are three key challenges which the Department must now tackle if it is to promote prosperity more effectively, consistently and sustainably in its investment decisions:

- **Prosperity guidance.** Prosperity is often the product of a highly complex amalgam of different factors which maximise “social welfare or wellbeing” and vary in importance and relevance in each nascent procurement choice.

Further work, consistent with the Treasury Green Book, is now needed in MOD to give clearer, practical guidance on the prosperity factors defence is most likely to consider, the reasons for their importance and the primary metrics which might be used in assessing their value and relevance. It should also permit sufficient flexibility in the way in which these factors might be weighted for each major procurement. (Recommendation 2.9)

The guidance needs to consider the factors that drive broader Industrial Strategy objectives, including sustained growth in UK productivity, also highlighted in the Defence Industrial Policy³³ as key areas of focus. Discussions with companies, trade unions and defence commentators revealed serious concerns about a skills shortage and the health and size of the pool from which employees are drawn.

As a critical enabler of growth and productivity in both defence and the wider economy, MOD should focus on technical education, skills and training in shaping MOD’s strategic approach to prosperity, including when talking with potential investment partners. (Recommendation 2.10)

- **Supply chain information.** The underpinning data and evidence on the Defence contribution to prosperity at both national and regional level is still too limited, making it difficult to assess UK content. This is particularly the case with the defence supply chain – a key driver in strengthening and rebalancing our economy at regional level, and in the defence sector’s ability to give adequate assurance of the integrity and security of the components and support it provides.

MOD and its key suppliers should develop a common approach and format for collecting data, preferably based on a digital solution, to underpin new guidance and metrics on key prosperity factors. (Recommendation 2.11)

- **Resourcing prosperity in MOD.** Driving prosperity in MOD requires greater focus and investment in its own right, including in training and tailoring capacity appropriately to support key export and UK defence requirements.

MOD should resource its responsibility to promote prosperity more appropriately and effectively. This should take account of new or recent additional commitments to support strategic exports. It should also implement policy on exportability in the design and development of defence equipment, and where appropriate help exports of equipment and services not in service with the UK Armed Forces. (Recommendation 2.12)

Industry and wider government also play an important role in providing some of the resources for this work, noting the wider economic benefits and likely sources of expertise.

³³ Ibid, paragraph 20, pages 17-18.

Agility in defence procurement

The integrity of the MOD acquisition process is generally well regarded, including by industry. Discussions with industry and the defence customer (particularly in the Armed Forces) revealed continuing frustration that the Department’s approach to acquisition lacks sufficient pace and simplicity in some areas, notably for the procurement of fast-moving technology. There was quite a widespread view that there was a case for Defence to do more “off-the-shelf” acquisition for some requirements, in particular where there are few realistic alternative capabilities, dispensing with time-consuming market-scoping activities, which can become process driven “box-ticking” exercises. But this clearly requires skilled requirement-setting and a commercially intelligent client. Commercial skills across Defence, including in parts of industry in an export context, can lack both quantity and quality.

There is some good work towards improving agility in procurement. The Armed Forces are developing and testing rapid capability offices, particularly for fast-moving or innovative technology, drawing on similar initiatives in the US, covered in more detail in Chapter 4. DE&S is categorising and setting out five different “routes to market” – ranging from bespoke procurement needs to out-sourcing – while also developing six standard forms of contract. There is also a recognition that the MOD may have built more burdensome process around its strict interpretation of EU procurement law than necessary.

MOD should increase agility and pace in defence procurement, adopting a culture more focused on finding the right procurement solutions and less on defining and avoiding obstacles at the outset. This requires MOD to develop its skill-base as a client, better understanding how defence requirements and the market interact and shape each other. Building the quantity and quality of commercial skills across Defence is an important part of this work. (Recommendation 2.13)



Computer generated image of the Type 26 Global Combat Ship for the Royal Navy, designed by BAE Systems; a versatile multi-mission warship designed to support anti-submarine warfare, air defence and general purpose operations. In June 2018, Australia awarded a contract for nine SEA 5000 Future Frigates, based on this design. © 2018 BAE Systems.



Astute-class construction at Barrow-in-Furness. © 2018 BAE Systems.

Chapter 3: People



Defence's role in growing the UK's human capital

Key observations:




People, and the skills they have, are vital to the prosperity of the UK and to a vibrant and productive Defence sector. Defence is a major employer, with around 500,000 direct and indirect employees, and a major investor in its highly skilled workforce. Developing and maintaining a workforce with relevant and evolving skills and experience across Defence is essential for the sector to contribute to the prosperity of the UK now and in the future.

- Our military personnel are trained and equipped with the skills for the multiplicity of roles protecting the UK. But they also develop skills and experience that contribute to the UK's prosperity in second careers when they leave the Armed Forces, whether with four or up to 40 years' Service.
- Defence industry pay is higher than the UK average or for similar sectors, reflecting the skilled nature of the workforce. Industry analysis suggest that its productivity is improving more quickly than other sectors, though there is no accepted figure for the productivity of the defence sector.
- A key risk is the ability of Defence to develop and maintain workforces with the right skills and experience, especially in science, technology, engineering and mathematics (STEM). Defence is not alone in this challenge, nor alone in lacking a detailed evidence base that fully defines the skills problem and solutions. Defence is one of the largest apprentice providers in the UK, with over 25,500 currently enrolled, and the MOD is the single largest provider in the UK.
- Industry faces the challenge that once lost, skills are expensive and time consuming to recreate; equally research suggests that individuals can earn less when they move to other sectors.
- Employing veterans is a business benefit rather than a social good. Data on the skills and qualifications of Service leavers and their salaries in second careers is limited, making it difficult to quantify the contribution they make to prosperity.

Key recommendations:



- MOD, the Armed Forces and industry should improve their evidence base of the skills they need to meet future requirements.
- The MOD should improve the data it collects on Service leavers, including skills levels, qualifications, and post Service salaries.
- Independent research should be commissioned on the social and financial impact attributed to defence industry jobs.

People in numbers

		Regulars	Reserves*		
	Armed Forces³⁴	Royal Navy	32,480	3,595	182,845
		Army	81,120	29,710	
		Royal Air Force	32,960	2,980	
	MOD civil servants³⁵			56,870	
	Defence industry	Direct UK sector ³⁶	140,000		260,100
		Indirect UK sector ³⁷	120,100		
				Total 499,815	

* Reserves numbers include individuals who are members of the university training units: the Army's University Officers Training Corps (UOTC), the University Royal Naval Unit (URNU) and the University Air Squadron (UAS).

Numbers (rounded) currently enrolled on apprenticeship schemes

	Royal Navy ³⁸	2,570		Civil servants ³⁸	1,200
	Army ³⁸	14,800		Defence industry ³⁹	4,300
	Royal Air Force ³⁸	2,725	Total 25,595		

There are around 20,000 civilian and military personnel on apprenticeship programmes at any one time, making the MOD the single largest deliverer of apprenticeships in the UK.

Cadets⁴¹ (1 Apr 2018)

<p>Estimated 2.5 million veterans⁴⁰ living in the UK</p>  <p>Estimated 936,000 veterans aged 16-64 are economically active</p>	Sea Cadet Corps Community Cadets	14,100
	Army Cadet Corps Community Cadets	38,080
	Air Training Corps Community Cadets	31,610
	Combined Cadet Force Schools	43,400
	Total 127,770	

³⁴ UK Armed Forces Quarterly service personnel statistics: 1 April 2018

³⁵ MOD biannual civilian personnel report: 1 April 2018

³⁶ ADS Industry facts and figures 2018

³⁷ ADS UK Defence Outlook 2017

³⁸ MOD data, 17 May 2018

³⁹ ADS UK Defence Outlook 2017

⁴⁰ Annual population survey: UK Armed Forces veterans residing in Great Britain 2016, <https://www.gov.uk/government/statistics/annual-population-survey-uk-armed-forces-veterans-residing-in-great-britain-2016>

⁴¹ MOD sponsored cadet forces statistics 2018, link <https://www.gov.uk/government/statistics/mod-sponsored-cadet-forces-statistics-2018>

Defence as a major investor in skills

Defence is one of the major employers in the UK with around 500,000 people working directly or indirectly in support of the sector. The people working in defence are some of the most highly skilled, particularly when it comes to scarce STEM skills. Developing and improving the skills of the people working in Defence is a key driver to prosperity.

The MOD is the nation's largest provider of apprenticeships, with around 20,000 military and civilian personnel enrolled at any one time. MOD is on track to meet the Government target of 50,000 completed apprenticeships by 2020. Across Defence as a whole, there are currently over 25,500 people enrolled on apprenticeships.

HELPING TO INSPIRE TOMORROW'S ENGINEERS



© QinetiQ, photo by Tim Hooper.

QinetiQ run an annual powerboat challenge along the south coast. Young people design and build a model powerboat over three months, with guidance from their teachers or cadet leaders and the aid of QinetiQ experts. Finals day is hosted at QinetiQ's Ocean Basin facility in Haslar, the largest space of covered water in Europe (equivalent in volume to 16 Olympic swimming pools and containing 40,000 tonnes of water), normally used to test the designs of new ships for the Royal Navy.

Armed Forces

A career in the Armed Forces is open to all, regardless of their skill level. This includes those who have low skills levels or are not in employment, education and training as well as graduates (61% of officers and 5% of other ranks joined the Royal Navy with a degree between September 2016 and August 2017⁴²) and people with professional qualifications such as doctors.

Members of the Armed Forces receive extensive military and trade or professional training to equip them to work in a military environment. New recruits can choose from more than 200 different trades across the Royal Navy, Army and Royal Air Force, all of which come with

qualifications ranging from improvement in literacy and numeracy skills and apprenticeships through to Masters Degrees and PhDs. Many have been mapped to the national qualification framework. Qualifications may be awarded by MOD's own Defence Awarding Organisation, which provides vocational qualifications awarded in line with Ofqual's national regulatory requirements; or by other bodies such as the Institute of Leadership Management, the Chartered Management Institute or City & Guilds.

Most training for the Armed Forces is provided in-house by the single Services or the Defence Academy which, with its academic partners Kings College London and Cranfield University, provides training and qualifications up to degree level. Much of the training provided is technical, reflecting the many STEM-related roles in the Armed Forces. All three Services train and employ engineers ranging from technician to post graduate level across a range of specialisms including aeronautical, weapons, marine, nuclear and civil engineers. In academic year 2016/17, MOD personnel (civil servants and military) undertook six Nuclear MSc and 633 Technology MSc qualifications. The Defence Academy, along with the single Services, provide well-respected training to students from other nations' armed forces.

Offering training with qualifications that are recognised in the civil sector helps those leaving the Armed Forces show how the skills learned during military service can be transferred to civilian jobs. Military training creates individuals, increasingly acknowledged by employers through the Armed Forces Covenant, as productive contributors to the economy on leaving.



A team of defence engineering apprentices working on a project at an MOD Apprentice Competition.

⁴²These are estimates not official statistics. Education qualifications are not captured during the recruitment process unless they are required as a mandatory academic qualification for the role or declared by the candidate as additional information.

MOD civil servants

There are a wide range of roles available to MOD civil servants including finance, engineering, information, commercial and working for the Royal Fleet Auxilliary (RFA), as well as several development schemes and training opportunities. DE&S, the Submarine Delivery Agency (SDA) and Dstl employ large numbers of people with scientific and technical skills. Along with the rest of MOD, they offer technical apprenticeship schemes.⁴³ DE&S is also focused on upskilling its commercial staff. The pay freedoms secured in recent years for both DE&S and the SDA are critical to being able to attract and retain people with the right skills and experience.

Work is in progress in the MOD to quantify how much is invested in training the Armed Forces. The delegated nature of the MOD's budgets means that there is no single figure setting out how much is invested in training and development of civil servants.

MOD should publish how much it invests in its military and civilian workforces. (Recommendation 3.14)



Civil Servant apprentice at Dstl.

PROMOTING STEM CAREERS

Marshall has founded Cambridge Launchpad which promotes STEM careers. The scheme already has 21 business partners and 24 schools and will engage with 5,000 pupils in 2018. Their target is to expand it to cover all 200 schools in the Greater Cambridge area, so that every student in the scheme will have at least one STEM qualification, preferably more, with particular emphasis on the encouragement of young women.

Defence industry

Many defence industry jobs are engineering related and many often require high levels of skills, experience and knowledge.⁴⁴ Around 30,000 R&D and design and engineering jobs depend on the UK defence sector.⁴⁵

In 2017, there were 4,300 apprentices in the defence industry, out of a total directly employed workforce of 142,000. 53% of UK defence companies employ apprentices and trainees.⁴⁶ Fourteen of the largest defence companies provided data on their apprenticeship schemes for this review. It showed that they have had over 6,700 apprentices over the last five years. These companies also invest in the continuing development of their workforces up to degree level in technical and STEM areas, as well as in leadership and management skills, but it has not been possible to determine an average annual figure for this investment.

The average age profile in the defence industry is older than industry at large, an indicator of a more experienced workforce, albeit presenting its own challenges.⁴⁷ Two fifths of manufacturers, which include defence companies, report that more than 40% of their workforce is over 50.⁴⁸ The emergence of new technologies from adjacent industries is likely to require a different skill set, so companies need to focus on the skill mix of their workforce, as recommended by the refreshed Defence Industrial Policy.

NADIA, SOFTWARE ENGINEER APPRENTICE

Nadia was a finalist for the 2016 IET Young Woman Engineer of the Year Awards. Thales has helped her become a STEM ambassador and thought leader, to encourage a greater number of young people into engineering. Nadia was featured in the January 2018 edition of Cosmopolitan in an article to follow up from the Institute of Engineering and Technology 2016 Young Women Engineer of the Year. Nadia currently works on SONAR processing for the Astute-class submarines.

⁴³ <https://www.gov.uk/government/publications/civilian-apprenticeships-in-the-ministry-of-defence-booklet>

⁴⁴ BEIS, 'Exploring the value of defence jobs in the UK' Sept 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/641575/value-defence-jobs-uk-report.pdf

⁴⁵ ADS 'UK Defence Outlook 2017'

⁴⁶ *ibid*

⁴⁷ BEIS, 'Exploring the value of defence jobs in the UK' Sept 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/641575/value-defence-jobs-uk-report.pdf

⁴⁸ EEF, 'An up-skill battle' skills report 2016

Pay and productivity in the defence industry

Research by BEIS shows that between 2004 and 2014 there was a consistent 'wage premium' of about 20-25% for working in the defence industry compared to the rest of the economy and manufacturing, estimated in cash terms at some £10,000 per annum. Only in a brief period after the 2008 recession was there any evidence of this premium reducing. The BEIS research also estimated that between 2012 and 2014, 9-12% of the wage premium could be attributed to the consistently higher skills/experience score of defence jobs (other drivers account for the rest of the premium). This increase could partly be a result of employing people in occupations where there are skills shortages.⁴⁹

In 2017, the average salary in the UK defence industry was £39,300, 42% more than the national average of around £27,600⁵⁰. Eleven of the largest defence companies provided information on their total remuneration package⁵¹. The average package for these companies was £44,641.

In its 'UK Defence Outlook 2017' report, ADS calculate that productivity in the defence sector had grown by 23% since 2010. This growth is seven times higher than the growth of the UK economy as a whole.⁵² MOD does not assess productivity statistics across the defence industry.

Skills shortages

The shortage of people with the right STEM skills and experience is well recognised as a national issue. A National Audit Office (NAO) report following publication of the Government's Industrial Strategy noted the work in progress and the challenge. Its research indicated an undersupply of people with the right STEM skills in general terms and the lack of a solid evidence base on skills needs making it difficult to identify the full scale of the problem.⁵³

Defence has a significant number of jobs that are classed as 'hard-to-fill' by the Engineering Employers Federation.⁵⁴ Another NAO report on military skills identified the likely challenge faced by the Armed Forces of competing for more specialist technical and digital skills in competitive recruitment markets.⁵⁵ The report found Defence has not yet identified how it will meet its future skill requirement to develop the nuclear, technical, engineering and digital skills needed to meet the intelligence demands for its people to create information advantage.

All three Services have identified trades in which there are not enough trained regulars to perform operational tasks without taking action to mitigate these shortfalls, or 'pinch points'. The main trades with pinch-points are engineering, intelligence analysts and pilots, with recruitment into these trades around 18% below what is needed. The size of the shortfalls in pinch point trades has increased over the last year.⁵⁶

RAF TAKING THE STEM MESSAGE TO YOUNG PEOPLE

The RAF have made STEM work with schools one of the flagship programmes of their centenary, RAF 100. The entire programme, the largest of its type delivered by the UK Armed Forces, is free to participants. It includes:

- 100 School STEM Days.
- Primary STEM in a Box; Primary school STEM competitions; and an activity book distributed to every Primary School.
- RAF 100 Schools Project, covering eight significant events in RAF history that involved significant developments in technology.
- A Robotics Challenge, involving over 400 schools.
- Residential courses – in April 100 young people attended the first of three large residential courses– with smaller courses also organised.
- Industrial Cadet Awards and School STEM Days. In 2018 the RAF will provide 10,000 Challenger Awards and 460 Silver Awards.

⁴⁹ BEIS, 'Exploring the value of defence jobs in the UK' Sept 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/641575/value-defence-jobs-uk-report.pdf

⁵⁰ ADS 'UK Defence Outlook 2017'

⁵¹ Total remuneration package includes salary, pension and other benefits.

⁵² ADS 'UK Defence Outlook 2017'

⁵³ NAO 'Delivering STEM (science, technology, engineering and mathematics) skills for the economy', 11 January 2018

⁵⁴ EEF, 'An up-skill battle' skills report 2016

⁵⁵ NAO report HC947 'Ensuring sufficient skilled military personnel' 18 April 2018

⁵⁶ *ibid*



© Thales UK. Thales stand at the Big Bang UK Young Scientists and Engineers Fair

The Armed Forces face difficult challenges in recruiting and maintaining the required force strength. The Mark Francois Review into recruitment last year made recommendations to improve recruiting performance, including lateral entry to help resolve skill gaps.⁵⁷ Air Chief Marshal Sir Stuart Peach, then Chief of the Defence Staff, has also suggested that fitness requirements could be relaxed for non-deployable specialist skills such as cyber warfare.⁵⁸

DE&S has identified skills gaps within its cadre of commercial officers. These are being addressed by training, secondments and lateral entry through external recruitment.

In its 'UK Defence Outlook 2017', ADS identified the top three areas where defence companies lack confidence in being able to access specific skills as: design and engineering; research and development; and production and assembly. One in three companies are concerned about securing the required R&D and design and engineering skills⁵⁹, while 18% of defence businesses expressed concerns about accessing the next generation of skilled workers through apprenticeships and training.⁶⁰

This was echoed in discussions with senior industry figures, with fourteen of the top defence companies providing their top three gaps for this review. The top skills gaps were engineering, especially systems and software engineering, and cyber, with others including project management, digital and naval architects. With its ageing workforce and changing age demographics in the UK, industry needs to think carefully about how it will meet its skill and experience requirements in future years.

The impact of Brexit is hard to predict, but while many defence industry occupations are for UK nationals only, some major defence suppliers noted the increased challenge they may face in finding engineers with the necessary skills if the pool of qualified engineers were to tighten across the UK. These concerns were echoed by some major science and engineering trade bodies.⁶¹ A recent study identified the potential loss of EU workers as a significant risk, particularly for bigger companies who are more likely to employ EU workers. In a sector where there are already shortages in skilled trades and technical and professional roles such as engineers, losing more skilled workers through Brexit may place pressure on defence employers.⁶²

MOD and industry should improve their evidence base of the skills they need to meet future requirements. (Recommendation 3.15)

Impact of loss of skills on the defence industry

In discussions with industry and the Trade Unions there was a concern that jobs and skills lost by the defence industry can be difficult and expensive to recover.^{63,64} The technical personnel, designers, builders and programme managers working on technical defence projects represent pools of knowledge that take years to collect and cannot be easily or quickly replicated or replaced.⁶⁵

A report by the Royal United Services Institute (RUSI), based on job data about BAE Systems employees who left the company, challenges the assumption that skills in the defence industry self-regulate through market forces. Their analysis suggested that 80% of people leaving a defence business are lost to the defence sector as a whole, rather than moving into another defence business.⁶⁶

BEIS have also identified that individuals entering defence businesses received a pay rise 5% greater than those moving out of defence businesses. As this is based on repeated surveying of the same individuals through the ONS Annual Survey of Hours and Earnings (ASHE), the relative difference of pay is on average only due to the change of sector.⁶⁷

With the exception of work by the Trade Unions and the RUSI study, most research on the impact of defence industry job losses dates from the 1990s. These surveyed former defence industry workers who had lost their jobs,

⁵⁷ Mark Francois, 'Filling the Ranks', July 2017

⁵⁸ Keynote valedictory address: Air Chief Marshal Sir Stuart Peach at the Policy Exchange 5 June 2018 <https://policyexchange.org.uk/pxevents/keynote-valedictory-address-air-chief-marshal-sir-stuart-peach-gbe-kcb-adcdl-as-chief-of-the-defence-staff/>

⁵⁹ ADS 'UK Defence Outlook 2017'

⁶⁰ ADS 'UK Defence Outlook 2017'

⁶¹ See for example: Engineering the Future, Engineering a future outside the EU, October 2016; Confederation of British Industry, Making a Success of Brexit', December 2016.

⁶² EEF 'Executive Survey: manufacturers expectations for the year ahead (2018)'

⁶³ See for example RUSI 'The twenty-first century armoury – a town called Barrow' November 2017, (<https://rusi.org/publication/rusi-journal/twenty-first-century-armoury-town-called-barrow>)

⁶⁴ See for example GMB report: <http://www.gmb.org.uk/turning-the-tide.pdf>

⁶⁵ RAND 'Learning from experience Volume III: lessons from the United Kingdom's Astute submarine programme' RAND monographs 2011 (https://www.rand.org/content/dam/rand/pubs/monographs/2011/RAND_MG1128.3.pdf link to monograph)

⁶⁶ Louth, Taylor & Heidenkamp 'Defence Skills: a shift in the myth' RUSI Briefing Paper June 2014

⁶⁷ BEIS 'Exploiting the value of defence jobs in the UK', Sept 2017.

for example following shipyard closures with significant localised impact. Typically these found that around 50% of those who had lost their jobs were still unemployed, and those in employment were in jobs that tended to be lower paid and skilled, and less secure.⁶⁸



Graphic of the design concept of what the Royal Navy's Type 31e frigates may look like.

Research conducted by the MOD to support its National Shipbuilding Strategy suggested that the Royal Navy's shipbuilding programme supports up to 25,000 UK jobs (direct and indirect). Work commissioned by IPSOS MORI also suggested that at a local level, an increase in shipbuilding work helps to create demand for additional high-skilled manufacturing jobs in the surrounding area, although these could be at the expense of lower paid and lower skilled service sector employment.⁶⁹ Building the Queen Elizabeth Class aircraft carriers contributed between 7,000 and 8,000 highly-skilled jobs across the Aircraft Carrier Alliance partners and their shipyards, and created an estimated further 2,000 – 3,000 jobs throughout the supply chain.⁷⁰

As well as the personal and localised impact, creating new jobs or replacing those that have been previously lost, can impact on MOD and industry. In its study on lessons from the Astute submarine programme, RAND note that the atrophying of submarine design and build skills resulted in a longer and more costly procurement.⁷¹ This is the so-called 'green labour' effect, with a cost to both MOD and industry.

Increasingly civil aerospace skills are interdependent with military aerospace industry skills. The upcoming Combat Air Strategy is likely to play an important part in determining UK capacity to design, develop, manufacture and integrate systems in military combat aircraft for the future.

Independent research should be commissioned on the social and financial impact attributed to defence industry jobs. (Recommendation 3.16)

PUTTING SCIENCE INTO ACTION

In 2017 Raytheon employees and Army personnel attended a pilot Army Cadet STEM camp. The Camp, known as Exercise "SCIENCE IN ACTION", brought together 70 specially selected Army Cadet Force and Combined Cadet Force cadets (aged 15-18) studying STEM subjects at school or college. This exciting, hands-on camp combined scientific theory with practical sessions to give cadets a real insight into how the Army uses STEM. Cadets could see the STEM theories covered in school demonstrated in an exciting, real-world way in an outside classroom, benefitting from expertise of soldiers from six technical regiments of the British Army. STEM employers spent a day observing cadets learning and applying various STEM skills. Raytheon employees met the cadets to demonstrate how STEM is used within the workplace.

Sharing skills across the defence community

MOD is collaborating with Industry on the critical skills challenge through the 'Enterprise Approach'. This is exploring how supply and demand for skills could be better anticipated, shared across organisational boundaries, and responsive to changes in technology. It commenced with a case study on nuclear skills. Through the Nuclear Skills Strategy Group, the MOD is involved in developing a mobilisation model for sharing and transferring skills across nuclear civil and defence employers.⁷²

The second stage is looking at how the model could be applied in other areas with skills shortages – cyber, logistics, health, and complex weapons engineering. The MOD is working with a range of new partners, and early sector skills analysis has shown common areas of need and the potential for shared solutions. This work is due to finish by the end of 2018.

In specialist sectors such as space and cyber, the Armed Forces should consider facilitating whole career flexibility with secondments across Defence, including in industry, at points during careers to remove barriers and retain skills. (Recommendation 3.17)

⁶⁸ See for example 'The Impact of Dockyard Redundancies at Plymouth', Gripiaios and Gripiaios, Defence Analysis, 6:3, 1990 and A survey of Former Swan Hunter Shipyard Workers, Tomany et al, University of Newcastle; The Local Impact of Rolls-Royce Closure, Fraser of Allander Institute, Report prepared for East Kilbride District Council, 1995

⁶⁹ National Shipbuilding Strategy: the future of shipbuilding in the UK 2017

⁷⁰ Oxford Economics, 'The impact of BAE Systems on the economy', 2015

⁷¹ RAND 'Learning from experience Volume III: lessons from the United Kingdom's Astute submarine programme' RAND monographs 2011 (link to monograph)

⁷² Nuclear Skills Strategic Plan' Dec 2016, <http://www.cogentskills.com/nssg/strategy/>

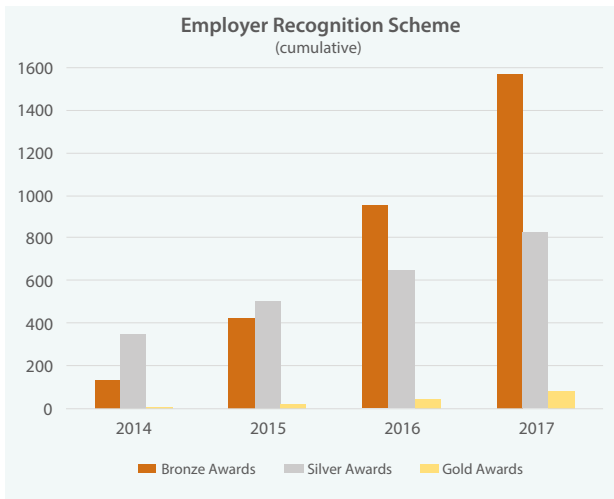
Armed Forces Covenant in business and the community



The Armed Forces parading at the start of Armed Forces Day 2017 in Liverpool.

Over 2,400⁷³ organisations have pledged their support to the Armed Forces Covenant, most from outside the traditional defence sector, making a statement to the Armed Forces community that they are valued by society.

The growing numbers of organisations putting in nominations for an award, and in some cases applying to upgrade their award level, shows how much organisations value the Armed Forces and the skills military personnel bring.



Source: Defence Relationship Management

The Employer Recognition Scheme was launched in 2014. It recognises support to the principles of the Armed Forces Covenant, particularly to the Reserve Forces and veterans. Bronze, Silver and Gold awards recognise increasingly higher levels of commitment, including to employing current and former military personnel.

Giving back – the role of reservists and veterans

There are many benefits to businesses of employing trained military personnel as they bring a portfolio of skills and behaviours beneficial to a modern working environment. A survey of public opinion by PWC revealed that people consider the Armed Forces to be a valuable training ground not just for the military and defence industry, but for the UK economy as a whole, offering young people secure employment that provides relevant, life-long skills.⁷⁴ 63% of veterans of working age are more likely to have gained a qualification through work than those who have not served in the Armed Forces (45%). This is likely to be a result of the training opportunities offered by the MOD.⁷⁵

Research undertaken for the MOD measures the attitude of employers to Reservists. The latest research showed that 90% of employers surveyed believe Reservists are an asset to the UK's workforce and 91% believe that employers can benefit from the skills and experience that Reservists bring.⁷⁶ This is supported by an earlier study of organisations that have employed veterans, who are positive about the value and skills they bring.⁷⁷

⁷³ As at 20 April 2018

⁷⁴ PWC Forces for Change 2017 <https://www.pwc.co.uk/government-public-sector/assets/forces-for-change-2017.pdf>

⁷⁵ MOD statistics: Annual population survey: UK armed forces veterans residing in Great Britain, 2016

⁷⁶ The Defence Relationship Management: Employer Attitude Monitor* produced by IFF Research for the Ministry of Defence dated Apr 2018

⁷⁷ Deloitte, 'Veterans work: recognising the potential of ex-service personnel' 2016



Reserve Engineers from 75 Engineer Regiment building bridges in Germany.

EMPLOYING RESERVISTS, BENEFITTING FROM THEIR SKILLS AND EXPERIENCE

Many defence companies appreciate what veterans and reservists can bring. Serco employ 160 reservists and veterans, as well as encouraging more staff to join the reserves. After serving in the Royal Navy for 25 years, Julian joined Serco in 2014 and works at Royal Naval Air Station (RNAS) Culdrose, the largest helicopter base in Europe with over 75 aircraft and 3,000 personnel. He is also a reservist, and in that role Julian gives 17 working days each year to support the engineering team working on the maintenance of the Navy's Merlin helicopter fleet. He uses his extra 12 days of annual leave to accommodate these days, along with some of his own annual leave. Julian sees this positively as his opportunity to step back into his uniform and look at the work he does from the customer side.

Approximately 14,500 people leave the Armed Forces each year. The MOD is therefore one of the largest providers of skilled workers joining the civilian workforce in the UK. The Career Transition Partnership (CTP) helps service leavers obtain jobs in the civil sector, with over 82% of those leaving gaining employment within 6 months, suggesting that veterans generally find jobs quickly. 22% of service leavers go into skilled jobs while 20% go into professional and technical professions.⁷⁸ Veterans in employment, particularly those aged 35 to 49, are significantly more likely to work in the 'public administration and defence' sector (12% compared to 6% of the general population), including civilian roles in MOD, the prison service, NHS and Police and Fire Services.⁷⁹

A Deloitte study has shown that veterans score well in picking up specialist knowledge and oral communication, as well as cross-functional skills like team working, positive attitude, problem solving and managing or motivating staff. Earlier research identified these sorts of skills as being increasingly important in the future. It also highlighted the issue of public perception of veterans as suffering some form of physical, emotional or mental health problem, and that its research did not support this perception⁸⁰.

Data on the level of skills and qualifications attained by members of the Armed Forces at the time they leave their Service and enter a second career are not available, making it difficult to demonstrate the full value they offer to future employers. There is also no data on the salaries of veterans which would help show the value to the economy of this group of skilled people, all of whom leave with more skills than when they joined.

The MOD should improve the data it collects on Service leavers, including skills levels, qualifications, and post Service salaries. (Recommendation 3.18)

The capabilities and mindsets of staff in turn influence the MOD's ability to innovate and accept new ideas, covered in the next chapter.



© KPMG 2018. KPMG employs around 200 veterans. It runs the 'KPMG Military Internship Programme' that offers six-month internships to service personnel as their first jobs on leaving the Armed Forces. This scheme attracts and develops veterans and reservists into roles at KPMG. So far around 40 interns have been recruited into a wide range of positions with a 100% conversion rate from internship into full time roles.

⁷⁸ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/675956/20180125_-_CTP_Statistical_Bulletin_-_O.pdf

⁷⁹ MOD statistics: 'Annual population survey: UK armed forces veterans residing in Great Britain, 2016' <https://www.gov.uk/government/statistics/annual-population-survey-uk-armed-forces-veterans-residing-in-great-britain-2016>

⁸⁰ Deloitte, 'Veterans work: recognising the potential of ex-service personnel', 2016.

Chapter 4: Ideas and innovation



Key observations:

- Defence has historically been a major source of ideas and innovation, many of which have been adapted for wide civilian use. But reliance on MOD as principal customer can hamper innovation by industry.
- Investment in UK defence R&D declined as defence budgets came under pressure.
- Innovation and technological advances are key both to military superiority and to growth of exports.
- Innovation within Defence is typically small scale, and can be hindered by 'rigid' procurement process with aversion to risk and a culture that does not encourage innovation.
- Suppliers who want to do business with MOD risk being deterred by continual ambiguity over ownership rights to intellectual property.
- The commitment in the refreshed Defence Industrial Policy to make it easier to do business with defence is welcome, particularly for innovators, SMEs and non-traditional defence suppliers.
- MOD launched the Defence Innovation Initiative in 2016 and has also established a number of internal organisations and other initiatives to improve innovation.
- Technological approaches, notably open architecture, allow Defence to cut costs and keep pace with technological change.
- There is increasing interest from investment companies in 'MilTech' (defence, security and cyber).

Key recommendations:

- MOD needs to scale up its approach to innovation so that it becomes an integral part of larger procurement.
- Measure the benefits of Defence R&D spending to the wider economy to justify R&D investment.
- MOD should consider whether its commitment to spend 1.2% of the Defence Budget on S&T is sufficient following the Government Industrial Strategy target to raise total R&D investment to 2.4% of GDP by 2027. The current level of funding of MOD's Innovation Fund should be maintained, if not increased, and its spending profile brought forward.
- MOD should develop further co-funding between the Innovation Fund and individual Front Line Commands to encourage take-up of innovation into use.
- MOD needs to encourage business to align their R&D with Defence needs.
- The MOD should look at how it can use emerging procurement structures in tandem with its existing procurement organisations to speed up acquisition and deployment of new capability.
- The uncertainties over Intellectual Property ownership need to be resolved so as not to discourage defence innovation happening in the UK.
- MOD should explore opportunities to deploy part of its Innovation Fund alongside MilTech development capital either through a dedicated structure or by developing relationships with trusted investors.

Innovation and new technologies, particularly information technologies, are changing the world in which we live. While they provide advantages and opportunities for Defence, they also create threats. Many new technologies are available to those who would use them against the UK, making it vital to adapt and innovate to combat these threats.

Innovation is key to maintaining military advantage into the future. Investing in defence R&D is essential to create operational advantage in defence capability.

A study in 2006 demonstrated a positive relationship between annual defence R&D spending some 10 to 25 years earlier and deployment of military capability. The US defence industry also had an international competitive advantage reflected in its defence export performance 10 to 25 years after the original R&D investment.⁸¹ The Government recognised the importance of R&D in the 2017 Budget, including by re-classifying it as capital expenditure.

To be innovative requires change, whether to systems, products, processes or markets. This can be disruptive, if the change is unexpected or where traditional industries and organisations with well-established culture and process go through a period of transformation to the way they do business.

Defence R&D can also result in unanticipated applications in military or civilian spheres, which deliver benefits to the public through new military capability products that boost the UK economy.

BRITCLOUD: MOD AND INDUSTRY R&D INVESTMENT KEEPING RAF PILOTS SAFE... AND CREATING AN EXPORT PRODUCT



BriteCloud Miniature Missile Decoy
Packed with missile-confusing advanced electronics.

BriteCloud is a world-leading expendable decoy that acts as a radar-jammer to counter the threat to aircrew from radar guided missiles

Investment from MOD's Chief Scientific Adviser of £13 million, alongside £12 million from DE&S, supported the pioneering research that led to BriteCloud. Collaboration with leading UK companies delivered the solution. Leonardo has invested more than £10 million into BriteCloud development and the work sustains around 25 jobs at its Edinburgh and Luton sites. Other companies in the supply chain include Chemring and QinetiQ, based in Hampshire and Wiltshire.

A battery powered, self-contained decoy draws missiles away from aircraft by breaking the missile's target lock, ensuring there is a large distance between the decoy and the aircraft. This means the pilot can effectively 'fire and forget' BriteCloud, safe in the knowledge that anything detonating will not affect the aircraft. This innovative technology is the size of a drink can, is relatively cheap to produce, straightforward to use and has low maintenance costs.

BriteCloud can easily be carried by a range of aircraft and exported to allies and partners. MOD procured the decoy in 2016 and it is deployed on Tornado GR4 fast jets. The world-leading decoy has generated international interest from UK allies. UK and Japanese industry are working together to develop the decoy further. Sweden has purchased BriteCloud and a square variety has been produced which is compatible with other aircraft used by NATO and other international parties.

⁸¹ Middleton, A and Bowns, S with Hartley K and Reid, J (2006) 'The effect of defence R&D on military equipment quality', published in Defence and Peace Economic, 17(2), pp117-139.

The role of ideas

Defence's role in generating ideas can make a significant contribution to the wider Industrial Strategy, creating an economy that boosts productivity and earning power throughout the UK.

The ability to develop new ideas and deploy them is one of the UK's historic strengths. British brains gave the UK the tank, the fighter aircraft, radar and the jump jet. British defence research and innovation gave the world technology that we now take for granted, such as microwave ovens and liquid crystal displays.

The Government Industrial Strategy emphasised that investment in R&D improves the productivity of the economy. Other government departments use public money to help fund investment in R&D, structured through accelerators, catalysts and direct investment. They also point to the wider benefits to the economy beyond the single firm or organisation that undertakes the work.⁸²

Successful defence R&D benefits will primarily benefit the Armed Forces in the form of improved military capability. But some benefits should feed into the wider economy when technologies are developed into civilian applications.

Military ideas, civilian benefit

FROM SUBMARINE HUNTING TO MORE EFFICIENT RAILWAYS

QinetiQ's Distributed Acoustic Sensing (DAS) solutions were born from the processing capability needed for the data created looking for the threat from hostile submarines. The technology has now solved challenges in civilian markets, including transport.

QinetiQ's OptaSense develops fibre optic cable for the national railways of Germany, Switzerland and Japan as well as other major railway clients across the world. DAS is used to deliver a wide range of information back to control rooms, including monitoring the condition of train wheels and tracks; detection of real-time attempts to trespass on the railway or to steal cable; detect rockfall in remote areas; monitoring of the speed and location of trains.

SORTING THE MAIL - WITH THE FRUITS OF DEFENCE RESEARCH

Lockheed Martin develops, deploys and maintains, from the UK, a range of complex solutions for the Royal Mail, PostNord, US Postal Service and Australia Post.

As a result, more than 25% of the world's automated letter mail is sorted by Lockheed Martin recognition systems using sophisticated artificial intelligence routines, which were originally developed to meet a defence requirement. This recognition technology is also used to help in storm damage assessment in the US. It was developed in Hampshire, employing approximately 120 UK staff.



Air Handling Units for Concourse A at Heathrow's Terminal 5

MODULAR CONSTRUCTION

Babcock were responsible for 50% of the detailed design of the new Queen Elizabeth Class aircraft carriers as part of the Aircraft Carrier Alliance. Babcock is now using its expertise in modular construction to offer cost-effective solutions for critical systems at the new Hitachi Wylfa power station project. That experience in complex naval design also allowed Babcock to deliver over 1,500 mechanical / electrical modules for Heathrow Terminal 5 and the plant rooms for the Queen Elizabeth Hospital in Birmingham.

⁸² <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>

Investment in ideas

Commentators have questioned the MOD’s commitment to R&D, halving its spending between 2002/03 and 2015/16 while the defence budget remained the same size in real terms.⁸³ In 2016, according to ONS, the Defence sector spent £1.8bn on R&D in the UK, an increase of 4% from 2015, representing 5% of total UK R&D expenditure. ONS also identified that Defence R&D expenditure has declined by 61% since its 1990 peak of £4.5bn, while defence industry R&D spending has fallen by 48%.⁸⁴

The decline in Defence spending since the collapse of the Soviet Union has had a knock-on effect on overall Defence R&D spending. The UK defence industry historically has relied heavily on government spending rather than funding its own R&D. This reflects that government is both the main customer of the defence industry, as well as having quite proper control (through a different department) of its export potential through the licencing system for defence exports. It can also suggest that industry lacks clarity on the areas of interest of its main customer which is needed for a company to make an internal case to invest its own funds in R&D with sufficient confidence in a financial return. While companies are beginning to spend more on R&D⁸⁵, data provided by 13 defence companies for this review suggested that they invested £380m in R&D in their most recent financial year.

RAIT: COMPANY-FUNDED RESEARCH

Using its own resources, SEA has developed a new miniaturised sonar array, much smaller than those in current use. It will allow very light vessels, including unmanned vessels, to detect submarines at long range. It has been tested successfully by the Royal Navy and is being sold to the US in increasing numbers. Many more opportunities have been identified.

The Government Industrial Strategy acknowledged that R&D funding needs to grow, and committed to raising total R&D investment to 2.4% of GDP by 2027. It also recognised that the private sector is not investing enough in R&D.⁸⁶ As well as its commitment to innovation, SDSR 2015 saw MOD repeat its 2010 commitment to dedicate 1.2% of the defence budget to science and technology (S&T) over the course of the Parliament. This was regarded at the time as a bare minimum, but in the light of the Government’s new target for the economy as a whole, the MOD should reflect, as part of the allocation of priorities in the next Spending Review, whether this is adequate.

MOD to consider whether its commitment to spend 1.2% of the defence budget on S&T is sufficient following the Government Industrial Strategy target to raise total UK R&D investment to 2.4% of GDP by 2027. (Recommendation 4.19)

INVESTING IN CUTTING-EDGE INNOVATION



© Copyright Reaction Engines Ltd. Synergetic airbreathing rocket (SABRE).

The UK Space Agency and BAE Systems have invested in Reaction Engines Limited (REL), a UK SME with a unique hybrid air/rocket engine that could provide reusable, single- and two-stage-to-orbit systems and hypersonic platforms, delivering strategic air capability that would dramatically reduce the cost and speed of access to space. BAE Systems invested £20.6m in 2015, taking a 20% shareholding and is providing its expertise in aerospace materials, system and integration design, as well as safety of operation, to enhance REL’s ability to develop a prototype engine into a capability with significant potential defence and commercial applications. Other defence industry contractors have recently also invested in REL, including Boeing and Rolls-Royce.

⁸³ Louth, Taylor & Tyler Defence innovation and the UK: responding to the risks identified by the US Third Offset Strategy RUSI occasional paper, July 2017

⁸⁴ <https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/ukgrossdomesticexpenditureonresearchanddevelopment/2016>

⁸⁵ *ibid*

⁸⁶ <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>

The defence budget is set to rise modestly over the next few years. As the current S&T spending target is expressed as a percentage of the defence budget, MOD's expenditure on core S&T will increase in line with the overall budget rise. The MOD has set aside £800m over ten years for an Innovation Fund, aimed at harnessing the entrepreneurship and ingenuity of the private sector, including SMEs. This represents around 1% of the Defence Equipment Plan for the same period.⁸⁷ The Fund aims to get innovation solutions into operational use within three years. MOD and industry face the challenge of meaningful investment of this money. As it is loaded towards the end of the ten-year period, very little of this will have effect during this Parliament. Without sufficient investment, the UK could lag behind its allies and competitors.

The current level of funding of MOD's Innovation Fund should be maintained, if not increased, and its spending profile brought forward. (Recommendation 4.20)



© Thales UK. Inside the laboratory of the new Thales Biological Surveillance and Collector System, designed to protect UK's deployed forces from biological attack by detecting incoming attacking particles in the air through specialised sensors and evaluating equipment. The system was designed by Thales, in partnership with Dstl, DE&S and 26 UK-based suppliers including 17 SMEs.

REVOLUTIONARY NEW TITANIUM MANUFACTURING PROCESS

Defence supported research has discovered a ground-breaking manufacturing process which could halve titanium production costs. The new process, known as FASTForge, will make titanium easier as well as cheaper to produce. It has the potential to revolutionise industry in the UK. The MOD invested £30,000 in the research at the University of Sheffield.

Titanium is as strong as steel and half its weight. This makes it an ideal material for use in both defence and industry, but at ten times the cost of steel, it's not always a viable option.

The FASTForge process will reduce the number of production stages from 40 to two which is key to lowering titanium's cost. The ready availability of titanium is crucial for industry as well as for Defence, particularly for the UK's growing aerospace manufacturing sector. Titanium is also widely used in the oil and gas, medicine, and transport industries as well as by jewellery manufacturers: improved production processes could bring significant benefits to these industries.

The successful small-scale trials of FASTForge at Sheffield University mean that larger-scale testing can now be explored. This testing is currently taking place at a specialist site at Kennametal Manufacturing (UK) based in Newport, South Wales.

With the intellectual property behind FASTForge owned in the UK, this world-leading manufacturing technology has the potential to generate a major boost to UK productivity and prosperity.

⁸⁷ Louth, Taylor & Tyler 'Defence innovation and the UK: responding to the risks identified by the US Third Offset Strategy' RUSI occasional paper, July 2017

The MOD's approach to ideas

In 2016, MOD launched the 'Defence Innovation Initiative', to shift cultural thinking across the Department and create a systematic approach to promoting innovation. By fostering entrepreneurial spirit and investing in skills, the Initiative aims to help the UK to maintain an operational edge over adversaries and contribute to prosperity.

The Initiative is supported by a number of separate entities, which MOD is seeking to coordinate more coherently through its Innovation Champion:

- The Defence and Security Accelerator (DASA), which helps UK military and security users access innovative ideas, equipment and services more quickly.
- The Innovation Fund to take forward best ideas from inside and outside Defence through open competition.
- The Innovation and Research Insights unit (IRIS), which briefs defence and security leaders on emerging technologies such as machine learning, autonomy, and quantum computing.
- Defence Innovation Unit to co-ordinate activities across Defence, share best practice, exploit opportunities across Government and internationally, and manage the Innovation Fund.
- The innovation hubs set up by each of the four Front Line Commands to drive innovation change in their own organisations.

MOD's investment in S&T is another major driver of innovation. The Defence Science and Technology Strategy,⁸⁸ launched in 2017, aims to direct and apply innovative research and thinking to meet current and future strategic needs of defence and security. It sets out an increased emphasis on strategic and high-risk, high-reward S&T, with the aim of exploiting the most promising emerging technologies to modernise UK defence capability. The strategy also includes partnering with industry, academia and internationally with our allies.

The MOD is seeing some success with developing technologies through the Innovation Fund. In its first full year, DASA have run a number of themed challenges, receiving over 700 proposals and distributing over £13m of funding. For its first external challenge, 'Revolutionise the human information relationship for Defence', 70% of the successful bids came from SMEs or academia.

MOD should maintain its priority on driving innovation, perhaps by further developing co-funding between the Innovation Fund and individual Front Line Commands to encourage take-up into use. (Recommendation 4.21)

USING NATURE TO INSPIRE WORLD-LEADING DRONE CAPABILITY

Animal Dynamics is a spin-out from Oxford University. £1.5m funding from the MOD's Chief Scientific Adviser helped it to develop a micro-drone, Skeeter, inspired by the biology of a dragonfly with flapping wings that deliver revolutionary flight performance. MOD's investment helped the fledgling business to grow, patent its innovation and secure a further £1.7m of private investment. At the same time as having the potential to offer game-changing technology to the Armed Forces, it could bring wider benefits outside Defence through potential civil uses like search and rescue or surveying.



Animal Dynamics' Skeeter in the hand.

⁸⁸ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/655514/Science_and_Technology_Strategy_lowres.pdf

The MOD is also examining policies to help Defence achieve information advantage.⁸⁹ One priority is open architecture IT infrastructure,⁹⁰ which allow easy upgrades for information systems and equipment. Costs are reduced as MOD can adapt or create products that connect into open architecture, and procurement is simplified as new technologies and upgraded or new software applications can be readily incorporated into existing systems. Open architecture also makes UK equipment more attractive for export, as other nations can more easily adapt using their own systems or applications. The Type 31e frigate is the first major platform being specified to require an open architecture system.

MOD should adopt open architecture across the defence spectrum. (Recommendation 4.22)

DIGITAL DEFENCE: OPEN ARCHITECTURE IMPROVES COLLABORATION

Defence is increasingly adopting open architecture to make the most of new digital capabilities for the Armed Forces and provide opportunities to pull in the best ideas.

- In 2012 2iC, a micro SME start-up, won a MOD Centre for Defence Enterprise (CDE) R&D project, worth £87k, for a Proof-of-Concept demonstration of Battlefield Interoperability. The software that resulted from this research, named the Lean Services Architecture, was published by MOD in 2014, under the Open Government Licence. 2iC then went on to develop a suite of commercial software products which were sold to (amongst others) Ultra Electronics, BAE Systems, Thales, Lockheed Martin and Leonardo in the UK, and internationally to the New Zealand Defence Force and the US Special Operations Command (SOCOM). The combined value of these initial (trial) software licence orders alone was over £500k.
- General Dynamics UK are developing the Army's next-generation tactical communication and information system via a new open standard, available to wider industry. This open, modular system will connect deployed tactical forces and their Commanders, improve access to operational IT and simplify the user experience. The system will enable new technologies to be rapidly integrated, to tackle emerging threats and enhance interoperability with allies.

Below a certain threshold under EU procurement rules, the process of investing in S&T and innovation can be much faster and more flexible. In some cases, MOD has taken the decision to invest in a proposal put forward through DASA in as few as 15 days. While this sort of timescale is not realistic for larger procurement, it represents considerable progress for the MOD in becoming more agile, and may provide a template for other parts of the procurement regime.

HELPING BRITISH ATHLETES



Helping Britain's BMX riders to be the best they can be.

BAE Systems is UK Sport's Official Engineering Partner, helping British athletes to achieve sporting excellence through the application of cutting edge technology and engineering solutions. Using its engineering knowledge, facilities and expertise to support UK able bodied and para athletes, BAE Systems has supported over 250 athletes from 30 different sports including speed-skating, windsurfing, track-cycling, taekwondo, bobsleigh, pentathlon and sailing. Innovative solutions include the UK's first computerised indoor training simulator for racing wheelchairs; a redesigned skeleton sled for Team GB and a new tracking system to capture the real-time speed and height of BMX riders as they jump. BAE Systems continues to support UK Sport in the lead up to Tokyo 2020. This work not only benefits athletes; it also drives BAE Systems' workforce to become more innovative and entrepreneurial on smaller projects that can carry across into defence.

⁸⁹ Defined by a US Department of Defense body as 'The superior position or condition derived from the ability to securely access, share, and collaborate via trusted information while exploiting or denying an adversary's ability to do the same.'

⁹⁰ Open architecture is a type of computer architecture or software architecture that is designed to make it easy to add, upgrade and swap components.

Barriers to success

These initiatives are all promising and show MOD's increasing level of commitment to ideas and innovation. But it faces barriers to making this truly successful. MOD needs to bring innovative ideas into service more rapidly, particularly on equipment, if it wants to cut costs and gain operational advantages.

Scale of ambition

The dedicated Innovation Fund is a visible marker for MOD's commitment to innovation. But the current approach of investing small amounts is delivering correspondingly small results. To derive full benefit from this investment, MOD needs to look at how it can make best use of the Innovation Fund to trigger greater exploitation of the money it has committed to spending on S&T and pulling through ideas into procurement at project and programme level, including how to exploit investments made in the civil sector. There is also a fragmented approach to innovation, with pockets of expertise across MOD. MOD needs to build on the initial work of the Innovation Champion and the Defence Innovation Unit to bring more coherence and to consider business benefit as well as technology solutions. The commitment in MOD's Innovation Initiative to improving innovation culture is also a positive step to mainstreaming innovation into Departmental thinking.

The MOD needs to scale up its approach so that innovation becomes an integral part of larger procurement. (Recommendation 4.23)

Process constraints

Traditional procurement processes are also problematic. The pace of change of both threat and technical innovation far outpaces the MOD's current ability to respond. The procurement process is neither fast nor agile enough to give our Armed Forces the latest technologies in their equipment, especially through data and software. British equipment can also be less attractive for export where other nations may be quicker at getting new technology into equipment brought to market. The way the MOD budgets for major equipment programmes can mean funding for software and other IT, which is not commissioned until the final stages of the project, can be vulnerable to savings measures.

A change of mindset and approach to expediting process (including assessment and approval) is also needed. Senior officials are concerned that MOD is too risk averse. "An industrial strategy that avoids risk is no industrial strategy at all"⁹¹ Fear of failure and concern over external scrutiny of how public money has been spent could result in decisions being taken not to invest, or projects left to run for longer than necessary to avoid criticism of

wasting public money. A certain amount of failure should be acceptable when developing new ideas, especially during the early stages. In encouraging experimentation of different technologies and solutions, the key will be to identify failure quickly and as early and cheaply as possible.

Defence needs to incorporate a greater appetite for risk into its innovation pipeline. (Recommendation 4.24)

Improving and broadening commercial engagement

Defence prime contractors also have a valuable role to play in stimulating and facilitating innovation through investing in partnership or acting as a customer of SMEs and academia. Most already do so, capitalising on the inherent creativity and technical skills to be found in the UK.

There is a welcome commitment in the recently refreshed Defence Industrial Policy to make it easier to do business with MOD, either indirectly through prime contractors or directly with MOD customers. This is aimed particularly at innovators, SMEs and non-traditional defence suppliers. MOD needs to improve its commercial engagement with a wider range of suppliers, including start-ups and SMEs outside the traditional defence industry, especially those with a track record for innovation and disruptive technology. This needs to be carefully managed to protect specific defence requirements.

To make Defence an attractive innovation partner, MOD needs to find an equitable way to share risk and reward, provide clarity and certainty on intentions, and make contractual processes less daunting, especially for SMEs. (Recommendation 4.25)

MOD should continue to build on this work and consider what other measures it could implement to encourage and incentivise non-defence companies to see defence as a customer. (Recommendation 4.26)

Intellectual Property

There has been a long-standing issue between MOD and industry over the status of intellectual property rights. Industry has highlighted implications for their willingness to invest in innovation while this issue remains unresolved. The problems originated from MOD's wish to be able to compete the support and maintenance for equipment projects it had originally funded and where it believed it owned the intellectual property. This needs to be resolved as it presents an obstacle to effective and value-for-money exploitation of defence technology, whether at home or for exports. It is important that a speedy solution is found that shares both risk and reward.

⁹¹ 'Building a Britain Fit for the Future' page 22, <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>

The intellectual property issue with industry should be resolved quickly in a way that does not disadvantage UK companies against foreign competitors and does not discourage new partner companies from working with the MOD. (Recommendation 4.27)

COMMERCIALISING INTELLECTUAL PROPERTY CREATED FROM MOD-FUNDED RESEARCH

Dstl set up Ploughshare in 2005 as its Technology Transfer Office to commercialise intellectual property mainly created by Dstl and MOD Chief Scientific Adviser funded research. Ploughshare supports licensing, development and investment in innovative technology to lower development risk, reduce R&D costs and enable faster time to market, which creates new technology for defence and civilian markets and contributes to UK prosperity. Last year an independent economics consultancy reported that between 2005 and 2016, Ploughshare had created tangible economic benefits for the UK by: creating £225m of gross value added for the UK economy (including forecast to 2019), launching spin-out companies attracting £140m of investment, creating 585 jobs at its peak, and generating £75m of exports with an additional £148m forecast to 2019. This commercialisation has also delivered wider defence, scientific and societal benefits, including new products for the Armed Forces, such as advanced vehicle armour and chemical threat detection.¹

¹ SQW report 'Assessment of the economic and wider benefits of Ploughshare Innovations Ltd's commercialisation activities – April 2017', http://www.sqw.co.uk/files/6515/0231/2870/Final_Ploughshare_economic_benefits_report.pdf

Looking to the future

It is widely expected that the pace of innovation in the commercial sector will mean that civil innovation increasingly feeds back into military use.

Competition between suppliers remains desirable as a way of delivering value for money. But providing greater awareness of the areas MOD is interested in would give industry as a whole confidence to invest more of their own shareholders' funds in R&D.

To prioritise resources, MOD should look to improve how it shares its thinking and intentions with industry at an early stage, so that companies know where to focus their innovation efforts. (Recommendation 4.28)

Learning from allies and new approaches

There is a growing recognition across Defence of the need to develop and deploy new capability more rapidly. Good practice by our allies is useful. Based on the US military's model, the RAF's Air Command set up a Rapid Capabilities Office (RCO) in 2017. This aims to exploit the full extent of what can be achieved within existing policy rather than being driven by set procedure, and employs a robust challenge process to achieve this. The focus is on products over which the UK has the intellectual property rights, and which can be designated as 'exportable by design'. To succeed, the RCO has pulled together a small number of highly skilled and experienced people from across the relevant MOD organisations, explicitly to speed up decision-making.

The US has also established a Defence Innovation Unit Experimental (DIUx), to accelerate commercial innovation for national defence. It does this by facilitating pilot contracts between companies and the US Department of Defense (DoD). After a successful pilot, any interested DoD entity has sole source justification to procure the piloted solution(s)⁹². It uses the 'Other Transaction Authority' (OTA) contracting mechanism, which sits outside the Federal Acquisition Rules. It can also be used to contract with academia or industry for research and is becoming increasingly widely used by the DoD and individual Services.

There are other initiatives in MOD. Joint Forces Command have established the j-Hub, while the Army has established ARIEL (Army Rapid Innovation and Experimentation Laboratory), still in its formative stage. The Navy is also reviewing procurement practice and introducing new much quicker decision-making processes for the Type 31e frigate.

MOD should look at how it can use emerging procurement structures in tandem with existing procurement organisations to speed up acquisition and deployment of new capability. (Recommendation 4.29)

⁹² http://www.defenceinnovationmarketplace.mil/DII_Defence_Innovation_Initiative.html

Financing future technologies

Much of future capability development will be in the drive for information advantage. The UK has existing strength in these sectors, for example BEIS has recently launched its £950m Artificial Intelligence sector deal.⁹³ There is a growing number of businesses emerging, including start-ups and University spin-outs, focused in particular on:

- Artificial intelligence and learning.
- Autonomy and robotics.
- Data analysis and visualisation.
- Virtual Reality for training.
- Modelling.
- Behavioural sciences.
- Block chain technology.

The digital technology sector is expanding 2.6 times faster than the rest of the UK economy⁹⁴. It was worth nearly £184 billion to the UK economy in 2017, up from £170 billion in 2016. This strength is matched by growing financial investor interest in the applications within an emerging 'MilTech' sector, covering defence, security and cyber technology companies. There are some 40⁹⁵ private equity and development capital funds active in the UK with a declared investment policy in the MilTech sectors. One is set to be announced shortly, claiming a £250m commitment⁹⁶.

Defence should explore opportunities to deploy part of its Innovation Fund alongside MilTech development capital, either through a dedicated structure or by developing relationships with trusted investors. (Recommendation 4.30)



The first RAF F-35B to arrive in the UK, escorted by two USAF F-35Bs and two RAF Typhoons.

⁹³ BEIS Policy Paper 'Artificial Intelligence Sector Deal', April 2018, <https://www.gov.uk/government/publications/artificial-intelligence-sector-deal>

⁹⁴ Tech Nation's 2018

⁹⁵ British Venture Capital Association estimate

⁹⁶ The fund's identity has been disclosed to this review but remains confidential until public announcement.

INVESTING IN LEADING EDGE FAST JET TECHNOLOGIES TO BOOST UK PROSPERITY

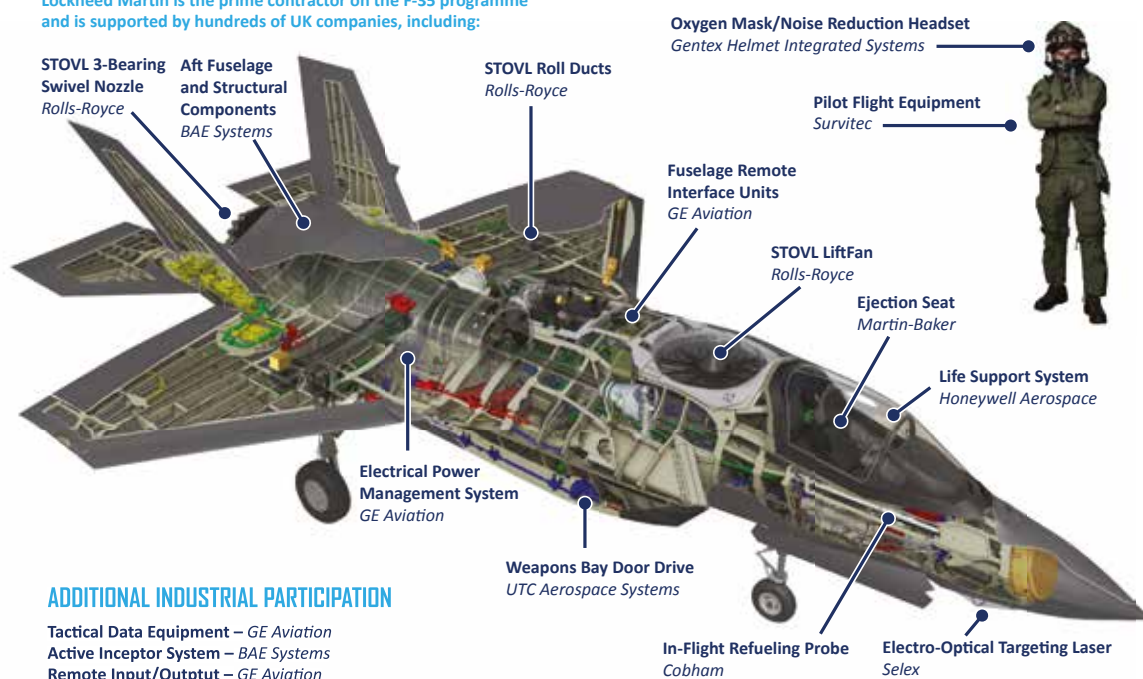
Investing in R&D is a long-term business. S&T investment by the MOD's Chief Scientific Adviser, going back decades, has helped generate the ability of UK industry technology and innovation to design and manufacture advanced combat aircraft, engines and associated advanced systems, often in collaboration with other nations. This investment, along with UK technology and innovation, has put the UK at the leading edge of combat air technologies.

International cooperation on Typhoon has brought work to the UK and been the major contributor to defence exports in recent years. The December 2017 agreement with Qatar to purchase 24 Typhoon and the March 2018 agreement in principle with the Kingdom of Saudi Arabia for a further 48 Typhoon will take UK final assembly above 250 aircraft and a 37.5% share in an overall production of more than 600 aircraft, soon to be operated by 9 nations. Typhoon continues to be developed with the RAF at the cutting edge of weapons integration, radar and agile mission data.

The F-35 is the world's largest defence programme. UK MOD funding of US\$2Bn, along with niche technologies, were key to helping the UK become the only Level 1 partner with the US during the System Development and Demonstration phase. This unlocked very significant benefits for the UK. It allowed an unparalleled understanding of the F-35's capabilities, increasing freedom of action. It also potentially creates a £35bn net contribution to the UK economy and up to 25,000 jobs in the UK - with over 3,200 aircraft expected to be built¹, 15% of each will be built in the UK. To date, over 290 aircraft² have been built, approximately US\$13bn worth of contracts have been signed with 500 companies across the UK, showcasing the best technology the UK has to offer. This is helping to sustain and develop the UK's world leading combat air S&T and manufacturing capabilities.

With an eye to the future to get the most benefit from decades of investment alongside decades of innovation, MOD has started work on its next generation of combat aircraft. The future Combat Air Strategy will establish a vision for how to maximise the military, technological, economic and international value to the UK of our Combat Air Sector. Being successful will require MOD and its industrial partners to work together much more closely. Joint work by the RAF and industry, Team Tempest, lays the foundation for a UK alliance approach to the replacement of Typhoon, ensuring the UK remains at the forefront of Next Generation Combat Air technologies.

Lockheed Martin is the prime contractor on the F-35 programme and is supported by hundreds of UK companies, including:



ADDITIONAL INDUSTRIAL PARTICIPATION

Tactical Data Equipment – GE Aviation
 Active Inceptor System – BAE Systems
 Remote Input/Output – GE Aviation

¹F-35 Lightning II program status and fast facts dated 14 May 2018
²ibid

Chapter 5: Place



Key observations:

- Defence geography is not uniform across the United Kingdom, but it has wide presence, often of considerable significance - whether an operating base, garrison or industrial plant, or in remote locations for training and testing - where it can be a principal provider of high quality and skilled jobs.

Key recommendations

- MOD should take more account than before of devolved and regional expertise and strengths – both public and industrial. MOD should explore further in each of these areas how it realises those opportunities.



Latest Commando Merlin Mk 4, built and upgraded in Yeovil for the Royal Marines, delivered in May 2018.

Defence is part of who we are locally, regionally and as nations in combining to form a unique, proud, diverse and effective British way of defending our people. It fuses local, national and multinational, from which there is much to learn and celebrate.

There are strong local historic and current ties to Royal Navy, Army and RAF bases, and to regiments, ships and squadrons; iconic local installations and employers like RAF Fylingdales; training areas synonymous with wild and remote Britain – the Hebrides, Brecon Beacons, Dartmoor, Northumberland but also on the Salisbury Plain; firing ranges in sparse coastal areas such as the Western Isles, Pembrokeshire and Shoeburyness; great industrial landmarks on the Clyde, in Rosyth and in Barrow; and close ties with centres of education, science and technology – from local cadet forces and apprenticeship schemes to partnerships between universities, industry and Dstl Porton Down.

This chapter draws out the strength and importance of the connection between defence and place in all nations and regions of the UK; and especially how the defence footprint and industry combine to bring prosperity and a uniquely valuable joint contribution to our national defence in every part of the UK.

Defence geography is not uniform across the United Kingdom, but defence has wide presence, often of considerable significance - whether an operating base, industry or garrison, or in remote locations for training and testing - where it can be a principal provider of high quality and skilled jobs.

ARGYLE AND BUTE AND HM NAVAL BASE CLYDE: PARTNERING FOR THE FUTURE

Faslane is Scotland's largest military base and also one of the largest industrial complexes and single site employers in Scotland. Its military population will increase by 1,500 over the next 15 years.

Argyle and Bute Council and HM Naval Base Clyde have seized the opportunity together to develop a Strategic Development and Delivery Framework for accommodation, education, infrastructure, the economy, community facilities and communications.

This is already delivering encouraging results. Persimmon is bringing forward the development of over 100 houses, while MOD is working with the Council to underwrite minimum occupancy to ensure the financial viability of a scheme to boost the supply of single occupancy rental housing. The early success of the Framework in housing development has led MOD to shortlist Faslane as a potential pilot for its UK-wide Future Accommodation Model.

Argyle and Bute Council is now looking into technology centred on support to Naval activity as a key development opportunity and is acting to help technology start-ups - often military spouses with ambitions to build their own enterprises.

As the third largest landowner in the UK with 220,000 hectares,⁹⁷ MOD and the Armed Forces have considerable responsibility and opportunity to manage the estate in the most economically and environmentally advantageous way.

The Defence Infrastructure Organisation (DIO) releases land which is surplus to requirements. Land formerly part of RAF Hullavington was purchased by Dyson in 2017 to expand its research and development centre; the Red Dragon hangar at MOD St Athan was sold to Aston Martin in 2016 for the manufacture of top-end sports cars. In 2016, MOD announced the potential disposal of 91 sites by 2032, and is releasing land for 55,000 houses as part of the wider government target of 160,000 new homes on surplus public land by 2020.

Some of this land could be used by MOD to help manage its own cost base through greater efficiency. The DIO has launched “Project Daybreak” to exploit opportunities to install solar panels on suitable MOD buildings or land, with advice on commercial, financial and procurement rules.

In discussions with defence industry, the Armed Forces, enterprise boards and politicians in Wales, Northern Ireland, Scotland and with some Local Enterprise Partnerships in England, it is clear there is interest in promoting stronger interaction between defence and regional industry, in particular to stimulate innovation, creativity and skilled jobs. Defence is not a devolved issue, nor should it be. Yet as the MOD considers its strategic engagement with commerce and industry under the

Modernising Defence Programme, as it starts to consider prosperity impacts in strategic outline business cases, and as it contributes to cross-government Industrial Strategy, there are important opportunities to take more account than before of devolved and regional expertise and strengths – both public and industrial.

MOD should explore how it might harness devolved and regional expertise and strengths to identify opportunities which may exist for Defence in contributing to, and benefiting from, local industrial strategies. The Devolved Administrations and the LEP Network in England should form part of this engagement. (Recommendation 5.31)

This should not involve burdensome new structures for defence, but MOD should work closely with the wider machinery of government in developing the right conduits for discussions with key bodies such as Invest Northern Ireland, Scottish Enterprise, and Trade and Invest Wales, as well as the Northern Powerhouse, Midlands Engine and those Local Enterprise Partnerships in England which are developing plans to promote defence, security, cyber and space or other relevant sector collaboration. There are good examples where MOD is already working in this way, including in development of the National Shipbuilding Strategy and through the DIO.

The Cities and Local Growth Team formed with BEIS and Department for Communities and Local Government (DCLG) should be consulted when defence considers significant or local projects. (Recommendation 5.32)



Faslane

⁹⁷ On 1 April 2017, the MOD owned 220,000 hectares of land and foreshore in the UK (either freehold or leasehold), which is about 0.9% of the total UK land mass. The MOD also held rights over a further 213,900 hectares, which is a further 0.9% of the total UK land mass. On 1 April 2017, the total UK land holdings over which the MOD has rights was 433,800 hectares.

The close working relationship between the devolved administrations, BEIS and the DCLG, as part of the Aerospace Growth Partnership, may also offer a model for the Defence Growth Partnership to explore in strengthening its own regional approach.

The stronger network which Defence needs if it is to be properly informed in its understanding of, and approach to, local industrial strategy and cross-sectoral partnering in the UK, requires skills and local expertise of the sort now needed to underpin export success, through long-term international industrial partnering.

As Defence strengthens its international engagement cadre and works with DIT-DSO and the Defence Growth Partnership in building a more coherent approach to exports, MOD should consider opportunities for adopting elements of the same approach at home, including with relevant government departments and regional and local government structures. (Recommendation 5.33).

In addition to building closer links between Defence and the devolved enterprise agencies and the LEP Network in England, MOD may also consider how far the expertise and different perspectives in the nationwide Defence network could be more actively harnessed in boosting the regional Defence prosperity impact.

Caring for the environment

MOD allocated £2.3 million in financial year 2017/18 to the Conservation Stewardship Fund, which supports projects relating to the natural and historic environment, and public access on the MOD estate. Projects include:

- The recovery of barn owl and raptor species populations across the Salisbury Plain training areas;
- Amphibian and reptile conservation in Wales; and
- Operation Nightingale, a programme of heritage projects engaging wounded, injured and sick personnel and veterans in archaeology as part of their recuperation.

Defence across the United Kingdom

Annex B provides for the first time a snapshot of the current geographic footprint of the main Defence locations in each region of the UK, bringing together the contribution of the Armed Forces, MOD civil servants and 22 major defence suppliers to MOD.



Soldiers and Officers on Exercise Celtic Warrior in Otterburn training area in Northumberland.

Chapter 6: Cross-cutting findings and recommendations



Key recommendations

- MOD should take the opportunity provided by Brexit to look again at procurement process and culture, including discussion of approach to major procurements during the transition phase.
- Proposal for MOD to commission academic work on the UK tax take from Defence work.
- Need to seek greater co-ordination across MOD's relationship with industry.
- Incentivise MOD's high-profile training institutions to market their paid services more widely.
- Look again with HMT/HMRC at reducing the burden of VAT administration.
- MOD to continue public information on its regional economic impact.

How Defence can deliver more benefit

The Report's subject chapters contain recommendations linking in to the themes of the Government's Industrial Strategy. This chapter proposes additional cross-cutting recommendations for Defence to implement, or to pursue with the rest of Government.

Impact of Brexit

Brexit offers the opportunity to consider whether it remains appropriate for Defence to operate as if the Defence and Security Directive⁹⁸ and Article 346 of the Lisbon Treaty⁹⁹ continue to apply to defence procurements. There should be a conscious strategic decision as to whether and how to take advantage of any new dispensation, rather than just a rolling-over of the substance of the current process.

The practice of when to apply the existing Article 346 exemption could be examined, to ensure that the UK maintains its critical skills for development of capability which ensures freedom of action and operational advantage. As customer nations for our defence exports who are not members of the EU increasingly seek industrial participation in-country as part of their contractual arrangements, Brexit provides an opportunity to consider if the UK should seek greater UK prosperity benefits from our own procurement.

Such arguments are being reflected in the current debate about the Type 31e frigate and Fleet Solid Support (FSS) procurements for the Royal Navy. The Type 31e has clearly been defined as a complex warship which will be built in the UK, but with a competitive tender process, including international contractors to help ensure best value for money. By contrast the FSS, as a Royal Fleet Auxiliary vessel, is not currently classed as a warship and therefore will not be subject to the Article 346 exemption. For FSS and as part of the early objective-setting for other future significant procurements, whether competitive or single source, development of relevant prosperity weighting for UK content and criteria to assess tenders should be considered.

When developing selection criteria for new procurements starting after withdrawal from the EU and during the implementation period, it would be desirable for some weighting to be attached to the prosperity impact in the UK and for the criteria to be transparent to the tenderers, whether international or domestic. (Recommendation 6.34)

Some internal criticism of the time and complexity in procuring equipment and services generally stems from overly rigid application of the EU procurement rules. Acknowledging that the current regime is likely to continue through the implementation period, there is a clear opportunity for the MOD to consider whether it wishes to seek any changes in approach when the UK can frame its own procurement regulations.

⁹⁸ Directive 2009/81/EC of the European Parliament and of the Council of 13 July 2009 on the coordination of procedures for the award of certain works contracts, supply contracts and service contracts by contracting authorities or entities in the fields of defence and security, and amending Directives 2004/17/EC and 2004/18/EC

⁹⁹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7310.pdf

MOD to take early action to safeguard its freedom of manoeuvre in procurement post Brexit. (Recommendation 6.35)

Consideration needs to be given as to whether and how any differing UK prosperity weighting and criteria should apply to major procurements expected to be placed after the implementation period following Brexit. (Recommendation 6.36)

There is current debate in some circles about whether to take into account tax revenues when making decisions on major defence procurements, as set out by GMB¹⁰⁰ and Unite.¹⁰¹ The prevailing orthodoxy deployed by HM Treasury and supported by other economists is that value for money for the taxpayer is achieved without taking into account the taxes raised from spending in the UK.

Given the strategic objective which the MOD now has to contribute to UK prosperity, the MOD should commission academic work to inform a discussion with the Treasury to settle the question of whether additional tax revenues flow back from procurement spend in the UK and whether a cost premium applies to maintaining freedom of action and operational advantage from UK manufacture. (Recommendation 6.37)

The MOD relationship with Industry

MOD is regarded by industry as being a leader in Whitehall in engaging with its suppliers, with strategic fora for dialogue with its suppliers as a group. But MOD is concerned that its current approach to engagement with key industrial partners is too complicated and not clear in its objectives. The previous system of recognised senior relationship owners is not effective and DE&S, Commercial, Policy and Capability functions all lead on their own interests, with little strategic co-ordination.

That situation harms the ability to maximise the prosperity benefit from defence spending, and leads to a lack of certainty and clarity for Industry. The Modernising Defence Programme appears to be addressing this situation, which is welcome.

Ideally the approach would extend beyond MOD, so that the whole of government is presenting a consistent message.

For the Defence Suppliers Forum to be effective as a channel for senior-level engagement between Government and industry, all parties need to accept its value.

The Defence Growth Partnership is a useful forum to secure senior industry participation in specific initiatives and produces good material. It needs to be supported to help it fulfil its potential and secure the Defence Sector Deal.

The refreshed Defence Industrial Policy commits to look again at the range of defence engagement with industry.

The Department and industry to look, together and against a fixed timescale, at how their relationships could work better, including engagement with SMEs. (Recommendation 6.38)

Incentivising training for payment

The UK Armed Forces have world renowned brands in provision of training, not just in areas like fast jet training (covered in Chapter 2) but also Sandhurst, Cranwell and Dartmouth. As noted previously, provision of training helps develop enduring military relationships with allies as well as a strong link to sales of capability and should be incentivised by MOD. But at present the financial rules make it unattractive for these world-renowned institutions with strong brands to expand and market their services in a responsible way: they generally are not able to retain any income from the places they provide and do not therefore benefit financially.

The Department should look sympathetically at creating a financial framework with more flexibility, to encourage Defence's training institutions to be more entrepreneurial and exploit the brand to their and wider UK benefit. (Recommendation 6.39)

Tax

The fiscal authorities could help to improve efficiency of teams within MOD and prevent distortion in procurement decisions. The existing VAT legislation is difficult to interpret and administer, for what is essentially a circular movement of money around Government.

At present MOD pay HMRC about £2.3bn VAT per annum, with approximately £1.5bn reclaimed for 'services' (as opposed to goods) under the Treasury Contracting Out Direction which determines whether VAT can or cannot be reclaimed on services provided to a government department. To illustrate the potential complexity, if MOD employ consultants purely to provide advice, the VAT is reclaimable, whereas if they employ consultants to design and implement a new vehicle trailer system, VAT reclaim would not be possible.

¹⁰⁰ <http://www.gmb.org.uk/turning-the-tide.pdf>

¹⁰¹ Unite paper: Team Provider: Delivering the Fleet Solid Support Ships

The balancing c£800m is the VAT paid to suppliers for goods and non-recoverable services which cannot be reclaimed. The Treasury funds departments for this element. MOD self-assess VAT on goods imported from outside the UK, and then pay any related VAT and duty to HMRC, unless the goods are entered into a tax suspense customs procedure. MOD also benefits from the VAT zero-rated supply of ships and aircraft under the Act. However, whilst not administratively burdensome in respect of invoice payment, MOD does often find itself working as a facilitating 'third party' between the supplier and HMRC to try and leverage legal tax efficient solutions for both the Department and supplier.

All of this, especially the administration around Contracted Out Services, creates significant work and concern about the effective use of resources, the consequences of error corrections/penalties, with consequent delay and impact on prompt payment.

MOD Ministers should ask the Treasury to work constructively with MOD to reduce cumbersome VAT administration and improve efficiency. (Recommendation 6.40)

End of year flexibility

As already noted, the MOD has one of the largest capital budgets in Government, with spend due in 2018/19 of around £16bn out of a ten-year equipment plan of £180bn.¹⁰² Landing the spend within end of the financial year can lead to inefficient use of resources. Some flexibility over year-end processes for large individual capital procurements might reap efficiencies.

Continued publicity of MOD's UK footprint

This review has shown the extent of MOD's prosperity impact across the country. There are valuable messages here. Gathering the information also highlighted the lack of Departmental knowledge about impact in the English regions.

MOD should consider building on the work done to pull the regional information together for this Review and to publish periodically details of its regional footprint and prosperity impact. (Recommendation 6.41)

¹⁰² Defence Equipment Plan 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/677999/20180125-EP17_Final.pdf

**Annex A –
Comprehensive
list of
recommendations**

The following recommendations have been numbered first by chapter, then sequentially for ease of reference.

Chapter 2

- 2.1 MOD should discuss with the Office of National Statistics whether existing surveys could be expanded to capture more information about spend with supply chains and prosperity, and how defence activity in the economy can be more easily identified.
- 2.2 The MOD should commission independent academic research into assessing and measuring the total economic benefit that Defence gives to the economy, consistent with the Treasury Green Book. This research might also attempt to highlight where MOD has already generated a prosperity “premium” to the wider economy.
- 2.3 The MOD should support DIT plans to strengthen DIT-DSO.
- 2.4 Industry need to show more leadership in driving the ‘Team UK’ approach, which also needs more encouragement from MOD.
- 2.5 Incentives should be developed for the Armed Forces (and others with a role) to provide strategic support for defence exports
- 2.6 Engagement between MOD and Treasury would be desirable to improve access to training and other critical enablers for defence exports.
- 2.7 MOD and industry should additionally bring forward proposals to improve how industry can access UK test and evaluation to support export of capability, whether in service, in development or not currently in service with the Armed Forces.
- 2.8 Defence needs to take a more strategic view of managing risks in its supply chain, both in understanding key UK requirements for freedom of action and operational advantage, and in how it goes about assuring the underpinning intellectual property in the supply chain. This should include stronger levels of cyber assurance and closer scrutiny of the security implications of changes in company ownership.
- 2.9 Further work, consistent with the Treasury Green Book, is now needed in MOD to give clearer, practical guidance on the prosperity factors defence is most likely to consider, the reasons for their importance and the primary metrics which might be used in assessing their value and relevance. It should also permit sufficient flexibility in the way in which these factors might be weighted.
- 2.10 As a critical enabler of growth and productivity in both defence and the wider economy, MOD should focus on technical education, skills and training in shaping MOD’s strategic approach to prosperity, including when talking with potential investment partners.
- 2.11 The MOD and its key suppliers should develop a common approach and format for collecting data, preferably based on a digital solution, to underpin new guidance and metrics on key prosperity factors.
- 2.12 MOD should resource its responsibility to promote prosperity more appropriately and effectively. This should take account of new or recent additional commitments to support strategic exports. It should also implement policy on exportability in the design and development of defence equipment, and where appropriate help exports of equipment and services not in service with the UK Armed Forces.
- 2.13 MOD should increase agility and pace in defence procurement, adopting a culture more focused on finding the right procurement solutions and less on defining and avoiding obstacles at the outset. This requires MOD to develop its skill-base as a client, better understanding how defence requirements and the market interact and shape each other. Building the quantity and quality of commercial skills across Defence is an important part of this work.

Chapter 3

- 3.14 MOD should publish how much it invests in its military and civilian workforces.
- 3.15 MOD and industry should improve their evidence base to define skills requirements to help address future needs.
- 3.16 Independent research should be commissioned on the social and financial impact attributed to defence industry jobs.
- 3.17 In specialist sectors such as space and cyber, the Armed Forces should consider facilitating whole career flexibility with secondments across Defence, including in industry, at points during careers to remove barriers and retain skills.
- 3.18 The MOD should improve the data it collects on Service leavers, including skills levels, qualifications, and post Service salaries.

Chapter 4

- 4.19 MOD to consider whether its commitment to spend 1.2% of the defence budget on S&T is sufficient following the Government Industrial Strategy target to raise total UK R&D investment to 2.4% of GDP by 2027.
- 4.20 The current level for funding of the MOD's Innovation Fund should be maintained, if not increased, and its profile brought forward.
- 4.21 MOD should maintain its priority on driving innovation, perhaps by further developing co-funding between the Innovation Fund and individual Front Line Commands to encourage take-up into use.
- 4.22 MOD should adopt open architecture across the defence spectrum.
- 4.23 The MOD needs to scale up its approach so that innovation becomes an integral part of larger procurement.
- 4.24 Defence needs to incorporate a greater appetite for risk into its innovation pipeline.
- 4.25 To make Defence an attractive innovation partner, MOD needs to find an equitable way to share risk and reward, provide clarity and certainty on intentions, and make contractual processes less daunting, especially for SMEs.
- 4.26 MOD should continue to build on this work and consider what other measures it could implement to in particular encourage and incentivise non-defence companies to see defence as a customer.
- 4.27 The intellectual property issue with industry should be resolved quickly and in a way that does not disadvantage UK companies against foreign competitors and does not discourage new partner companies from working with the MOD.
- 4.28 To prioritise resources, MOD should look to improve how it shares its thinking and intentions with industry at an early stage, so that companies know where to focus their innovation efforts.
- 4.29 MOD should look at how it can use emerging procurement structures in tandem with existing procurement organisations to speed up acquisition and deployment of new capability.
- 4.30 Defence should explore opportunities to deploy part of its Innovation Fund alongside MilTech development capital, either through a dedicated structure or by developing relationships with trusted investors.

Chapter 5

- 5.31 MOD should explore how it might harness devolved and regional expertise and strengths to identify opportunities which may exist for Defence in contributing to, and benefiting from, local industrial strategies. The Devolved Administrations and the LEP Network in England should form part of this engagement.
- 5.32 The Cities and Local Growth Team formed with BEIS and Department for Communities and Local Government should be consulted when defence considers significant or local projects.
- 5.33 As Defence strengthens its international engagement cadre and works with DIT-DSO and the Defence Growth Partnership in building a more coherent approach to exports, MOD should consider opportunities for adopting elements of the same approach at home, including with relevant government departments and regional and local government structures.

Chapter 6

- 6.34 When developing the selection criteria for new procurements starting after withdrawal from the EU and during any implementation period, it would be desirable for some weighting to be attached to the prosperity impact in the UK and for the criteria to be transparent to the tenderers, whether international or domestic.
- 6.35 MOD to take early action to safeguard its freedom of manoeuvre in procurement post Brexit.
- 6.36 Consideration needs to be given as to whether and how any differing UK prosperity weighting and criteria should apply to major procurements expected to be placed after the implementation period following Brexit.
- 6.37 Given the strategic objective which the MOD now has to contribute to UK prosperity, the MOD should commission academic work to inform a discussion with Treasury to settle the question of whether additional tax revenues flow back from procurement spend in the UK and whether a cost premium applies to maintaining freedom of action and operational advantage from UK manufacture.
- 6.38 The Department and industry to look, together and against a fixed timescale, at how their relationships could work better, including engagement with SMEs.

- 6.39 MOD should look sympathetically at creating a financial framework with more flexibility, to encourage Defence's training institutions to be more entrepreneurial and exploit the brand to their and wider UK benefit.
- 6.40 MOD Ministers to ask Treasury to work constructively with MOD to reduce cumbersome VAT administration and improve efficiency.
- 6.41 MOD should consider building on the work done to pull the regional information together for this Review and to publish periodically details of its regional footprint and prosperity impact.

Annex B – The UK Defence Footprint

The maps and data in this annex are illustrative of the broader defence footprint in Scotland, Northern Ireland, Wales and England. They include the main sites of 22 major suppliers to the MOD nationwide¹⁰³. The maps do not list every site and cannot be comprehensive of all defence suppliers; accompanying case studies focus on some of the wider defence industrial activity in each region, including examples of work by innovative SMEs.



¹⁰³ AWE; Airbus Defence and Space; Babcock; BAE Systems; Boeing; Capita; Cobham; Cooneen Defence; DXC Technology; GE Aviation; General Dynamics; Leonardo; Lockheed Martin UK; MBDA; Northrop Grumman; QinetiQ; Pearson Engineering; Raytheon UK; Rolls-Royce; Serco; Thales UK; and Ultra Electronics.

Scotland

MOD spending with commerce and industry (2016-17)



£923m

Largest MOD industry group expenditure:
Shipbuilding and repairing



£1.6bn

Expenditure with industry and commerce



10,500

Jobs supported by MOD expenditure
with industry



**Major Defence
suppliers:**

Babcock, BAE Systems, Boeing, Leonardo,
QinetiQ, Rolls-Royce, Thales UK

Personnel (1 April 2018)

9,910

Regular Military

4,560

Reservist Military

4,010

Civilian

Scotland is well known for leading-edge engineering and design across defence:

Scottish industry is renowned for building the world's finest warships – including the UK's new aircraft carriers. The Scottish defence sector also underpins the UK's wider marine, aerospace, nuclear and security capabilities. Working with universities and SMEs, and in partnership with Scottish Enterprise, the defence sector is generating good prospects for growth, including through further innovative partnerships with adjacent sectors. Glasgow is rapidly becoming a key centre for small satellite technology with investments by companies like Clyde Space and Spire Global.

Type-26

The £3.7 billion contract to start building the first three of eight state-of-the-art Type-26 frigates sustains 1,700

jobs in Scotland for two decades and safeguards 4,000 jobs in Scotland and across the wider UK supply chain until 2035.

Less well known...

MOD and Boeing have jointly funded a maintenance facility at RAF Lossiemouth, home base for the RAF's future P-8A Poseidon maritime patrol aircraft. This £400 million investment includes training simulators, accommodation for squadron personnel, an operations centre and engineering support. A new three-bay aircraft hangar has been made large enough both for the RAF's needs and for collaboration with other NATO air forces. This will allow Norway to maintain its P-8A aircraft at RAF Lossiemouth, and for work to be carried out there on US aircraft. Construction at Lossiemouth will support around 200 local jobs. An additional 470 RAF and Boeing personnel will be based at RAF Lossiemouth when the P-8A enters service. Overall, the investment will bring an estimated 25% increase in associated economic benefits from the base for the wider community.

Northern Ireland

MOD spending with commerce and industry (2016-17)



£31m

Largest MOD industry group expenditure:
Manufacture of Clothing



£103m

Expenditure with industry and commerce



600

Jobs supported by MOD expenditure
with industry



**Major Defence
suppliers:**

Cooneen Defence, Thales UK

Personnel (1 April 2018)

1,960

Regular Military

2,170

Reservist Military

950

Civilian

Known as:

The top location globally for cyber security inward investment. The Centre for Secure Information Technologies at Queen's University Belfast is the UK's largest cyber Security research Centre.

But also...

Industry has committed to more than double its revenue from the aerospace, defence, security and space activities in Northern Ireland to over £2 billion a year.

Bombardier Belfast has military applications which date back to the development of the Stirling bomber and Sunderland flying boat, from its history as Short Brothers Plc.

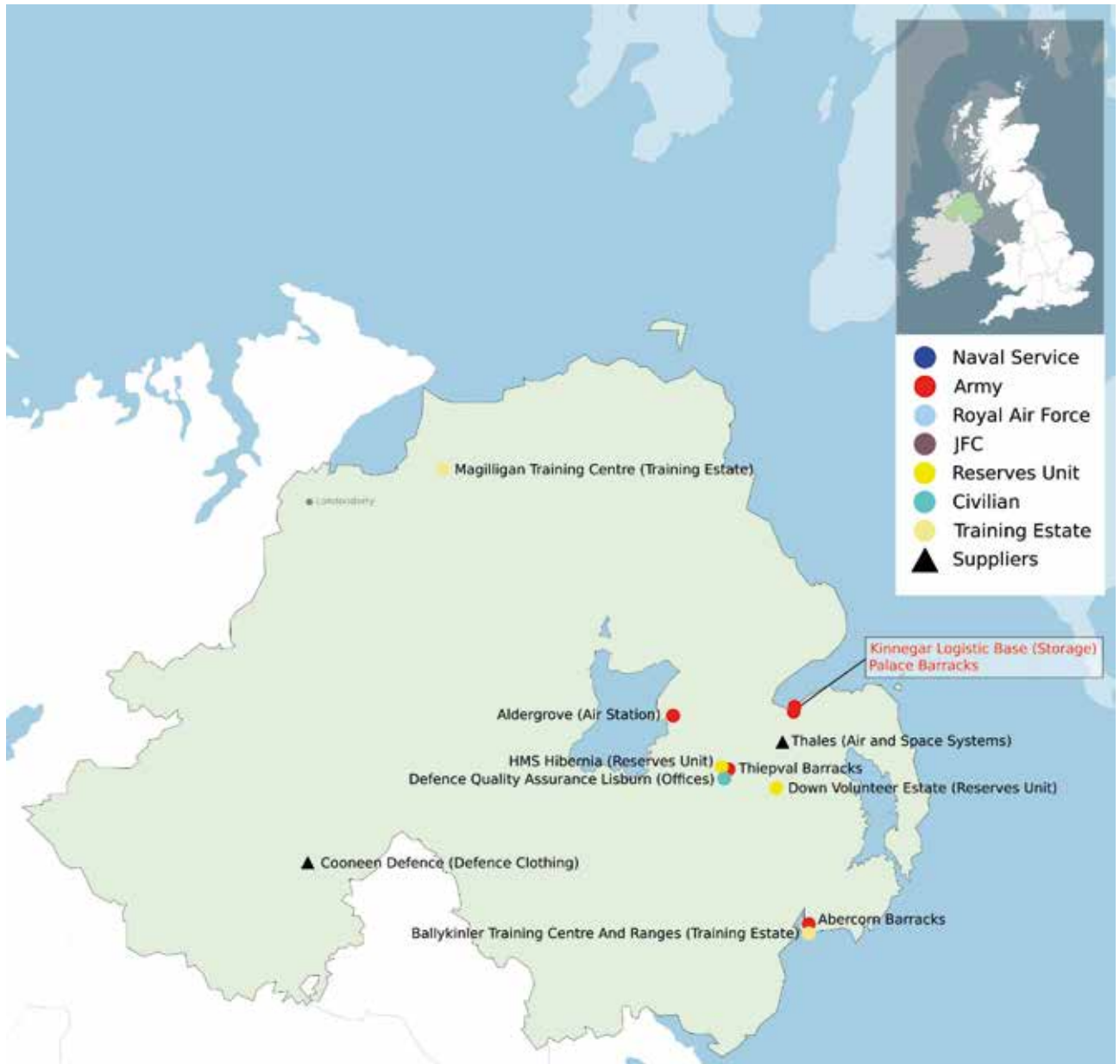
Cooneen Defence is the largest provider of uniforms and clothing for the UK Armed Forces, and supplies military and police forces around the world.

A world leader in Belfast

Thales in Belfast is a leader in the design and development of light-weight weapons, their integration onto tactical land, sea and air platforms and their support through life. In contributing to Thales' global air defence offering, Thales in Belfast has helped secure Thales UK record exports which it estimates were worth over £500 million in 2017.

In 2016 Thales Alenia Space decided to invest £6 million to create a global centre of excellence for electric propulsion systems in Belfast. From 2018, these facilities will produce Electric Propulsion Modules for Thales Alenia Space's future global satellite offering. This is an example of Northern Ireland's developing space industry. It also demonstrates where investment in skills and technology has crossed over into civil applications to provide a world-class export offer in the space sector.

Known for: Space and missile work at Thales in Belfast



Wales

MOD spending with commerce and industry (2016-17)

 **£246m**

Largest MOD industry group expenditure:
Computer services

 **£945m**

Expenditure with industry and commerce

 **6,300**

Jobs supported by MOD expenditure
with industry

 **Major Defence
suppliers:**

Airbus, General Dynamics UK, GE Aviation,
QinetiQ, Raytheon UK

Personnel (1 April 2018)

2,200

Regular Military

1,970

Reservist Military

1,050

Civilian

Wales is known for:

Providing a vast training area for the Armed Forces, both in the skies and on land. Sennybridge Training Area is the third largest training area in the UK at approximately 12,000 hectares with access agreements over a wider area in mid-Wales.

But less well known for:

MOD Aberporth Range: Located on the west coast of Wales Aberporth range occupies 6,500km² of sanitised airspace from surface to unlimited altitude. The Range has a fully-instrumented 3D area for Test and Evaluation, and space for training activities. It provides both live and virtual environments, real-time data, and deployable systems, all supported by highly skilled jobs. It is receiving significant investment to modernise, securing its long-term future, as part of a £1 billion contract amendment to MOD's existing Long-Term Partnership Agreement with QinetiQ.

Jobs in the Valleys...

The General Dynamics factory in Merthyr Tydfil, opened in 2016, bringing around 250 jobs to the area,

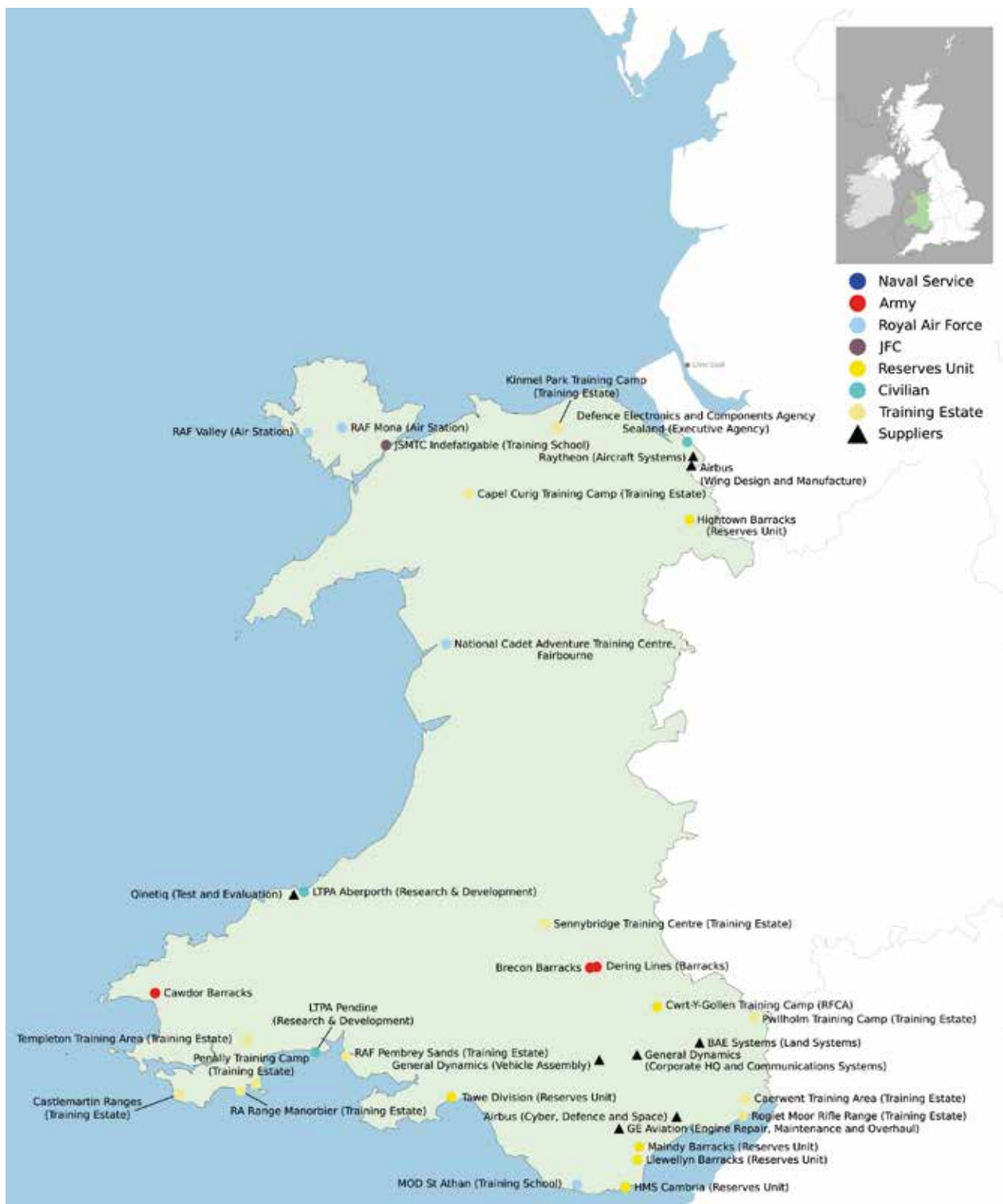
is home to the Ajax family of armoured fighting vehicles. The Ajax range will form a key component in the Army's modernised warfighting Division. They will operate in a variety of Army formations and multinational situations across a wide-range of future operating environments. The MOD spent £945m in Wales in 2016/17, with Ajax representing the biggest single order for a UK armoured vehicle in 30 years. The Ajax programme has safeguarded or created over 4,000 direct UK jobs across 230 UK-based companies.

...and in the North

In 2017, Qioptiq, employing over 500 people on two sites at St Asaph, North Wales, was awarded an £82 million contract to provide support for vital surveillance and targeting equipment to our Armed Forces (including night vision systems and weapons sights).

This underlined Wales' reputation as a world leader in the defence technology sector, shortly after the award by the Joint Strike Fighter programme to DECA Sealand as the global repair hub for the avionics and electronic systems on the F-35 aircraft. This is a unique joint partnership between MOD, BAE Systems and Northrup Grumman.

Known for: The Ajax armoured vehicle plant at Merthyr Tydfil



North West England

MOD spending with commerce and industry (2016-17)

 **£904m**

The largest MOD industry group expenditure in the North West is **shipbuilding and repairing**

 **£2bn**

Expenditure with industry and commerce

 **12,300**

Jobs supported by MOD expenditure with industry

 **Major Defence suppliers:**

BAE Systems, Cammell Laird, MBDA and Northrop Grumman

Personnel (1 April 2018)

1,810

Regular Military

3,000

Reservist Military

1,670

Civilian

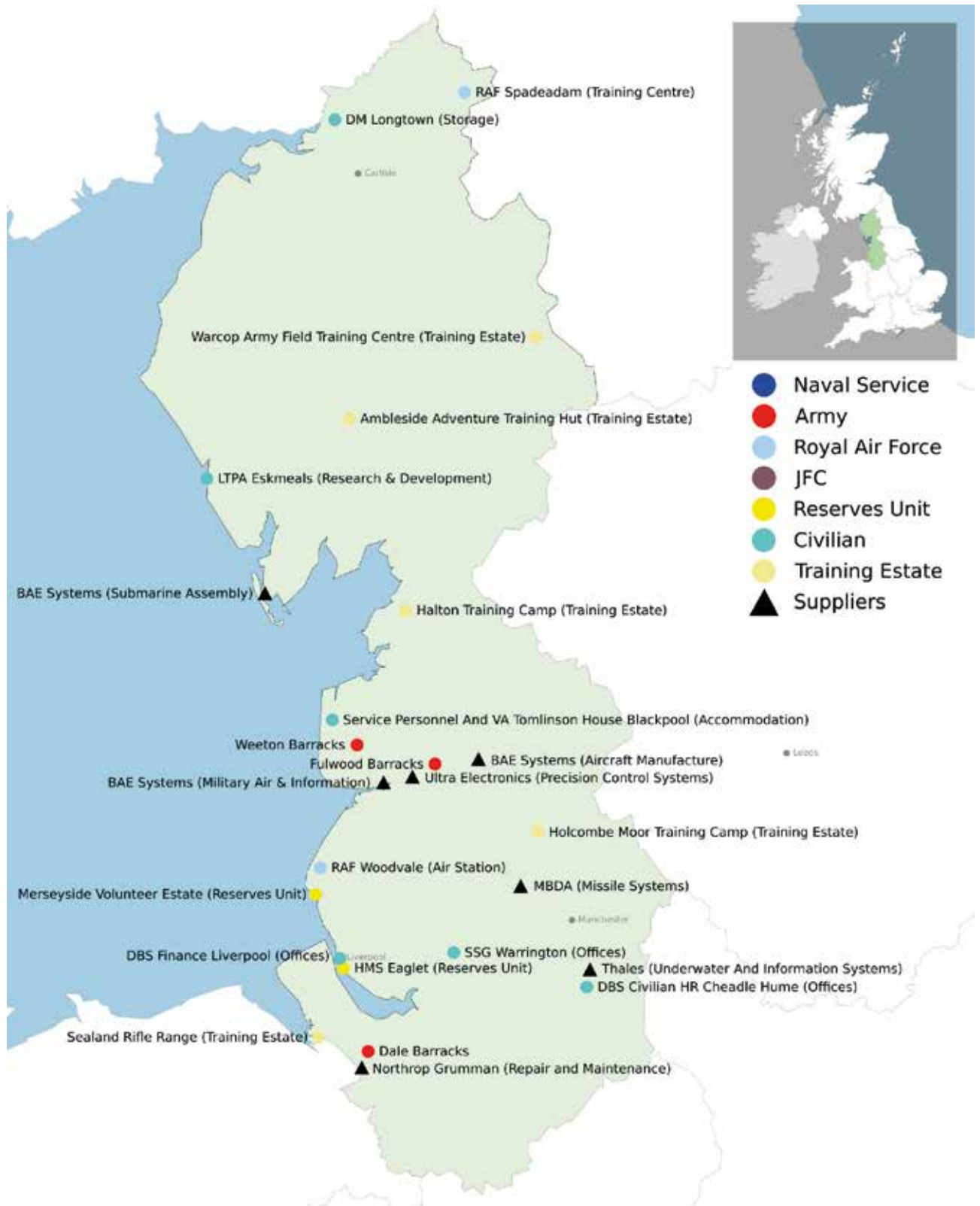
Key military platforms and high technology

The North West of England is a leader in submarine construction and combat aircraft. It is less well known that the region hosts leading cyber technologies. One example is the cyber-cluster created by Raytheon in Salford, co-located with SMEs and Micro SME experts in cyber security. The cluster collaborates with regional universities to produce software and deploys trained 'ethical hackers' to ensure personal data is being protected in banks, insurance companies and the public sector.

Cutting edge in the North West

BAE spends over £10 million each year on R&D in UK universities. An example is Project MAGMA, the development and construction of a modular unmanned air vehicle testbed with the University of Manchester. This supports BAE Systems' work on innovative technologies to change aerodynamic flow without flaps, change aircraft observability, and on variable propulsion. With clear military applications, this technology could also be used in the civil sector to optimise the geometry of aircraft at various stages of flight, increasing speed and fuel efficiency.

Known for: Submarines at Barrow in Furness and combat aircraft manufacture



North East England

MOD spending with commerce and industry (2016-17)



£67m

Largest MOD industry group expenditure: **Computer services**



£100m

Expenditure with industry and commerce



700

Jobs supported by MOD expenditure with industry



Major Defence suppliers:

DXC Technology, Capita and Pearson Engineering

Personnel (1 April 2018)

1,100

Regular Military

1,980

Reservist Military

250

Civilian

North East England is known for its precision engineering...

The decision by Reece Group Ltd to invest in the former Armstrong Works in Newcastle symbolises the renaissance of the precision engineering sector in the North East of England. UK engineering is increasingly bringing together the best of civil and defence expertise, technology and innovation and developing applications serving multiple markets.

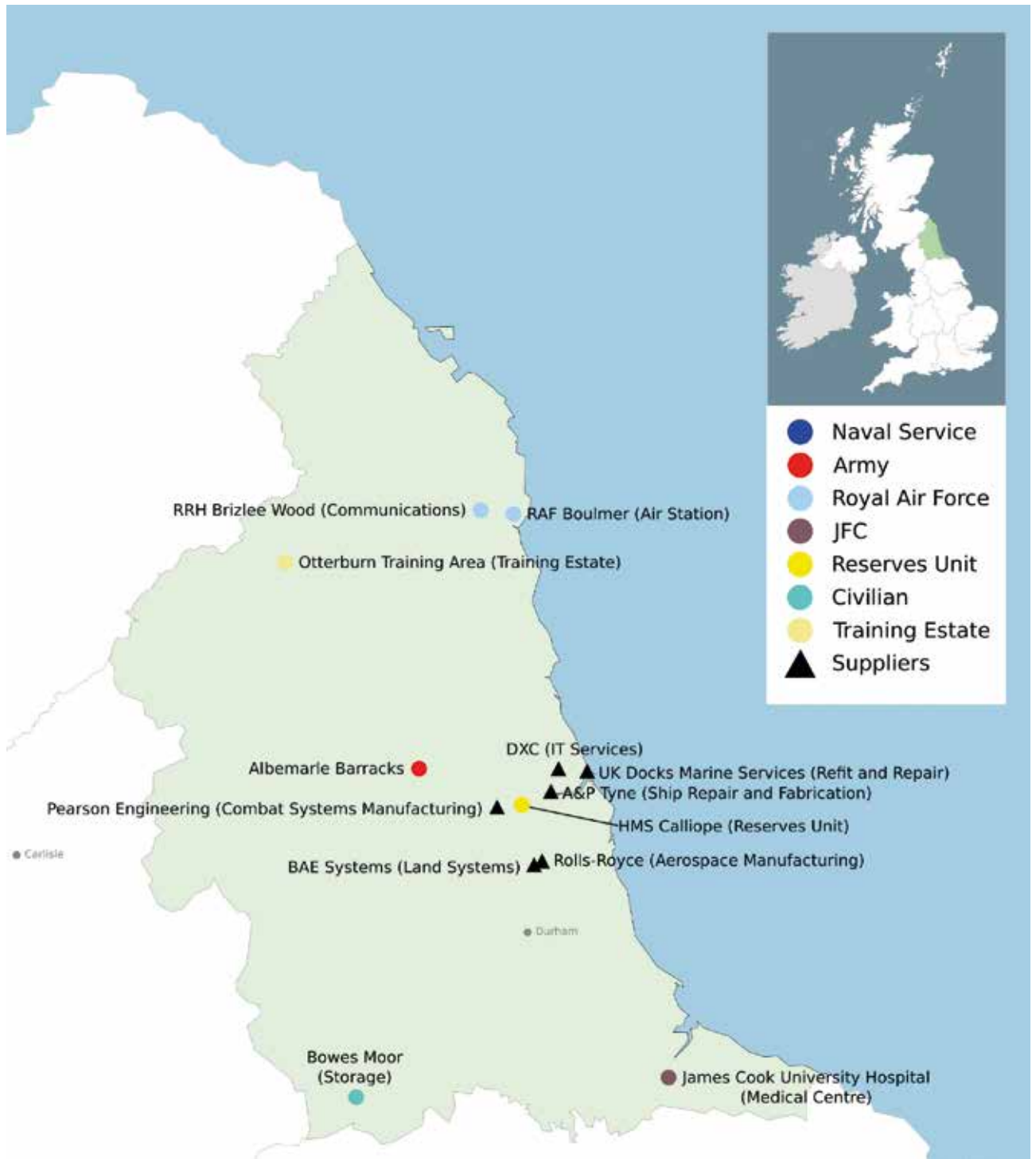
The skilled workforce and rapidly configurable manufacturing space in the Armstrong Works allow it to be mobilised rapidly to support a variety of complex engineering requirements. Pearson Engineering Ltd, part of Reece Group, is also supported by an SME community. A close working relationship with SMEs has underpinned a

successful approach in developing a counter improvised explosive device capability in the North East of England. Pearson Engineering was awarded the Queen's Award for Enterprise and Innovation in 2012 for its development of the Self-Protection Adaptive Roller Kit (SPARK) that has helped save many lives in Iraq and Afghanistan.

Otterburn Ranges

The Otterburn Ranges cover nearly a quarter of the Northumberland National Park, helping protect some of the most spectacular scenery in England, where moorland birds, wild goats and rare black grouse flourish. Northumberland National Park works closely with the MOD to encourage as much access to the area as possible, while providing a vital training area for the UK Armed Forces.

Known for: Defence services and component manufacturing, including by BAE Systems and Rolls-Royce



Yorkshire and the Humber

MOD spending with commerce and industry (2016-17)



£67m

Largest MOD industry group expenditure:
Manufacture of **basic metals** and **fabricated metal products**



£232m

Expenditure with industry and commerce



1,800

Jobs supported by MOD expenditure with industry



Major Defence suppliers:

BAE Systems, General Dynamics, Serco

Personnel (1 April 2018)

12,080

Regular Military

2,680

Reservist Military

2,330

Civilian

Aircraft maintenance academy, Humberside:

BAE Systems is investing £5 million in the Aircraft Maintenance Academy at Humberside. Opened in 2015, it is taking on up to 60 apprentices a year, to train in skills needed at air force bases across the world. It is expected to create more than 150 jobs in three years.

Engineering Excellence:

Yorkshire is renowned for engineering excellence. World-famous names like William Cook, David Brown Gear Systems and Sheffield Forgemasters Ltd, together with many more recently-formed companies, provide high-quality, world-class capabilities for UK and international defence customers. Defence helps give engineering in Yorkshire and across the UK the critical mass, opportunity for innovation and diversified customer base it needs to succeed.

Boeing's first European manufacturing facility:

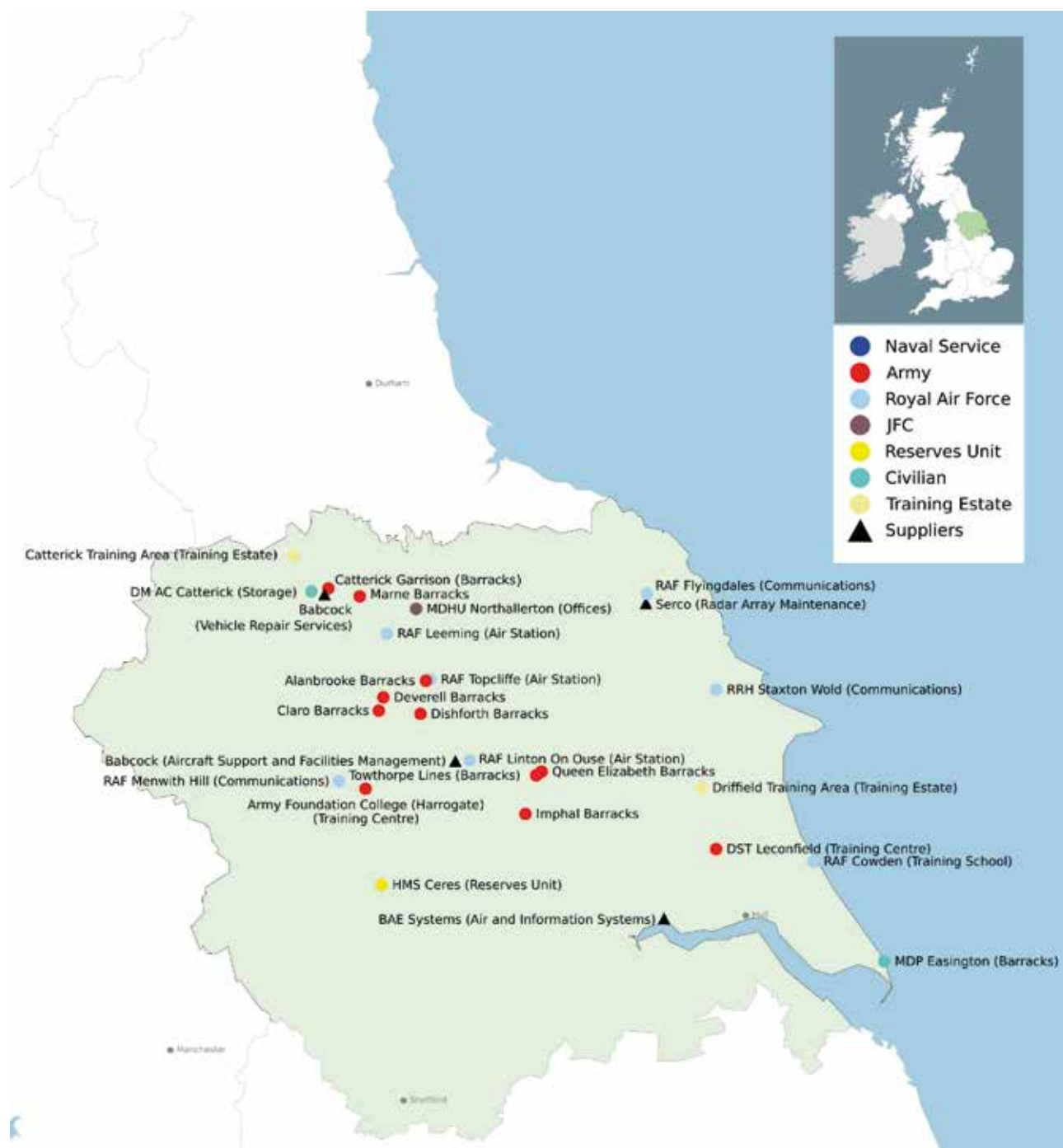
In 2018/19 Boeing is making significant dual-use capital investments in the UK. They include £40m in Boeing's first European manufacturing facility in Sheffield, which will make actuator components for the civil and defence B-737 fleets. Using techniques developed by the Advanced Manufacturing and Research Centre at Sheffield University, of which Boeing was a founding partner, the factory will employ artificial intelligence to bring mass efficiencies to component manufacture. The factory is currently under construction and will create over 50 jobs.

RAF Fylingdales:

Providing early warning to the UK and US of intercontinental ballistic missile attack, and broader surveillance of space, RAF Fylingdales employs some 350 service personnel, military police and civilian staff. The physical estate is managed by SERCO. This iconic site on the North York Moors has been supporting our defence for over fifty years.



Known for: RAF Fylingdales and precision engineering



East Midlands

MOD spending with commerce and industry (2016-17)

 **£433m**

Largest MOD industry group expenditure:
Manufacture of **basic metals** and
fabricated metal products

 **£845m**

Expenditure with industry and commerce

 **6,900**

Jobs supported by MOD expenditure with
industry

 **Major Defence
suppliers:**

Babcock, Leonardo, Rolls-Royce

Personnel (1 April 2018)

8,660

Regular Military

2,530

Reservist Military

1,490

Civilian

The East Midlands is known as:

- Home in Derby to Rolls-Royce, one of the world's iconic and best-known engine and nuclear component manufacturers, providing cutting edge solutions across both military and civil work;
- The seat of both RAF training and air defence; home of the Red Arrows.

But less well known it also:

- Will host the new Defence National Rehabilitation Centre.
- Is the venue of cutting edge technology co-operation between the RAF and defence electronics experts to provide the capabilities and information that modern combat aircraft require. This technology is increasingly in demand for export and the skills involved provide jobs for veterans.

Cutting-edge military and civil cyber

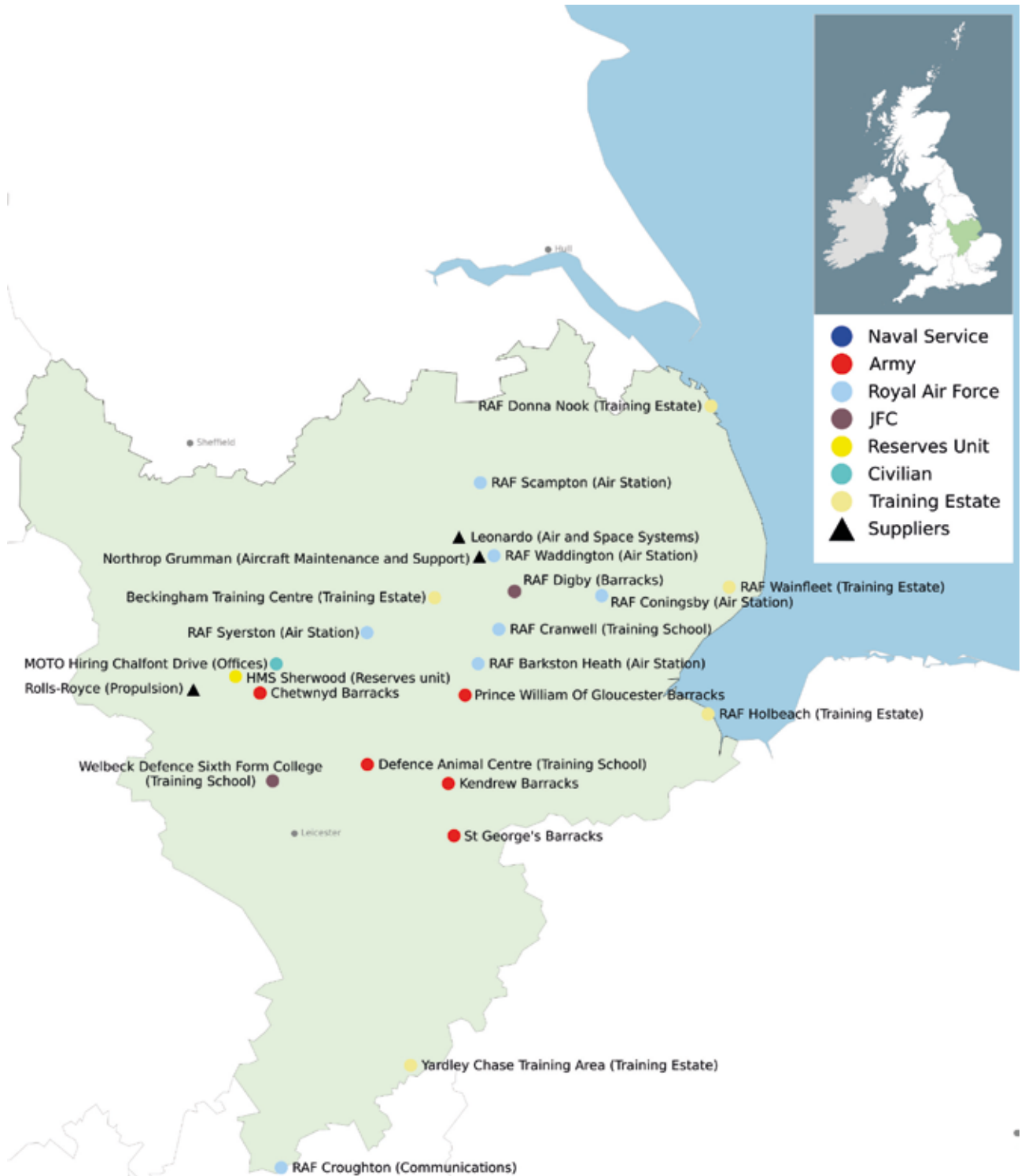
Nottingham-based Nexor have strong links with the international research community. They are currently delivering cyber-security solutions at NATO HQ, Brussels and have designed and built Coalition interoperability demonstrators for the European Defence Agency. Nexor's cyber-guards are deployed by 15 other Ministries of Defence within NATO and NATO itself.

Nexor are also working with partners on the design, development and testing of new autonomous and connected on-demand vehicles (Pods). The project will culminate in on-road public trials at London's Queen Elizabeth Olympic Park. The highly connected Pods will receive data providing information on the proposed journey, route and road traffic conditions.

Working with Warwick Manufacturing Group, part of the University of Warwick, Nexor is researching how to assess the impact of a cyber security attack on the cyber-physical safety of the Pods.

Nexor anticipate that this work will help develop new protection measures in an increasingly connected Internet of Things world.

Known for: Home of Rolls-Royce and the Red Arrows



West Midlands

MOD spending with commerce and industry (2016-17)

 **£281m**

Largest MOD industry group expenditure:
**Technical, Financial and Other
Business Services**

 **£918m**

Expenditure with industry and commerce

 **4,700**

Jobs supported by MOD expenditure
with industry

 **Major Defence
suppliers:**

BAE Systems, Northrop Grumman, QinetiQ,
Ultra Electronics

Personnel (1 April 2018)

7,700

Regular Military

2,340

Reservist Military

2,380

Civilian

The West Midlands is known as:

The headquarters of Defence Medical Services, including those pioneering medical advances for treatment of wounded servicemen at the joint military-civil Queen Elizabeth Hospital in Birmingham.

It also:

Hosts the Manufacturing Technology Centre at Anstey Park in Coventry, one of the largest public-sector investments in UK manufacturing, helping bring academia and industry together. It provides an environment for the development and demonstration of new technologies on an industrial scale. It has worked with GE Aviation and its supply chain, increasing productivity, on-time delivery and competitiveness at Bishop's Cleeve.

Working with Local Enterprise Partnerships (LEPs)

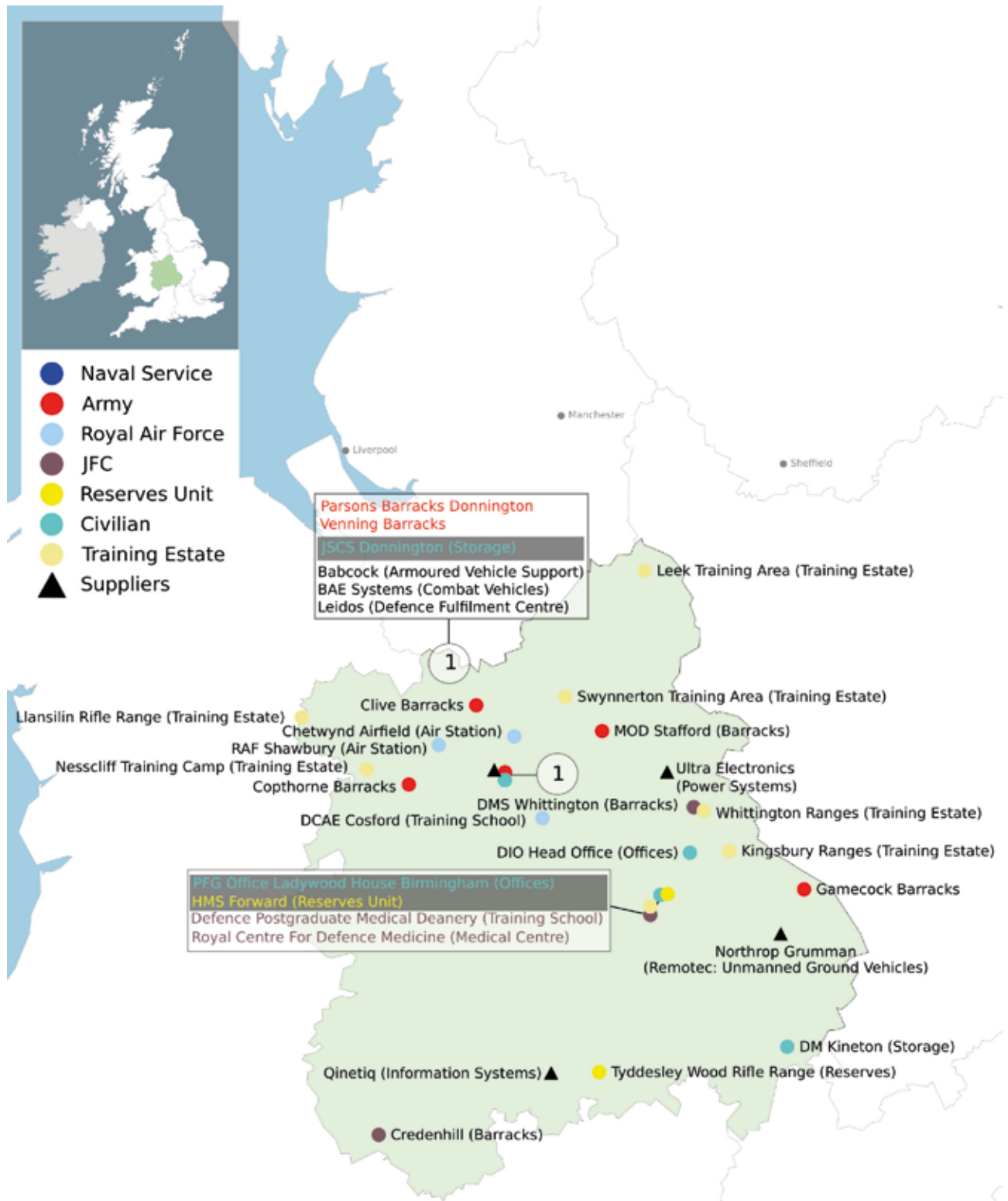
QinetiQ are hosting a testbed with local technology

partners, the Marches LEP, Worcestershire County Council, and Malvern Hills Science Park to test infrastructure and systems for the next generation mobile technology – 5G.

More than 1.4 billion 5G connections are predicted by 2025, as this technology rolls out across industries such as health, transport, retail and manufacturing there will be an increasing reliance on network. The consequences of hacking or denial of service could have much greater implications than for current mobile infrastructure, meaning that the system will have to be more secure and resilient.

The collaboration includes industry leaders in the telecoms sector, who will be building and running the network, these include: Huawei, O2, BT, 5GIC (Surrey University), and AWTG (a telecoms SME) and other local partners include Mazak and Worcester Bosch who are experimenting with 5G applications for advanced manufacturing including preventative and assisted maintenance using robotics, big data analytics and augmented reality. Worcester University and Heart of Worcestershire College, will be creating 5G courses to add depth to the local skills base.

Known for: Defence Medical services and the military/civil Queen Elizabeth Hospital in Birmingham.



East of England

MOD spending with commerce and industry (2016-17)



£191m

Largest MOD industry group expenditure: **Weapons and Ammunition**



£918m

Expenditure with industry and commerce



5,700

Jobs supported by MOD expenditure with industry



Major Defence suppliers:

Airbus, Boeing, Cobham, Leonardo, Lockheed Martin, MBDA, QinetiQ, Raytheon UK

Personnel (1 April 2018)

13,280

Regular Military

1,820

Reservist Military

3,600

Civilian

The East of England is known for:

Its many air bases, both RAF and US Air Force (USAF), hosting state of the art air systems. These bases date from the Second World War and remain a proud part of the military heritage of the East of England.

But today it also:

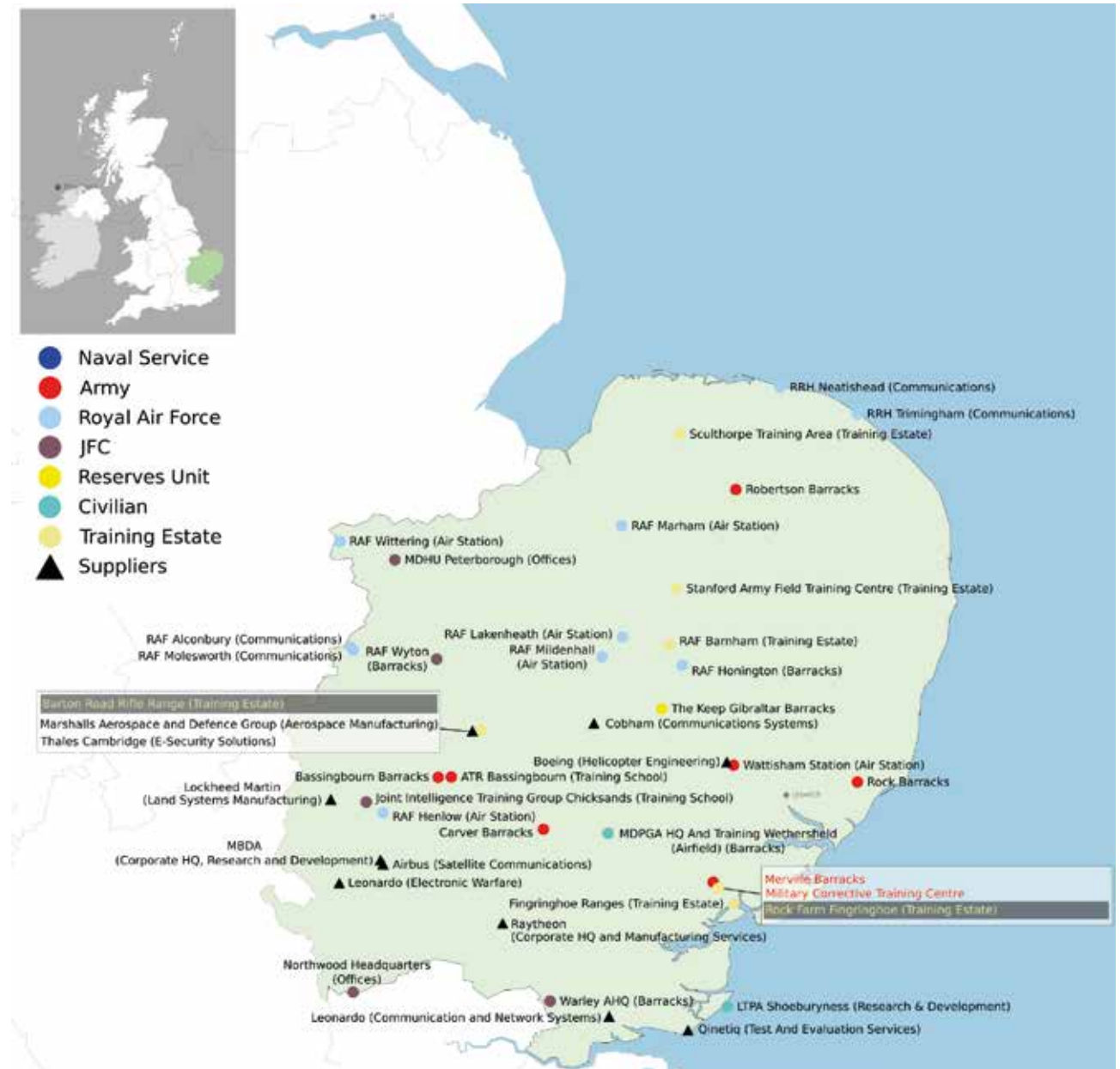
Hosts cutting-edge electronics, space and missile technology that continue to keep the UK safe and prosperous. Key facilities operated by Raytheon, MBDA, Lockheed Martin and Airbus are well-known employers in Harlow, Basildon, Stevenage and Cambridge, where Marshall ADG is also a leading defence services supplier. Raytheon organises science exercises and hackathons for primary / secondary school students. In 2015 a pilot programme was launched in Essex County Council with four schools. It was later rolled out to schools UK-wide.

Investing in the East of England;

MOD is investing more than £300 million at RAF Marham for the arrival of the UK's first F-35B Lightning II Aircraft in 2018. The investment is funding extensive work on infrastructure and facilities, creating up to 1,000 new additional jobs directly in the construction phase and a further 700 in the supply chain.

The East of England will also become the heart of US European Joint Strike Fighter operations. Alongside the UK F-35s based at RAF Marham, RAF Lakenheath on the Norfolk-Suffolk border will become home to the first two US F-35 squadrons in Europe, with the first aircraft due to arrive in 2020. For the first time in decades the USAF and the RAF will operate the same type of aircraft from the UK. This highlights the strength of shared commitment to transatlantic security and paves the way for the next generation of continued close collaboration between respective air forces and significant economic benefit to the UK from the F-35 programme over decades to come.

Known for: Operational RAF bases, including basing of new F-35 Lightning II



London

MOD spending with commerce and industry (2016-17)



£1.4bn

The largest MOD industry group expenditure in London is **technical, finance** and other **business services**



£568m

Expenditure with industry and commerce



7,100

Jobs supported by MOD expenditure with industry



Major Defence suppliers:

Airbus, BAE Systems, Boeing, Capita, MBDA and Ultra Electronics

Personnel (1 April 2018)

4,810

Regular Military

4,310

Reservist Military

3,340

Civilian

London also hosts...

A global hub for the technology development that will play a big role not only in the UK's future prosperity but also the capabilities of the UK Armed Forces and the ability of our defence companies to compete globally. The London technology sector leads in artificial intelligence. The global financial sector is driving FinTech, pioneering private investment in MilTech (defence, cyber and security) application.

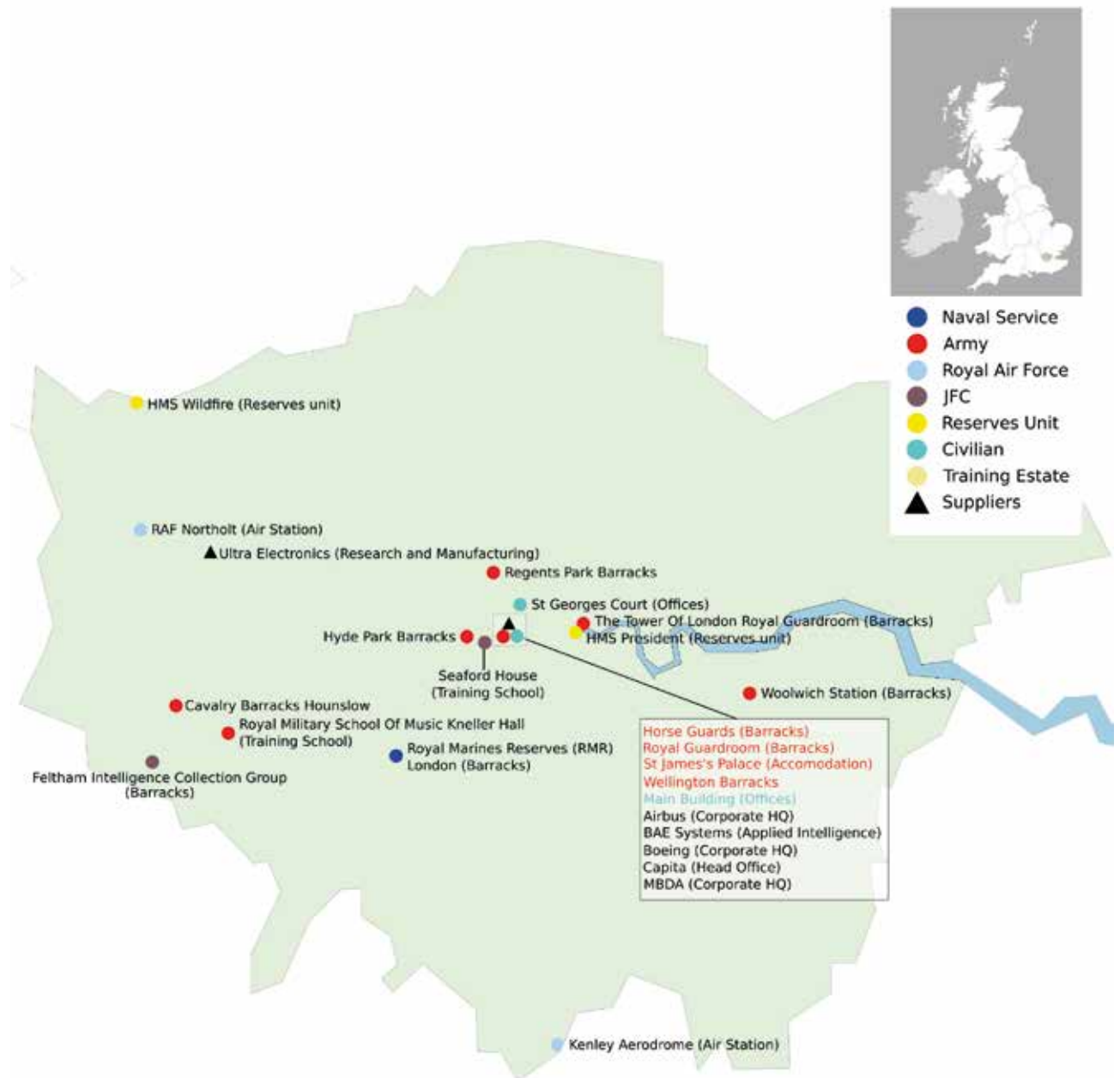
Industry and Queen Mary University of London

Inspired by recent scientific breakthroughs in transformation optics and metamaterials, Queen Mary University of London and UK industry (including QinetiQ, BAE Systems and Thales) have demonstrated several novel antenna solutions.

These potentially offer new composite flat lens antenna, surface wave and metasurface devices that could be embedded into the skin of vehicles without compromising aerodynamic performance.

Such collaboration helps UK science and industry maintain their leading position, supporting the Government's Industrial Strategy goals, facilitating retention and growth of highly skilled jobs and the UK's knowledge economy.

Known for: Military-themed museums, including the Imperial War Museum London, with over a million visitors a year.



South East England

MOD spending with commerce and industry (2016-17)



£1.3bn

Largest MOD industry group expenditure:
Technical, Financial and Other Business Services



£4.9bn

Expenditure with industry and commerce



33,100

Jobs supported by MOD expenditure
with industry



Major Defence suppliers:

Airbus, AWE, Babcock, BAE Systems, Boeing, Cobham, DXC, GE Aviation, General Dynamics UK, Leonardo, Lockheed Martin, Northrop Grumman, QinetiQ, Serco, Thales UK, Ultra Electronics

Personnel (1 April 2018)

37,100

Regular Military

4,460

Reservist Military

9,640

Civilian

The South East is...

- Home to the three service Headquarters: the Royal Navy at HMS Excellent at Whale Island; the Army at Marlborough Lines in Andover; and the RAF in High Wycombe.
- Custodian of some of our proudest naval history at Portsmouth Historic Dockyard. This was the fourth most popular paid attraction in the South East in 2016, with 604,213 recorded visitors.

The South East also...

- Provides a unique mine and improvised explosive device detection capability to the UK Armed Forces and close international partners, through Cobham's engineering and production facilities in Leatherhead, Surrey and Marlow, Buckinghamshire.

Moreover

QinetiQ is working with the Solent LEP, at Portsdown Technology Park near Portsmouth, to establish a centre of excellence in Maritime Missions Systems – a total investment of £23 million. QinetiQ's investment was made possible by award of the Naval Combat Systems Integration Support Services contract in autumn 2016, securing 200 jobs and creating up to another 100.

BAE Systems in Rochester produces state-of-the-art head up displays for fixed and rotary wing aircraft with helmet-mounted systems deployed on Typhoon. The latest generation of helmet-mounted display (called Striker II), is an all-digital, high-resolution colour display system with high accuracy, hybrid head tracking. This technology is now being spun out into the civil domain. There are potential uses in civil aviation, providing primary flight information through low-cost glasses, and in fire services – for navigation through buildings and in providing thermal images.

South West England

MOD spending with commerce and industry (2016-17)

 **£1.2bn**

Largest MOD industry group expenditure: **Technical, Financial and Other Business Services**

 **£5.1bn**

Expenditure with industry and commerce

 **33,500**

Jobs supported by MOD expenditure with industry

 **Major Defence suppliers:**

Airbus, Babcock, Boeing, Capita, Cobham, GE Aviation, Leonardo, MBDA, QinetiQ, Raytheon, Rolls-Royce, Serco, Thales, Ultra Electronics

Personnel (1 April 2018)

36,240

Regular Military

4,160

Reservist Military

18,610

Civilian

The South West is known as:

The historic base of Army training on Salisbury Plain, the Royal Navy at Devonport and Royal Marines bases; as well as helicopter manufacture by Leonardo at Yeovil. Bristol is a major defence industrial hub with aero-engine manufacture by Rolls-Royce, and is the headquarters of MOD's Defence Equipment & Support.

It also...

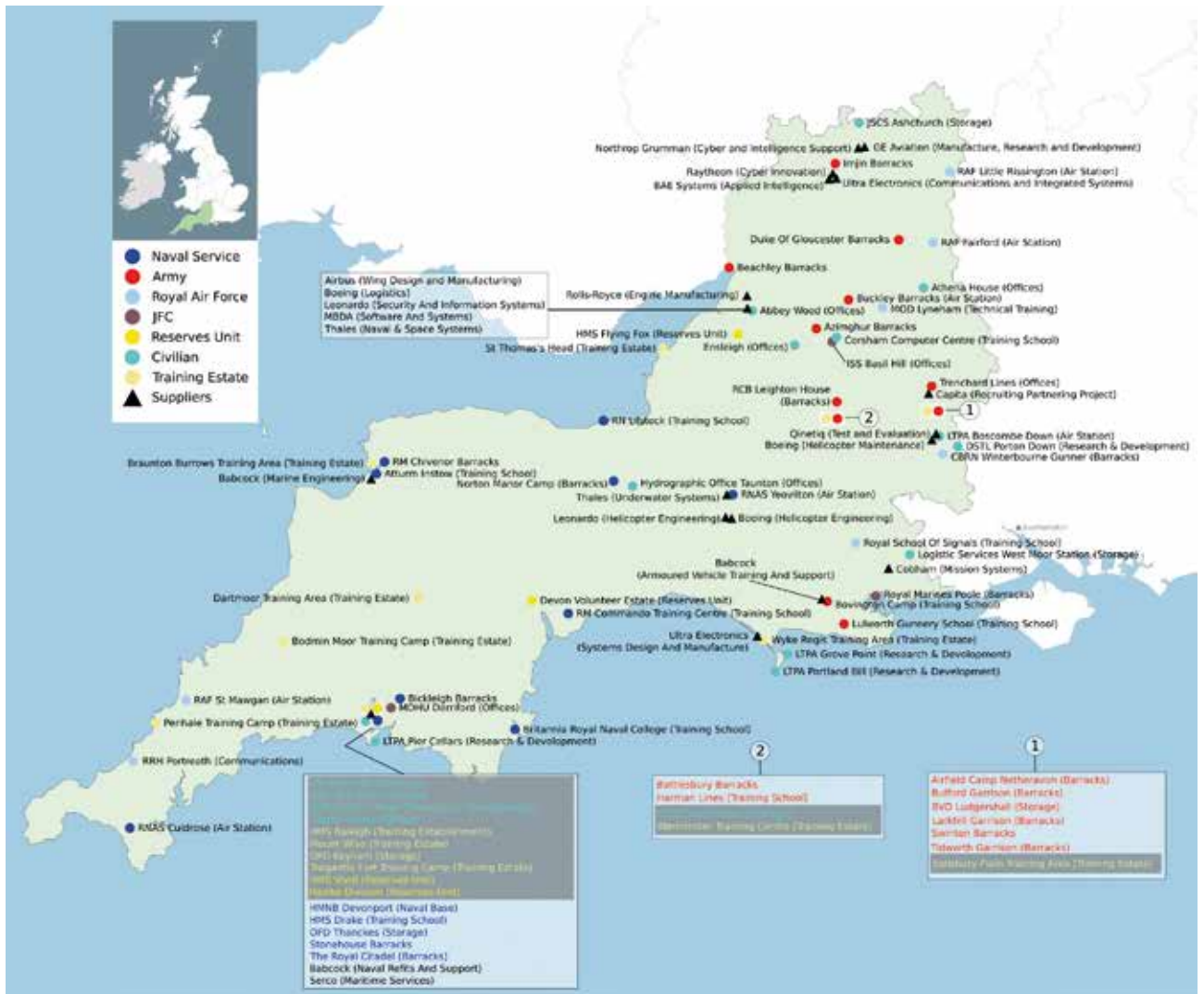
...hosts the UK operation of ATLAS Elektronik (AEUK) in Dorset. In 2016, their ARCIMS unmanned minehunter successfully demonstrated at Exercise Unmanned Warrior, Scotland, when the Royal Navy invited AEUK to demonstrate its capabilities. To date 10 vessels are in service or under contract.

Co-operation with SMEs for defence needs produces technology for the wider economy:

A key environmental and time constraint for major warship support periods is the need to remove paint coatings. Working with a specialist SME in Bristol, the major defence company Babcock have introduced a laser system that is able to remove paint coatings in a precise manner and without the normal environmental issues related to shot-blasting.

Babcock have been working with Bristol-based OC Robotics, who have developed a robotic articulated arm ("LaserSnake") that can be used for complex operations in difficult environments. For example, it has also been used by the Magnox team (led by Babcock) in the decommissioning of the Dragon reactor at Winfrith in Dorset.

Known for: Helicopter manufacture at Yeovil and Armed Forces training



Annex C – Terms of reference

Defence contribution to national economic and social value. Terms of reference for study led by Philip Dunne MP

1. The review [working title ‘Growing the Contribution of Defence to UK Prosperity’], is to focus on providing an external perspective and challenge to how defence ensures it supports UK economic growth and prosperity. It will consider how to work more effectively across government and with industry and allies to identify opportunities to increase the wider value of defence and remove barriers to achieving this.
2. The study will identify and engage with a range of stakeholders, including those outside of Government. It will include consideration of, but not be limited to, the following areas:

UK national life:

Articulating the contribution that defence makes to our national life including to: the “fabric of the nation”; the image of the UK as strong and stable economy; tourism and support to wider Government efforts to enhance UK influence (and the contribution to defence engagement).

Place

Generating a stronger evidence base to set out the economic impact of Defence activities across the UK including the direct and indirect employment it creates and its local impact across the UK.

Economic Growth

Capturing the opportunities for defence exports to make a greater contribution to Defence and the wider UK economy. Realising the opportunities to grow defence inward investment and looking at how defence prosperity can help sustain current and develop new partnerships with industry and our allies. Linked to this is consideration of how exploiting such opportunities can help sustain otherwise unaffordable defence capabilities and lead to increased efficiency in the defence sector. Identifying areas where defence capabilities and investment can be leveraged to support civil/commercial infrastructure or opportunities (for example space and communications).

People

Defence contribution to the national skills agenda. Defence contribution to UK social mobility, including how it develops the human capital of military and civilian personnel in both the Regular and Reserve forces through apprenticeships, skills development and other means. Defence support to veterans after they leave Service.

Ideas

- Enhancing the return on Defence’s investment in Science and Technology, innovation, research and development. Making the most of its capability to benefit the wider economy and society, including opportunities for spin-off into the civil sector and vice versa, in areas such as medical technology.
3. The work will be conducted in the context of the Modernising Defence Programme, feeding into Workstreams 3 and 4. Its emerging findings and conclusions will, as appropriate, influence the outcomes of the wider programme. It should consider the Department’s refreshed Defence Industrial Policy, and the Government’s Industrial Strategy, including the industry-led work on a Defence Sector Deal.
 4. The report should offer estimates of the size of the benefit to the UK economy where practicable in the timescale. It should include recommendations for how Government can make more of this work, including aligning policy levers to support defence sector growth and opportunities to deliver more by closer work with other Departments.
 5. The report is to be delivered to the Defence Secretary on 17 May¹⁰⁴ so that it can contribute to the Modernising Defence Programme.
 6. The Department will provide some non-dedicated support to this work particularly in providing access to research and analysis and supporting meetings. Authorial control will however rest with Philip Dunne. The report will be of advisory status to the Secretary of State.
 7. It is expected that most interviews and evidence gathering can take place in London. Funding will be available for necessary travel within the UK in line with the usual procedures of the Department, and will fall in FY 2018-19. (Any required foreign travel would be subject to additional clearance process.)
 8. The Secretary of State will launch the study on Thursday 15 March, with further publicity to be agreed with the Department. The study should contribute to making Defence relevant to the general public. It will be published by the Ministry of Defence upon its conclusion.

¹⁰⁴Draft delivered on 17 May 2018. Final pre-publication report delivered on 7th June 2018.

Annex D – Engagements

Philip Dunne MP engaged with the following stakeholders during his review:

Industry discussions			
1	Industry roundtable (DSF ¹⁰³ Main representatives) 26th March 2018 Ministry of Defence	ADS	Paul Everitt
		Airbus Defence and Space (UK)	Colin Paynter
		Babcock	John Howie
		BAE Systems	Nigel Whitehead
		Boeing	David Pitchforth
		DGP	Ed Frankland
		DXC Technology	Roger Hood
		General Dynamics UK	John Hiorns
		Leonardo	Andrew Cowdery
		Lockheed Martin UK	Peter Ruddock
		MBDA	Paul Crawley
		QinetiQ	William Tew
		Serco	Paul McCarter
		Thales UK	Avril Joliffe
UK DSC	Sir Brian Burridge		
2	Industry roundtable (DSF Mid-Tier representatives) 29th March 2018 Ministry of Defence	Atkins Global	Alan Buckland
		BMT Global	Muir Macdonald
		BSA	Mark Fox
		CGI	Neil Timms
		Cobham	Greg Bagwell
		Cohort	Andy Thomis
		NDI (EEF)	Ollie Welch
		EEF	Stephen Phipson
		Fujitsu	Tim Gibson
		GE Aviation	Jonathan Walton
		L-3 Communications	Richard Flitton
		Marshall ADG	Alastair McPhee
		Northrop Grumman	Ian Menzies
		Raytheon UK	Sen Sami
		Rolls-Royce	Dave Gordon
		techUK	Fred Sugden
UK Cloud	David Lawfod Mee		
UK DSC	Mark Barclay		
Ultra-Electronics	Chris Binsley		

¹⁰³ Suppliers Forum

Industry discussions			
3	Defence Growth Partnership 1 st May 2018	Airbus Defence and Space UK	Colin Paynter
		Atkins Global	Philip Hoare
		Axillium	Will Searle
		BAE Systems	Nigel Whitehead
		BEIS	Keith Hodgkinson
		Cobham	Greg Bagwell
		DGP Chairman	Allan Cook
		DGP	Ed Frankland
		DGP	Paul Crawley
		DIT DSO	Simon Everest
		General Dynamics	Steve Rowbothan
		High Value Manufacturing	Dick Elsy
		Leonardo	Norman Bone
		Lockheed Martin	Peter Ruddock
		MBDA	Chris Allam
		MOD	Huw Walters
		QinetiQ	Sophie Lane
		Rolls-Royce	Bob Stoddart
		Serco	Paul McCarter
		Thales	Victor Chavez
UK DSC	Sir Brian Burridge		
UK DSC	Mark Barclay		

Visit to Wales and Bristol (9 th April 2018)			
4	Meeting	Welsh Assembly	Alun Davies AM, Cabinet Secretary for Local Government and Public Services
5	Meeting telephone	Welsh Assembly	Ken Skates AM, Cabinet Secretary for Economy & Transport
6	Meeting	160 Infantry Brigade and HQ Wales	Col Lance Patterson, Deputy Commander 160th Infantry Brigade and HQ Wales
7	Visit	Rolls-Royce	Dave Gordon, Dir UK
			Andy Hare, VP UK
			Bob Stoddart, Dir Customer Business
			Alex Zino, Dir Strategy and Future Programmes
8	Visit	Defence Equipment & Support	Michael Bradley, CEO (Acting)
			Sir Simon Bollom, CoM Ships
			Lt Gen Paul Jaques, CoM Land
			Pete Worrall, CoM Joint Enablers
			David Johnson, DG Resources
			Tony Chisnall, DG Progs
			Nick Elliot, DG Commercial
			Barry Burton, Dir Corp Ops
			Dawn Cunningham-Martin, CEO-COS
			Capt Paul Carroll, Ships Acquisition T31
			Kyla Isbell, Ships Acquisition T31
Steve Hyde, Ships Acquisition T31			
9	Visit	Submarine Delivery Agency	Ian Booth, CEO
			Paul Bell, Head of Commercial
			Andrew Hazard, Consultant

Visit to Northern Ireland (19 th April 2018)			
10	Meeting	38 (Irish) Brigade	John McCullagh
11	Industry roundtable (hosted by Thales)	ADS Group Ltd	Leslie Orr
		Bombardier Aerospace	Nick Laird
		Denroy Plastics Ltd	John Rainey
		Moyola Precision Engineering Ltd	Mark Semple
		Seven Technologies Group	Jim Hook & Moya Johnston
		Survitec Group	Philip McBride
		Thales Belfast	Angus Cameron
		Thales UK	Avril Jolliffe & Alasdair Ambroziak
12	Meeting	Invest Northern Ireland Representing the Northern Ireland Department for the Economy	William McGuinness
			Michael Polson
			Noel Brown
13	Reception	HMS Caroline	Arlene Foster MLA PC & Gavin Robinson MP

Visit to Scotland (26 th April 2018)			
14	Visit	Meeting with Senior Military Officers in Scotland	Maj Gen. Bob Bruce, General Officer Scotland
			Gp Capt. Clive Coombes, Chief of Staff representing Air Officer Scotland
			Cdre Mark Gayfer, Naval Base Commander HM Naval Base Clyde, representing Flag Officer Scotland and Northern Ireland
15	Visit	Raytheon	Richard Daniel, Raytheon UK CEO
			Paul Johnston, Head of Manufacturing
			Sen Sami, Government Relations
16	Meeting	Scottish Enterprise	Chris McClean, Aerospace and Defence Lead
17	Industry roundtable (hosted by Raytheon)	ADS	Andy Johnston
		BAE Systems	Stuart Gallacher
		JFD	Chloe Cannon
		Leonardo UK	Linda McVey, Philip Pratley
		Penman Engineering	Stuart St John Claire
		Raytheon UK	Richard Daniel
		Scottish Enterprise	Chris McClean
		Thales UK	John McDonald
		Walker Precision Eng	Gary Walker
18	Meeting (telephone and written submission)	Scottish Government	Keith Brown MSP, Cabinet Secretary for the Economy, Jobs and Fair Work

Individual meetings			
19	Ministers UK Government	Secretary of State for Defence	Rt Hon Gavin Williamson MP
		Secretary of State for International Trade	Rt Hon Liam Fox MP
		Secretary of State for Scotland	Rt Hon David Mundell MP
		Secretary of State for Northern Ireland	Rt Hon Karen Bradley MP
		Secretary of State for Wales	Rt Hon Alun Cairns MP
		Chief Secretary to the Treasury (and then with HMT officials)	Rt Hon Elizabeth Truss MP
		Minister of State for the Armed Forces	Rt Hon Mark Lancaster TD MP
		Minister of State for Exiting the EU	Steve Baker MP
		Minister for Defence Procurement	Guto Bebb MP
		Minister for Defence People and Veterans	Rt Hon Tobias Ellwood MP
		Parli Under Sec of State, BEIS	Richard Harrington MP
		Parli Under Sec of State, DCLG	Jake Berry MP
20	Ministry of Defence	<i>Senior Civil Servants</i>	
		MOD Permanent Secretary	Stephen Lovegrove
		DG Finance	Catherine Little
		Chief Scientific Advisor	Hugh Durrant-Whyte
		DG Strategy and International	Peter Watkins
		Chief Exec (des) DE&S	Sir Simon Bollom
		Defence Innovation Champion	Kristina Murrin
		ESP Director	Huw Walters
		<i>Senior Military Officers</i>	
		Chief of Defence Staff	ACM Sir Stuart Peach
		Vice Chief of Defence Staff	Gen Sir Gordon Messenger
		Chief of the General Staff	Gen Sir Nicholas Carter
		Chief of the Air Staff	AM Sir Stephen Hillier
		Commander Joint Forces Command	Gen Sir Chris Deverell
		Chief of Defence People	Lt Gen Richard Nugee
		Deputy Chief of Defence Staff	Lt Gen Sir Mark Poffley
		Assistant Chief of the Naval Staff	R Adm Nick Hine
		Air Cap COS	AVM Rocky Rochelle
		Army Capability Director	Maj Gen Christopher Tickell
21		Former Commander Joint Forces Command (Retired)	Gen Richard Barrons
22		Former CEO DE&S	Tony Douglas
23		Former Chief Exec DSC	Steve Brittan

Individual meetings			
24	Academics / commentators	RUSI	Prof Malcolm Chalmers Prof Trevor Taylor
		Defence commentator	Mike Maiden
		Defence commentator	Howard Wheeldon
		Birkbeck, University of London	Prof Ron Smith
		York University (written submission)	Prof Keith Hartley
		Cranfield University (written submission)	Prof Ron Matthews
25	Industry	Airbus Defence and Space UK	Colin Paynter
		Babcock International Group	Archie Bethel, John Howie, John Gardner
		BAE Systems	Nigel Whitehead, Oliver Waghorn
		Boeing	Sir Michael Arthur, David Pitchforth, Nick Whitney, Julian Moore
		Cobham	David Lockwood
		DAS	Peter Cook
		General Dynamics	Mark Roualet, Steve Rowbothan, Kevin Connell, John Hiorns
		Leonardo	Norman Bone, Andrew Cowdery, Simon Jones
		Lockheed Martin	Peter Ruddock
		MBDA	Chris Allam, Paul Crawley, Howard Borrington
		QinetiQ	Steve Wadey, William Tew
		Serco	Rupert Soames, Rupert Sykes
		Thales (UK)	Victor Chavez
		UK DSC	Sir Brian Burrridge, Simon Forrester, Mark Barclay, Andrew Radcliffe.
26	Senior Government Official	DIT-DSO	Simon Everest

Individual meetings			
25	Trade Unions	CSEU / Unite	Ian Waddell
		GMB	Ross Murdoch
		GMB	Laurence Turner
		Prospect	Mike Clancy
		Unite	Steve Turner
26	Consultancies¹⁰⁴	KPMG	Jonathan Gill, Shareef Maund
		PWC	Roland Sonnenberg
		Renaissance	Michael Formosa

The Defence Suppliers Forum (DSF), in both Main and Mid-Tier formats, was asked to respond to a questionnaire covering aspects of industry’s wider contribution to UK prosperity – including on training, R&D and supply chain spending and the spill-over between defence and civil activities. Responses were provided in confidence, but anonymised information has been collated for inclusion in this Review. Philip Dunne would like to acknowledge the helpful support he received from all those attending the DSF meetings and in meetings he held bilaterally with companies, commentators, consultancies and trade unions. He would like to give particular thanks to the companies and organisations which provided comprehensive and informative responses to his questionnaire: Airbus Defence and Space UK, Babcock International Group Plc, BAE Systems Plc, Boeing, BSA, CGI, Cobham Plc, General Dynamics UK, Leonardo, Lockheed Martin UK, Marshall ADG, MBDA, QinetiQ Group Plc, Raytheon UK, Rolls-Royce Plc, Serco Group Plc and Thales UK.

¹⁰⁴The Team supporting Philip Dunne also met representatives of McKinsey and Deloitte in connection with the Review.

