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DEFENCE INNOVATION: NEW MODELS AND PROCUREMENT IMPLICATIONS

The British Case

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ABSTRACT

The UK has emphasised the importance of innovation in defence for over five years in light of both the deteriorating political environment and increasing technological opportunities. In its hopes for such technology-based initiatives, the British Government looks particularly to Small and Medium-Sized Enterprises. The paper addresses the evolution of policy stances on innovation, including in the 2021 Defence & Security Industrial Strategy, itemises the organisational arrangements that have been developed, and analyses the areas of technology seen as most significant. Funding issues are discussed and five approaches to stimulating innovation are identified.

These are:

- the government's readiness to work in cooperative, partnered relations with the private sector, including private sector businesses operating in the UK that are foreign-owned;
- recognition that innovation will need a readiness to collaborate with foreign partners, including continental Europeans. There is awareness of the challenges of collaboration with the US and also a readiness for patience in development ties with countries including Japan and Australia;
- the UK recognises that, given the level of R&D spending and the types of advancing technology, defence needs intelligent access to gains that are being made in the civil and commercial world and in the university sector. Like the defence sectors of other states, the UK faces the challenges of understanding what is moving in the civil world, how it might be used in the military, and how to secure access. There is no evidence of any significant reluctance on the part of UK businesses to get involved with defence, but government contracting practices need some attention;
- there is an emphasis on modularity and the use of an open systems approach in the design of major systems to facilitate the easy integration of novel elements. The Type 26 frigate, with Australia and Canada having ordered their own versions, is significant in this regard.
- Financially, the government has looked to secure significant changes with modest sums of money, although the defence settlement of November 2020 reversed the trend towards lower R&D spending by the MoD.

The paper concludes with a short discussion of the commercial developments needed to promote innovation and with an exploration of the idea that information-focused innovation in defence has implications for organisational and cultural change in the military, transforming whose expertise and experience is of central value.

Keywords: *Innovation, Multi-domain operations, collaboration, partnering, research, development, Defence and Security Industrial Strategy, small and medium-sized enterprises (SMEs).*

INTRODUCTION

This piece here deals in turn with:

- the UK's policy stance on defence technological innovation within the context of national approaches to defence industrial capabilities
- the programmes and organisations with an innovation focus
- the foci of concern for innovation efforts
- routes to innovation and overall government funding for defence R&D
- the recognised and implicit challenges.

INNOVATION IMPORTANCE AND POLICY

The UK governmental defence sector placed particular policy emphasis on need for technological innovation once the extent of Russian (and Chinese) assertiveness, defence spending and technological progress became apparent after the first decade of the 21st century. These were also the developments that prompted the US Third Offset Strategy with its stress on the need to counteract hostile anti-access and area denial (AA/AD) capabilities, which the UK also could not ignore.[1] There was both the opportunity and need for technological innovation, recognised by the Government's 39 references to it as a target in the National Security Strategy and Strategic Defence & Security Review document of 2015. [2] Innovation was to serve both defence needs and the wider economy. For the UK, innovation was also seen as a promising means of reducing the financial pressures arising from the tendency to increased costs for major systems as one generation gave way to the next. This trend was most prominently noted by the US industrialist Norman Augustine in the early 1980s when he argued that, if the extant trends continued, in 2054 the entire US defence budget would have to be devoted to the purchase of a single aircraft.[3] UK research confirmed that this analysis had real weight[4]

[1] John Louth, Trevor Taylor and Andrew Tyler, 'Defence Innovation and the UK Responding to the Risks Identified by the US Third Offset Strategy', *RUSI Occasional Paper*, RUSI Occasional Paper, July 2017, https://rusi.org/sites/default/files/20170707_defence_innovation_and_the_uk_louth.taylor.tyler_final.pdf

[2] National Security Strategy and Strategic Defence and Security Review 2015 (publishing.service.gov.uk)

[3] See for instance, 'The cost of weapons**:** Defence spending in a time of austerity', *The Economist* Briefing, 28 August 2010.

[4] N. Davies, A. Eager, M. Maier and L. Penfold, Intergenerational Equipment Cost Escalation, Defence Economic Research Paper, undated, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/280041/18_december_2012.pdf.

and successive UK defence equipment plans were challenged in the 21st century (and before) by the estimated likely costs much exceeding the funding likely to be available.

The UK focus throughout has been on technological innovation although there has been recognition that, in order to deliver this, innovation in procurement practices, particularly to decrease the time taken to get things on contract, would be needed (see below). Also, since around 2004, the UK had used a wide-ranging checklist to specify the factors that needed to be added to equipment in order to provide usable capability. The TEPIDOIL framework provided a reminder that capability came from a combination of Training, Equipment, People, Infrastructure, Doctrine, Organisation, Information and Logistics. Thus there was awareness that organisational, people and perhaps doctrinal innovations might also be needed.

The commitment to innovation in defence was continued and underlined in the 2021 document set comprising the Integrated Review *Global Britain in a competitive age,*[5] the Defence Command Paper *Defence in a competitive age*,[6]and the *Defence and Security Industrial Strategy (DSIS).*[7] The Prime Minister's vision for 2030 in the Integrated Review was that Britain would embrace 'innovation' in science and technology to boost our national prosperity and strategic advantage'.[8] In the defence Command Paper, there was intent to harness civil innovation for defence purposes and that 'Innovation and experimentation will be the drivers of modernisation, with access to cutting-edge technology' (p. 11).

The word innovation permeates the DSIS, with multiple references amounting to one on almost every page.[9]

It would be little exaggeration to assert that the UK Government in 2021 presented innovation, linked with the country's alleged expertise in science and technology underlined in the Integrated Review, as the country's 'get out of jail card' allowing optimism about dealing with external threats, delivering prosperity after leaving the EU, dealing with defence's financial problems and even recovering from the damage of COVID-19.

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[5] https://www.gov.uk/government/publications/global-britain-in-a-competitive-age-the-integrated-review-of-security-defence-development-and-foreign-policy;

[6] https://www.gov.uk/government/publications/defence-in-a-competitive-age.

[7]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/971983/Defence_and_Security_Industrial_Strategy_-_FINAL.pdf;

[8] Integrated Review p.6, https://www.gov.uk/government/publications/global-britain-in-a-competitive-age-the-integrated-review-of-security-defence-development-and-foreign-policy

[9] Innovation appears on 83 occasions in 106 pages.

PROGRAMMES AND ORGANISATIONS WITH AN INNOVATION FOCUS

From the last years of the Labour Party governments and through the Conservative ministers of defence since 2010, the Government launched a number of innovation-focused initiatives which, by the time of the Integrated Review announced in 2021, had led to a mosaic of activities and funding arrangements, many of which recognised the belief that Small & Medium-Sized Enterprises (SMEs) would be key to bringing more innovation to defence.

1. In 2008 the MoD set up the Centre for Defence Enterprise (CDE) which could and did make small awards to companies offering bright ideas in response to themed challenges: having 'placed 1059 contracts, 43% with small and medium-sized enterprises (SMEs), 29% industry and 28% academia', in 2016 the CDE was re-badged as the Defence & Security Accelerator (DASA) which makes awards for both DASA-specified challenges and for unspecified innovation offerings.[10] Its website gives details of its work and provides instructions of how to apply and also of contracts awarded.[11]
2. Niteworks, was an arrangement in which seconded industrial personnel and government staff generated studies aimed at solutions to specified defence problems. This body was wound up after 2018 when its contract ended but in 2021 was re-established as Future Lab working particularly for the engineering group in the MoD's Defence Equipment & Support organisation.[12]
3. The formal series of meetings linking the MoD and its industrial suppliers, badged as the Defence Suppliers Forum was re-energised in the second decade of the 21st century with multiple sub-groups, one of which published a paper at the end of 2020 on how defence could reduce its carbon footprint.[13] Included on its agenda

[10] https://www.gov.uk/government/collections/defence-and-security-accelerator-funding-competitions?utm_medium=email&utm_campaign=govuk-notifications&utm_source=78483a00-6941-420a-b86d-ab0fdf657d4e&utm_content=daily.
[11] https://www.gov.uk/government/latest?departments%5B%5D=defence-and-security-accelerator
[12] https://www.gov.uk/government/collections/niteworks; https://www.qinetiq.com/en/what-we-do/services-and-products/edp; Defence and Security Accelerator funded contracts: 1 April 2020 to 31 March 2021 - GOV.UK (www.gov.uk)
[13] Defence Suppliers Forum Research Technology & Innovation Group (RTIG), Powering Future Operations: Net Zero Challenges & Opportunities, December 2020, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/967965/Energy_and_Power_Deep_Dive_Final.pdf.

was how SMEs could secure better access to the MoD market both directly and through the supply chains of larger primes.

4. The Defence Growth Partnership (DGP) was set up in 2012 as a joint government industry body working on different aspects of industrial performance including exports and skills development.[14] This was an indication that the Government was looking to reinforce national defence industrial capabilities and not merely leave them at the mercy of international market and political forces.
5. The Defence Solutions Centre was established within the DGP, 'working alongside industry and government to deliver objective evidence-based analysis on future capabilities and innovations'.[15]
6. Demonstrating their readiness to try new ways of doing things, each of the four military commands set up their own innovation focused organisations. [16]

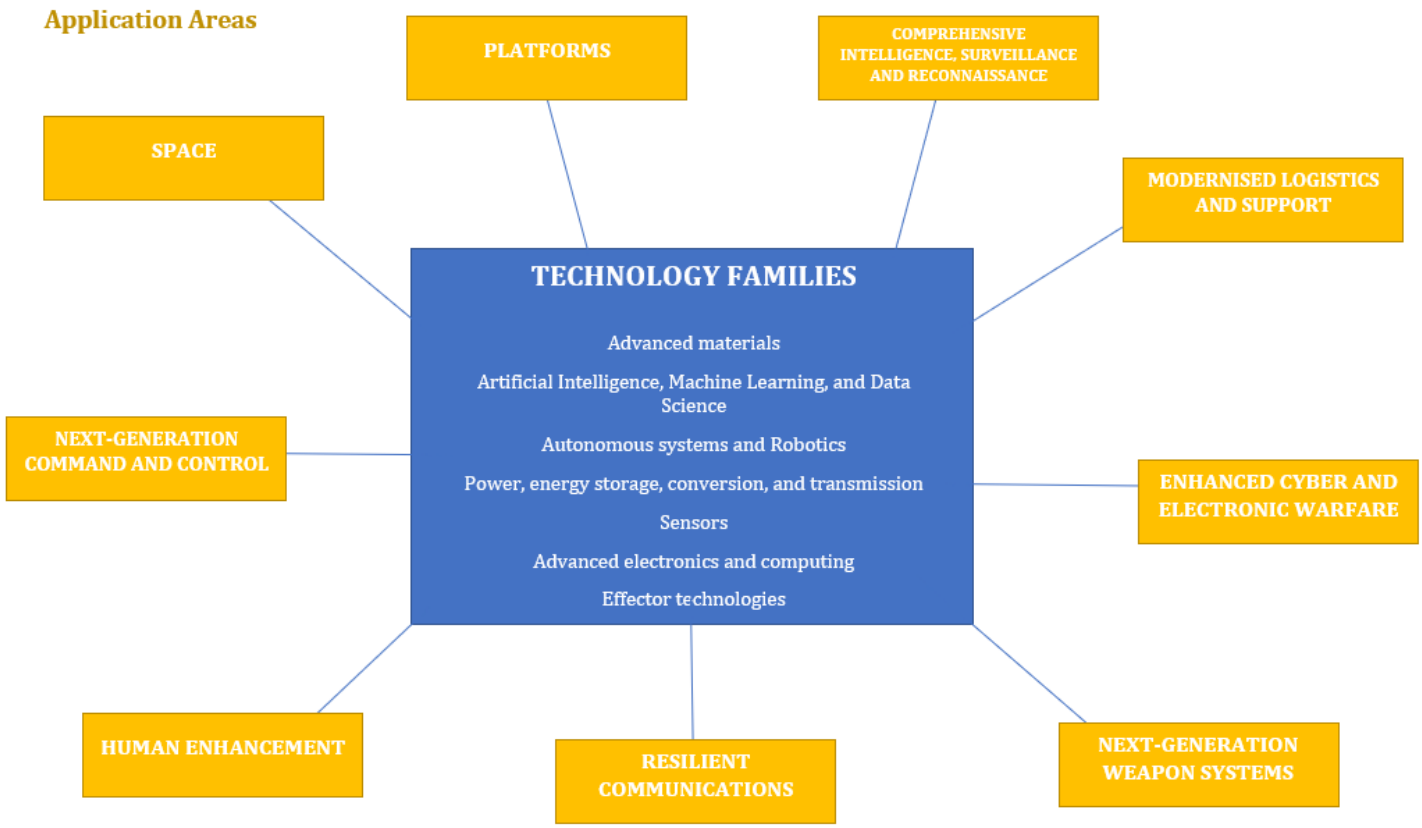
As noted, defence industrial capabilities and innovation were seen as highly compatible with a perceived key being to capture the potential of small and medium-sized enterprises (SMEs). By 2019 the MoD had a target of spending 25% of its external spending with SMEs and published a plan for the way forward in 2019.[17] The MoD's own research body, Defence & Security Laboratories Limited (DSTL), which has DASA as a sub-unit, was pleased to announce that it had spent 27% of its external spend with SMEs in 2019/20.[18] Responsibility for the monitoring and coordination of all these efforts lay with the Chief Scientific Adviser and her office [19] and with the two-star Director of Defence Innovation who was appointed in 2019 to run a small Defence Innovation Unit, both offices being located in the ministry 'Head Office' in central London.[20]

[14] Home - Defence Growth Partnership
[15] NEW_DGP_Customer_Ready_Int_A4p_FIN_4 (defencegrowthpartnership.co.uk)
[16] The UK military is organised around three services (The British Army, the Royal Navy and the Royal Aid Force, each of which recruits, trains and career manages its own people). However, defence money is allocated to four commands, three of which focus on the single services with the fourth Top Level Budget (TLB) holder, being the four star head of Strategic Command (formerly Joint Force Command) which has specific responsibility for information and communications and many aspects of logistics.
[17] Ministry of Defence, 'Small and Medium-Sized Enterprises Action Plan: 2019-22', https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/793101/20190405_SME_Action_Plan_2019.pdf.
[18] https://www.gov.uk/government/news/dstl-exceeds-spend-target-with-small-and-medium-enterprises ; although much of the defence spend with SMEs is difficult to trace since it involves the lower levels of prime contractors' supply chains, data from the primes plus MOD information suggests that between 22% and 25% of defence spending with the private sector goes to SMEs.
[19] https://www.gov.uk/government/people/angela-mclean
[20] New Director Defence Innovation appointed at Ministry of Defence - GOV.UK (www.gov.uk)

THE FOCI OF CONCERN FOR INNOVATION EFFORTS

The MoD has and continues to cast a wide net in its search for what are often referred to disruptive technologies, [21] although with one exception the disruption envisaged novel sources of capability rather than disruption to the organisation and culture of UK armed forces.

To provide a guide to the size and shape of defence interests, a Defence Technology Framework was issued in 2019 in which key technologies were divided into seven families. The Framework also spelled out nine 'Application Areas' for these technologies (see Table below)[22] :



[21] See for instance, Secretary of State Michael Fallon's speech of September 2016 announcing the Defence Innovation Initiative, https://www.gov.uk/government/speeches/defence-innovation-initiative.
[22] Ministry of Defence, *Defence Technology Framework*, September 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/830139/20190829-DTF_FINAL.pdf;

At the same time, it published a list of six Defence Technology Priorities:

- Integrate Information and all Physical Activity across all Domains;
- Deliver Agile Command and Control;
- Operate and Deliver Effect in Contested Areas;
- Defence People – skills knowledge and experience; and
- Simulating Future Battlespace Complexity.[23]

The first three of these could be summarised as improve performance with regard to the OODA loop, while the last two refer to the Prepare elements of a Defence Capabilities Framework. [24]

However, within these broad areas, there was UK central MoD recognition that 'in the modern world, data collection, sharing and analysis should be considered a top defence priority. Data and information systems are critical to the ability of Defence to achieve its objectives. Gaining 'information advantage' will be key to future operational success'. [25] This stress on information and its integration was a clear feature of the Integrated Review. However, as the Prime Minister signalled in late 2020, his government also has interest in novels, including hypersonic missiles, directed energy and lasers.[26]

Our warships and combat vehicles will carry "directed energy weapons", destroying targets with inexhaustible lasers. For them, the phrase "out of ammunition" will become redundant.[27]

Sitting opposite what technology could offer, the Science and Technology Strategy identified five key areas of mission and military capability which innovation should

[23] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/831427/20190906-InnovationPrioritiesPub_Final_.pdf
[24] See British Defence Doctrine, 2nd edition, 2001, pp.4.2-3.
[25] Minis https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760823/20181130-Response_to_the_Defence_Innovation_Advisory_Panel_Report_2018.pdftry of Defence, Innovation in Defence: Response to the Defence Innovation Advisory Panel Report 2018,
[26] PM to announce largest military investment in 30 years - GOV.UK (www.gov.uk);
[27] Prime Minister Boris Johnson to the House of Commons, 19 November 2020, Integrated Review - Thursday 19 November 2020 - Hansard - UK Parliament.

target,[28] a categorisation which was also included in the 2021 Defence Command Paper.[29] [p. 41)

1. Pervasive, full-spectrum, multi-domain Intelligence, Surveillance and Reconnaissance (ISR) –
2. Multi-domain Command & Control, Communications and Computers (C4)
3. Secure and sustain advantage in the sub-threshold
4. Asymmetric hard power
5. Freedom of access and manoeuvre

OVERALL ROUTES TO INNOVATION AND GOVERNMENT FUNDING FOR DEFENCE R&D

Five themes can be discerned to the UK's approach to generating innovation at what could be designated the operational level.

The first, which is tied to overall UK Defence Industrial Strategy for the maintenance and development of defence industrial capabilities, emphasises government readiness to work with industry in the UK on a partnered basis. The emphasis on formal competitive tendering as a default procurement strategy that was a feature of the 2012 National Security Through Technology has gone. In the 2021 Integrated Review document set including the Defence & Security Industrial Strategy of 2021, a more 'nuanced' approach to competition was proclaimed. Working closely with industry was already a feature of many of the organisational arrangements made to support innovation noted in the programmes noted earlier in this paper. From 2021 such close working was to include greater MoD transparency about and commitment to its plans in part to encourage industry to invest some of its own resources to generate advances.

In 2021 the UK underlined its long-standing position that it would work closely with foreign-owned businesses operating in the UK if they added significant value and would

[28] MOD Science and Technology Strategy 2020 (publishing.service.gov.uk)
[29] Defence in a Competitive Age, 2021 p.41, Defence in a competitive age (publishing.service.gov.uk)

do R&D work in-country. Such companies de facto need to be based in allied or friendly states with the UK in 2021 seeking to strengthen its powers to prevent the takeover of British firms by companies from hostile or potential adversary countries.[30] Raytheon, Thales and Airbus would be among the multiple companies that met the criteria to be British Government partners.

A second operational element is recognition of the need to work collaboratively with other governments on the development of equipment. The intent was to continue to collaborate with European states and even the EU if that was judged in the UK's interest, but also to further develop ties across NATO and with friendly states across the world. Japan and Australia were two such potential partners.

We will work at pace with our allies to reduce barriers to sharing technology, skills and knowledge, and accelerate collaborative innovation and industrial cooperation to secure and extend our collective advantage over our potential adversaries. From the business space to the battlespace, we will enhance the UK's academic and industrial base, collaborating with partners to shape global thinking, standards and norms for the responsible and ethical adoption of these new technologies.[31]

Regarding the likely most prominent and important collaborative partners, the DSIS gave little away and certainly closed no doors. With regards to Europe, while a Brexit deal has been completed and most 'Remainers' recognise that any reversal is unlikely in the near future, the population and the political class are still deeply divided. There are many, not least in the defence sector, who see close and deep relations with European partners as central to UK prosperity, security and indeed scope for freedom of action. On the other hand, the populist Brexit cause lives on with numerous issues fishing disputes and Covid-19 vaccines having the potential to provide a negative context in which defence cooperation will try to operate. While all forecasters must be sensitive to the dangers of wishful thinking, this author would expect any future government and UK leader to be less wary of working with both EU states and the EU itself. On the other hand, this author has found few signs that the European Commission has accepted any responsibility for

[30] See Rebecca Lucas & Trevor Taylor, 'Sealing Technology Transfer Leaks: The Whack-a-Mole Analogy', *RUSI Journal*, 22 March 2021, No: 1

[31] Defence in a Competitive Age, 2021 p.62, Defence in a competitive age (publishing.service.gov.uk)

the elements of its own behaviour that made such a large section of the UK public be persuaded into voting to leave the EU.

The big risk is that the EU will not wish to facilitate UK success in almost any field except perhaps golf and the Ryder Cup for fear it could reinforce any beliefs that the EU does not serve its members well while the UK government and the Brexit-supporting media will always be tempted to underline EU shortcomings so as to reinforce that leaving the EU was a good idea. Such an environment does not bode well for defence cooperation (or even for NATO).

Regarding working with the US, the UK industrial and governmental defence sectors have no illusions about the strengths and limitations of American links. The 2021 IR and related documents delivered strong hints that buying from and collaborating with the US should be reconciled with the UK emphasis on national freedom of action. References in these documents to expectations of industrial participation and inward investment reflect these factors. On collaboration specifically, there is a clear understanding that the UK will need valuable technology to offer if it is to persuade the US Government and its companies to take an interest in the UK: hence the importance of the size and targeting of defence R&D spending.

A Conservative Party and its leader with such enthusiasm for the idea of Global Britain clearly would appreciate collaborative work with other developed states, with Japan and Australia high on the list. Stable democracies with serious funding and defence ambitions are still not numerous. While Japan has little experience in this area and moving with caution, if at all, the UK government and its major companies are prepared for a patient approach. The Type 26/Hunter class ship programme will be central to UK and Australian perceptions of each other, perhaps just like the Australian submarine programme will be central to Australian defence industrial relations with France.

Third, the overall the British stance recognises that the technology bases for much innovative equipment was to be found in the wider civil-commercial world and universities, and that the MoD needs to develop its awareness of what is happening and of what civil advances might be adapted for defence purposes. As discussed above, the MoD is particularly concerned at the policy level to draw on the potential of SMEs. There is growing awareness of the knowledge needed to be expert in the specification and

prioritisation of demanding but feasible military needs and in the assessment of potential bidders. An Innovation and Research Insights Unit (IRIS) was formed under the Director of Science & Technology in the MoD in 2016 to monitor 'emerging trends in technology and analyse the implications for UK Defence and Security, informing critical decisions to maintain our military advantage and protect the UK'.[32] The Government has also set up a pan-Government body, UK Research and Innovation (UKRI) with funding covering a wide range of topics, including COVID responses and climate change. That body is sensitive to opportunities for defence to benefit from its efforts. [33]

In the 2021 UK, the 'intelligent customer' needs to understand much more than focused 'military technology'. Improvements in this expertise are targeted in the Science & Technology Strategy 2020 document along with the need to broaden and deepen technology awareness across defence.[34]

Fourth, there is emphasis on innovation in development, testing, manufacturing and support practices. At a basic level this means that platforms and large systems should be as modular as possible, enabling their low-risk, regular modification and update. This was apparent in the way that MoD with MBDA had developed families of missiles sharing common or very similar sub-systems. In the case of the Type 26 frigate, which generated modularity in part through the provision of space and power on board, modularity meant that Australia and Canada could define and acquire their own versions. Related but more ambitious was the aspiration to apply fourth industrial revolution techniques to the design, development, production and even support of major platforms. Digital designs, the generation and maintenance of digital twins, digital modelling and testing, digital manufacturing using both subtractive and additive methods, increased robotic assembly, and a digitised approach to support, were at the heart of efforts to break the trend towards increasing development and production costs for major platforms, a trend originally made famous by the US industrialist Norman Augustine. The UK Tempest programme was only most prominent in UK defence efforts for such ambitious industrial techniques[35] which were also relevant to warship and submarine programmes.

[32] Innovation Initiative to bring future-tech and ideas to the Armed Forces - GOV.UK (www.gov.uk)
[33] https://www.ukri.org/
[34] Ministry of Defence, *Science & Technology Strategy 2020*, MOD Science and Technology Strategy 2020 (publishing.service.gov.uk)
[35] Trevor Taylor, 'Gambling Responsibly and the UK Tempest Programme Experiences, Risks and Opportunities', London, RUSI Occasional Paper, November 2020, tempest_programme_final_web_version_0.pdf (rusi.org)

Fifth, the British approach of necessity includes recognition of the importance of funding. Of the programmes listed in the previous section, only DASA and the single service innovation hubs involved meaningful government money. However, DASA's annual spend is at best modest (in 2018-9 it provided funding worth £36.8 million)[36] while the single services hubs have access to the Defence Innovation Fund announced in 2016 which made £800 million available over a decade.[37] DASA and the Defence Innovation Fund (which is directed by the Defence Innovation Unit in the MoD) are in the domain of the 2* Director of Defence Innovation in the MoD. The Director of Defence Innovation is also charged with the promotion of an innovation culture within defence (which at least implicitly involves seeking to break down resistance to disruptive change).

Even before the Integrated Review, in Head Office there were increasing efforts to work together by the Director Science & Technology (whose IRIS people were seeking to monitor all technological advances that could be of possible defence interest) the Director of Defence Innovation (whose staff provided funding for specific technology advances) and the Deputy Chief of the Defence Staff (Finance & Capability) with his insight into military problems and needs. The interaction among responsibilities for technology awareness, technology development and military relevance was being addressed.

Overall, however, the emphasis on innovation particularly from 2015 had not been accompanied by increases in funding for research and development which actually continued to decline in the wake of the financial crisis of 2009. Thus the innovation search was often for inexpensive rather than radical but expensive changes. The UK Ministry of Defence has published its spending on R&D over a protracted period and Table 1 gives a clear sense of the extent to which it was allowed to decline in real terms after the end of the Cold War and even after 2010. The table gives the cash figures and then converts them to 2019 values.

[36] DASA Annual Report 2018 2019 FINAL for web.pdf (publishing.service.gov.uk)
[37] Response to the Defence Innovation Advisory Panel Report 2018 (publishing.service.gov.uk)

UK Defence R&D spending[38]

	1990/ 91		1999/ 2000		2009/ 10		2018/9
	Cash value in £m	2019 value In £m	Cash value	2019 value	Cash value	2019 value	Cash value
Research	412	**944**	600	**1048**	669	**904**	**548**
Development	1296	**2968**	1745	**3047**	1369	**1878**	**1101**
Total	1708	**3912**	2345	**4095**	2038	**2782**	**1649**

It is clear that research spending held up in cash terms but dropped by 42% in real terms and development spending fell by 63%, again in real terms. The wider context was that overall defence spending did not fall by anything like the same amount going from £21.6 billion using the NATO definition in 1990, which was £50.2 billion at 2019 values, to £46.5 in 2019, a decrease of just 7%.[39]

These changes were driven by a number of considerations: operational problems in Iraq and then Afghanistan after 2007 meant that the UK obtained many Urgent Operational Requirements (UORs) from US production lines, including Predator UAVs and fleets of mine-protected vehicles. Also, as noted above, in the 2012 National Security Through Technology document, the government announced that its default position for defence procurement would be to buy on a competitive basis from the international market. Thus by the end of the second decade of the 21st century, the UK was operating numerous US platforms, not least in the surveillance and signals intelligence area, and the US State

[38] Figures available in the Government statistics at https://www.gov.uk/government/statistics/defence-departmental-resources-2020; and in Defence Analytical Services Agency,, UK Defence Statistics 2001, Ministry of Defence, London, Table 1.6. Conversion to 2019 values using the inflation calculator at https://www.bankofengland.co.uk/monetary-policy/inflation/inflation-calculator?number.Sections%5B0%5D.Fields%5B0%5D.Value=1369&current_year=843&comparison_year=1139.3.
[39] See NATO data at NATO - Pressrelease: Defence Expenditure of NATO Countries (2013-2020), 21-Oct.-2020; and Defence Analytical Services Agency,, UK Defence Statistics 2001, Ministry of Defence, London, Table 1.1.

Department was still reporting British defence imports of over $8 billion a year. Some of these items would have been re-exported in UK and collaborative products but it remains notable that the UK figure was a larger figure in 2017 than those for France, Germany, Italy, Netherlands and Spain combined.[40]

However, in the light of Brexit developments and the economic damage caused by the COVID 19 crisis, in November 2021 defence was awarded significant additional funds amounting to over £24 billion over the four-year period from April 2021. Of this increase, was to boost R&D spending which therefore should more than double in the early 2020s compared with its 2018/19 level.

Also, in 2021 it is clear that the MoD hopes that, by working more closely with industry and by being more transparent about its needs and plans, the private sector will feel more confident about investing its own resources to move technologies forward. This is already working in the combat air domain. [41]

ISSUES WITH INNOVATION EFFORTS FOCUSED ON RESEARCH AND SMES, AND IMPLICATIONS FOR MILITARY CULTURES

There are several recognised challenges associated with looking particularly to SMEs for defence innovations.

These challenges do not appear to include any widespread reluctance to embrace the defence sector on ethical grounds. The British armed forces remain respected and supported in UK society and many businesses have signed up to support them in the various ways involved in the Armed Forces Covenant arrangements.[42] An industrial body, Make UK, has a defence arm (formerly known as NDI) which particularly represents smaller businesses. It has a growing membership above 240 companies. [43] A privately organised database for defence in which companies can record their key attributes as a

[40] US State Department, World Military Expenditures & Arms Transfers, Table 2 IV, https://2017-2021.state.gov/world-military-expenditures-and-arms-transfers-2019/index.html,
[41] Trevor Taylor, 'Gambling Responsibly and the UK Tempest Programme Experiences, Risks and Opportunities', London, RUSI Occasional Paper, November 2020, tempest_programme_final_web_version_0.pdf (rusi.org).
[42] https://www.armedforcescovenant.gov.uk/.
[43] Make UK Defence Membership | Make UK

means of reducing the burdens of Pre-Qualification Questionnaires (PQQs) is understood to include around 7,000 firms. [44]

However, SMEs without defence experience can struggle to know whom in the large world of defence they should contact that might be interested, either in the user community or the procurement body (Defence Equipment and Support (DE&S)), in what they had to offer.

A further matter was the measured speed at which defence contracting processes tended to move. This was problematic for SMEs who looked for rapid choices. Many Ministry of Defence Procurement staff had little sense of urgency and also felt comfortable with formal competitive tendering processes. These were time-consuming and could make some SMEs nervous about the intellectual property that might be released into the public domain in order to facilitate a competition that would attract multiple bidders. Clearly, from a financial perspective, SMEs by their nature lacked access to the resources needed to rescue a struggling project and so were not attractive to officials looking to minimise the financial risk to the Ministry of Defence.

Moreover, insofar as the MoD uses framework contracts with a small number of large firms in areas where it has a large number of smaller tasks, the MoD is essentially passing responsibility for taking risks on innovative small firms to major companies.

A further recognised but unresolved problem was how to get technological innovations across the 'valley of death' in which promising ideas fell because of lack of funding to complete their development into safe and usable products.

As a related point, while some technological innovations would be easily integrated into a wider military capability, raising largely people and organisational issues that in principle could be addressed by the commands, others needed technical integration into larger platforms that required SMEs to work effectively with prime contractors. In some such cases, the integration effort could be more time-consuming and expensive than the innovation development.

[44] It is called JOSCAR and run by Hellios consulting.

Sensitivity to these matters is apparent, and methods of addressing them outlined, in the Integrated Review and associated documents published in the spring of 2021.

There is one serious likely serious issue that the Integrated Review and other documents did not directly confront. British stress on the increasing centrality of the collection, analysis, and distribution of information through a 'Digital Backbone' linking all five domains (land, sea, air, space and cyberspace) can be seen as to disruptive to long-standing organisational arrangements and even military culture. The UK single services have historically sought to constrain 'joint arrangements' and to protect their separate identities and freedom of action with regard to capability development.[45] Yet the UK 2021 papers apparently took for granted that the UK already had a Joint Force.

To innovate to a capability for Multi-Domain Operations will mean even in the short run that Strategic Command, which leads on the Digital Backbone, will be more important and influential than the three other commands. As its commander, General Sir Patrick Sanders, was able to write in The Times before the announced Integrated Review:

At the heart of this modernisation lies the more discreet organisation I head, known as Strategic Command. From our headquarters in Northwood, it brings together everything that integrated the armed forces – the enabling information age technologies, cyberspace, space (with the RAF), intelligence, special forces, our force design brain and the support base.

In the longer term all implies that those with the most valued knowledge and experience in the information space will be best-placed to lead defence rather than those with experience of direct fire and 'front-line' combat. It should not be taken for granted that information-based defence innovation efforts will have an easy ride in terms of internal British defence politics.■

[45] Trevor Taylor & Andrew Curtis, 'Management of Defence After the Levene Reforms: what comes next?', RUSI Occasional Paper, 9 September 2020, rusi_pub_232_op_defence_management_final_web_version.pdfseptember02 0

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Policy Paper

DEFENCE INNOVATION: NEW MODELS AND PROCUREMENT IMPLICATIONS
The British Case

BY
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ARES GROUP

The Armament Industry European Research Group (Ares Group) was created in 2016 by The French Institute for International and Strategic Affairs (Iris), who coordinates the Group. The aim of the Ares Group, a high-level network of security and defence specialists across Europe, is to provide a forum to the European armament community, bringing together top defence industrial policy specialists, to encourage fresh strategic thinking in the field, develop innovative policy proposals and conduct studies for public and private actors.

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