

Written Evidence Submitted by ADS

(RFA0086)

ABOUT ADS

- 1.1 ADS is the trade association for the UK's aerospace, defence, security, and space industries. ADS has more than 1,100 member companies, with over 95% of these companies identified as small and medium sized enterprises (SMEs).
- 1.2 The UK is a world leader in the supply of aerospace, defence, security and space products and services. From technology and exports, to apprenticeships and investment, our sectors are vital to the UK's growth – generating £79bn turnover a year for the UK, including £44bn in exports, and supporting over one million jobs.

2. SUMMARY

- 2.1 ADS welcomes the establishment of a UK Advanced Research Projects Agency (ARPA) and believes it could, if executed well, be a transformative mechanism for research and development (R&D) in the UK.
- 2.2 Taking innovation from early stage discovery to the delivery of tangible outputs is key to realising sustainable economic growth and supporting UK national security and prosperity. These are crucial goals in the context of the likely incoming recession as a result of the COVID-19 pandemic, and complex challenges presented by wide-ranging global issues from national security to climate change. ARPA should seek to deliver UK technological advantage in those contexts. If delivered effectively, it could lead to industrial leadership, more effective public services, deter adversaries, and influence allies. ARPA's ambition would signal to the world that the UK is a global leader in technology and innovation.
- 2.3 Our sectors are well-primed to contribute to ARPA. The UK aerospace industry is a world leader in developing sustainable aerospace technologies and sustainable aviation fuels. Our defence and security industries meet evolving security threats through developing novel capabilities to maintain the UK's technological edge. Our space sector is growing rapidly, with the UK a world-leader in satellite technology and with emerging ambitions in space launch capability.
- 2.4 The benefits to the UK of ARPA are only possible if delivered through the right framework and culture. **ARPA should be set up so that it is able to rapidly address strategic technology issues by embracing disruptive innovation. It must have the autonomy, risk appetite and ability to fund a variety of projects. It should not duplicate existing R&D institutions, such as those which focus on discovery science or incremental innovation. It should, crucially, be orientated towards practical applications to ensure society's biggest challenges are being tackled.**

3. What gaps in the current UK research and development system might be addressed by an ARPA style approach?

- 3.1 ARPA could be a revolutionary player in the UK's research and development ecosystem. In order to fulfil its promise, **it should centre around developing solutions to key challenges that enhance the UK's prosperity and national security. It should bring together industry,**

academia and government by building out of the UK science base to integrate technology into world-leading capability. Having an institutional set-up that is risk-tolerant, fails fast and potentially high-reward would help to unlock the technological advances of the future. If ARPA is not geared up to have a high rate of failure then it will be incorrectly calibrated; its primary purpose should be to embrace 'moon-shot' research projects - ambitious, measurable projects defined by their aim of having a significant impact on an important societal issue.

3.2 The UK's current research and development system tends towards either basic research (driven by knowledge gain) or near-to-market incremental development (driven by lower risk, assured, markets. There is a need for ambitious, more radical and potentially disruptive innovations. The unique nature of the UK's R&D ecosystem, whereby university research is strong but commercial application of research is weak compared to other countries, means that technological progress is often slow, risk-averse and products often do not reach the market. Existing structures certainly have their place in the ecosystem and, indeed, it is important to have a diverse approach to R&D to get the best results. However, ARPA would help to fill the gap in the system through a more radical approach that other R&D institutions have tended to avoid. ARPA should spread its investments widely, knowing that most projects will need to fail fast, so that the best ideas can receive support from customers who are positioned to pull successful projects through to products, platforms and services.

3.3 Moreover, most R&D organisations tend to conduct programmes in-house, which is often expensive and resource heavy. If structured well, ARPA will not need to rely on such expensive base infrastructure but can direct and redirect as appropriate its resources to the funding of specific projects.

4. What are the implications of the new funding agency for existing funding bodies and their approach?

4.1 There is the need to de-risk duplication and 'culture capture' to avoid ARPA replicating the processes and approach of existing R&D organisations. It is vital that there is deconfliction from current organisations, for example Dstl and UKRI, as the Government's support for the UK's innovation system is already highly complex. To avoid this, ARPA must be designed to tackle problems in a new, nimble and autonomous way. **ARPA should be independent but complementary; it should work with Government and commercial customers that have a high risk-reward appetite to shape the challenges it wishes to tackle but, crucially, should sit outside established innovation structures. ARPA should be well connected to existing technology programmes and centres, both within industry and academia.**

4.2 One example of where it could be complementary is in aerospace technology. The Aerospace Technology Institute (ATI) promotes transformative technology in air transport and funds world class research and development through a £3.9 billion joint government-industry programme. There is also the Future Flight Challenge, which is funded by £125 million from the Industrial Strategy Challenge Fund and matched by up to £175 million from industry. It aims to revolutionise the way people, goods and services fly and to position the UK as a world leader in aviation products and markets. Both the ATI and Future Flight Challenge are focused on delivering aerospace industrial policy and therefore represent more traditional routes to technological maturity. **These institutions and initiatives should continue to be supported by Government and ADS has called for the ATI's budget to be doubled to accelerate progress in sustainable technology to move towards net zero.** However, the ATI and other aerospace technology development initiatives would be interested in using the ARPA model and processes for specific challenges, where their own models may not allow for rapid or more radical innovation.

- 4.3 One complementary area ARPA could focus on in the field of aerospace technology is urban air mobility (UAM). This is an exciting area of development that could transform urban mobility in the UK, but existing funding streams do not fund whole vehicle development. ARPA focusing on this area could help establish the UK as a source for the potentially explosive growth in this segment and the opportunity for re-shoring whole aircraft design in the UK.
- 4.4 The foundation of a new ARPA should also take account of the existing landscape of innovation in national security. With the recent creation of a new National Security Science and Technology Exchange (NSTIx) and pre-existing bodies such as the Defence and Security Accelerator (DASA), the Defence Science and Technology Laboratory (Dstl), Innovate UK, and the Defence Innovation Unit, there are already a range of funding agencies and coordinating bodies at different stages of the Technology Readiness Level (TRL) spectrum. ADS believes that if the new ARPA is to effectively address national security issues then new channels for engagement should be established between it and the existing security machinery across Government, industry and academia. In this, NSTIx may offer a useful route for ARPA to utilise to connect with existing structures and avoid the duplication of existing initiatives elsewhere in the national security community. **The Government should clearly demarcate the remit of each of these organisations, perhaps through a landscape map, to ensure their work is complementary. Specifically, ARPA should avoid projects based on incremental change or discovery science.**

5. What should be the focus of the new research funding agency and how should it be structured?

- 5.1 **ARPA should be challenge-led and exploitation-driven.** This means that it should be tasked with a small number of missions, each addressing a major societal or national security challenge that cannot be addressed through existing or conventional innovation. Exploitation pathways need to be understood to ensure successful projects can be scaled, commercialised and brought to market with speed. Roadmaps for how ARPA investments generate impacts and returns (be those commercial or societal) need to be established during project inception. These should support, rather than hinder, ARPA's risk appetite.
- 5.2 **It is important that industry and Government collaborate in defining these challenges.** This is to ensure ARPA has clarity on its remit, complements other R&D funding and can work with industry from the outset. The latter point is important because industry will be a key lever in exploiting ARPA's outputs and applying them to general use. For instance, the establishment of Team Tempest is an excellent example of Government-industry partnership that fosters later-stage innovation in developing national capability (in this instance, a future combat air system). However, **ARPA itself should remain autonomous in what it chooses to fund.**
- 5.3 **ARPA should draw from expertise across multiple sectors in forming its core project management team,** ensuring its leadership do not necessarily come from traditional sources. The Government should take account advanced manufacturing sectors such as those within the ADS membership when making decisions about personnel. The aerospace, defence, security and space industries are leading conveners of R&D capability and they routinely collaborate with the UK's foremost research organisations in the application of research to complex systems.
- 5.4 **Including industry within ARPA's structures – from the setting of priorities through to product development and final application – will significantly aid with commercial pull-through of science and technology to products, platforms and services.** Our industries utilise a wide range of emerging technologies, are well-dispersed across the entire UK, and contain an extensive supply chain of companies and major exporters. Our well-developed, high-

technology sectors are primed to contribute towards ARPA as well as the ability to use the projects developed by ARPA in a commercial setting. **Those industry personnel brought in to ARPA should be able to move back into other sectors to enable the exploitation of ARPA developments and to ensure there is commercial and societal use for the projects ARPA develops.**

5.5 The Government should consult with industry on the purpose and governance of ARPA to ensure it is established with the best chance of long-term success.

5.6 An important aspect of the success of ARPA will be developing a commercial framework and terms that encourage innovative practices. **This includes allowing the appropriate protection of generated intellectual property and not including liability terms that are too stringent.** This will foster a more collegiate and innovative approach, with higher risk tolerance. The mechanisms for competing requirements and agreeing contracts therefore need to be agile, which entails a necessary degree of autonomy for the ARPA construct.

6. What funding should ARPA receive, and how should it distribute this funding to maximise effectiveness?

6.1 ARPA will only be successful if it is set up with a risk-tolerant, fail-fast and potentially high-reward mandate and culture. Due to high failure rates, the resources available must match the scale of the reward sought.

6.2 To ensure this funding is allocated to its greatest effect, project managers should be given genuine autonomy in allocating funding to projects. Project managers should be given the freedom to action their ideas at speed.

6.3 ARPA should identify where there is opportunity and use its funding power and organisational agility to make the most of them. Not conducting programmes in-house will ensure that ARPA remains nimble, effective and can meet its goal of conducting radical innovation with a potentially high reward. It will also avoid the cost of constructing and maintaining facilities, and duplication.

6.4 Moreover, **funding must be based on a long-term model to ensure ARPA operates outside of political or budget cycles.** This is crucial because projects will be medium- to long-term and project managers will require confidence that they have the freedom and mandate to see them through. As outlined in Section 7, organisations in the US such as DARPA and NASA have been successful precisely because they can operate with this long-term confidence, which brings subsequent benefits to the state and society.

7. What can be learned from ARPA equivalents in other countries?

7.1 The US DARPA appears to be the inspiration behind the planned UK ARPA, due to its reputation as a “master of innovation”¹. There are also other variants of an ARPA in the US, such as ARPA-E, modelled on DARPA, which focuses on energy. There are several lessons for the UK to learn. They are successful because they do not run institutes or employ researchers long-term. Instead they fund specific teams for specific projects. This enables them to be highly flexible and effective. They also have well-articulated governance and purpose, with a level of independence under an appointed director. This person is often taken from industry, making it important that Government consults with industry prior to ARPA’s establishment.

¹ <https://www.kcl.ac.uk/policy-institute/assets/the-road-to-2.4-per-cent.pdf>

- 7.2 They are also purpose built to be radical. They do not require academic peer review that slows down the process and can prompt greater involvement from central Government. Having a fast-fail remit means that time is not unduly wasted on projects destined to fail and lessons can be learnt quickly. It also means that unconventional ideas which would usually be passed over can be investigated, potentially to great reward.
- 7.3 DARPA also does not just produce technology for scientific reasons but aims to meaningfully apply it. It has a prototyping culture where societal and commercial application is part of the development cycle. Part of this entails having people from different disciplines involved to ensure that the products are suitable for and compatible with human behaviour.
- 7.4 However, an important caveat is that the research organisations and universities it draws on are already established and well-funded by central government. This underlines the points made in Section 4 on the importance of a diversified and well-supported R&D ecosystem that an ARPA can complement.
- 7.5 Learning from innovation cultures in other countries is also important. In Israel, disruptive innovation is seen as critical to drive job creation and GDP growth, improve productivity and competence and create a globally competitive industrial sector. In France, the Government has focused on fostering innovation and reforming the overall business environment for entrepreneurs, especially focused on developing the competitiveness of strategic industries such as transport and defence. ARPA should foster these innovation cultures to ensure its success.

8. What benefits might be gained from basing UK ARPA outside of the 'Golden Triangle' (London, Oxford and Cambridge)?

- 8.1 In terms of aerospace, defence, security and space, most businesses operate outside of London and the South East. For instance, 90% of aerospace jobs and 65% of defence jobs are located throughout the rest of the UK. These represent hubs of activity spread across the country, including the west country, Northern Ireland, the midlands, North England and Scotland. As well as our member companies, many of the UK's leading universities operate outside the 'Golden Triangle' and provide an R&D infrastructure ripe for cultivation.
- 8.2 **That being said, the location of ARPA is inconsequential if it does not leverage the huge R&D ecosystem our sectors are part of.** In 2019, our sectors contributed a combined £30bn in added value to the economy, and £4bn annual investment in innovation and technology. Investment in R&D in our sectors supports clusters of innovation across the economy. Every £1 spent in R&D in aerospace generates £7 worth of spill-over to the UK economy overall and technology spill-overs in other sectors worth four to five times more than the benefits accruing to aerospace. **Engagement with industry is crucial if it is to be a success and further contribute to prosperity across the regions and nations of the UK. To enable ARPA to fully leverage this potential, it should have a small project management office and tap into the plethora of innovation capability in existence across the UK.**

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