

A new UK research funding agency

Submission from the Campaign for Science and Engineering (CaSE)

The development and potential success of a new funding agency will be determined by the setting of the parameters within which the UK Government wants the agency to operate. The first, and most important question, is how closely the UK wants to emulate the model of Advanced Research Projects Agencies (ARPA)¹ in the US. It has been made clear that the idea for a new funding agency stems from the US model, as outlined by the Chancellor during his budget speech in March:

“I can confirm that we will invest at least £800m in a new blues-skies funding agency here in the UK modelled on the extraordinary ‘ARPA’ in the US².”

The preference to broadly model a new funding agency on ARPA was also reaffirmed in the Government’s R&D roadmap³. To date, there is scant information on exactly how the UK Government plans to establish such an agency leaving a great number of questions. The UK must decide how it wishes to proceed, starting with understanding the complexities of the ARPA model. As experts have said in the US:

“There is not and should not be a singular answer on ‘what is DARPA’—and if someone tells you that [there is], they don’t understand DARPA”^{4,5}

US ARPA operates very differently to any type of public funding of R&D in the UK. For example, rather than using peer review to decide how to allocate research funding, individual ARPA program managers have much greater autonomy to control a research budget for a fixed-term period. They also show a willingness to terminate research contracts that are making limited progress and the public sector plays a crucial role in early technology adoption, acting as a pull-through mechanism for research outcomes. None of these are current features of most UK funding streams. These differences will be explored in more detail later in this submission but creating a research agency operating in the UK with these parameters would represent a significant culture change.

While the individual US ARPA programme have focused on explicit areas of research and development, the UK may choose to focus on other areas of R&D. VINNOVA⁶, which is a close equivalent of ARPA in Sweden, supports a broad range of research. A stated aim of a similar agency in Japan, called ImPACT, is “to realize a sustainable and expandable innovation system”⁷. Much has been written about what is ‘ARPA-able’, in other words how possible it is to replicate ARPA-style programmes in different countries. Understanding the characteristics that underpin US ARPA programmes will be crucial in setting up a new funding agency, from which the UK can build its own workstream priorities.

¹ Throughout this submission, ARPA will be used to refer to the general set of agencies operating in the US. This includes [DARPA](#), [TIP](#), [HSARPA](#), [IARPA](#), [BARDA](#) and [ARPA-E](#). Specific examples relating to one agency will be referred to by their official name.

² [Spring Budget 2020 Speech](#)

³ [UK Research and Development Roadmap](#), 2020

⁴ Fuchs, E.R.H., 2010. [Rethinking the role of the state in technology development: DARPA and the case for embedded network governance](#). Res. Policy 39, 1133–1147

⁵ Van Atta, R. H., 2007. [Testimony before the Hearing on “Establishing the Advanced Research Projects Agency-Energy \(ARPA-E\).”](#) Subcommittee on Energy and Environment, Committee on Science and Technology, United States House of Representatives, Washington DC.

⁶ [VINNOVA Sweden](#)

⁷ [ImPACT Japan](#)

The introduction of a new funding stream can present new opportunities. In supporting projects that would otherwise be deemed too 'high-risk', the UK could help to broaden and strengthen its research capabilities and allow new sectors to emerge. In enabling the emergence of new ideas, businesses and technologies, DARPA has been able to build confidence amongst venture capitalists and angel investors in the US.

Any new research funding agency will still require the types of support the entirety of the UK's research and innovation sector need in order to be successful. A sustained, long-term vision will be vital in attracting companies to the UK to undertake cutting edge research. The ability for individuals to move freely from across the world to come to the UK to support the development of new and ambitious research will be required to make a new funding agency successful.

This submission will primarily focus on highlighting some of the questions that still remain over the proposed funding agency. Throughout will be examples and characteristics of the US ARPA and how the UK Government may seek to decide to set the direction for its own research agency.

What are the components of US ARPA programmes?

This section of our submission will reflect on the measures that have made ARPA, and in particular DARPA, a success in the US. If the Government intends to model a new funding agency on ARPA, as they have suggested, it is vitally important to understand how the US agencies have been successful.

In one of the most comprehensive studies carried out on ARPA in the US, Azoulay et. al.⁸ wrote that the programmes have four characteristics that underpin the core ARPA model:

1. General organizational flexibility
2. Bottom-up programme design
3. Discretion in project selection
4. Active project management

What features most prominently across these four characteristics is the importance of having talented individuals, called program managers, who are both deeply knowledgeable and connected in their fields of expertise and are also highly motivated to drive projects forward. Importantly, program managers do not perform their own research. Their role is to identify and support research and development in areas of friction in the innovation system and/or where they feel progress can be made.

Program managers are hired from across industry, academia, from government departments, many of whom may have experience of working in all three sectors. Program managers in the well established DARPA have even been referred to as "100 geniuses connected by a travel agent"⁹. Due to the arms-length nature of US ARPA organisations, they are able to recruit individuals outside of civil service regulations which allows for higher salaries to be offered. Program managers serve a fixed-term period in the research agency, charged with creating a programme of work to oversee during their tenure.

The relatively flat organizational structures of US ARPA programmes means that these program managers have a great deal of autonomy in deciding which projects to fund. Program managers may

⁸ Azoulay, P., Fuchs, E., Goldstein, A., Kearney, M. (2018). [Funding Breakthrough Research: Promises and Challenges of the "ARPA Model"](#). NBER Working Paper 24674

⁹ Bonvillian, W.B., 2009. [The Connected Science Model for Innovation—The DARPA Role, in: 21st Century Innovation Systems for Japan and the United States: Lessons from a Decade of Change](#). National Academies Press.

decide to take advice from external experts, somewhat similar to a peer review process, but the final decision on whether the project is funded resides with the program manager¹⁰. Program managers in DARPA in particular also take opportunities to link organisations and individuals together and encourage them to take forward ideas as a partnership.

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

What can the UK learn from the establishment of US ARPA programmes?

The motivation for the US Government to create a new research funding agency was fuelled by the USSR launching its first Sputnik rocket in 1957. The US announced it was creating a new funding agency, later renamed to DARPA, in order to 'avoid future technological surprises'¹¹. The evolution of DARPA over the past 60 years have been driven by the visions of Directors of the agency with respect to the needs of the customer of their research, primarily the Department of Defense (DoD). This mission-oriented approach, outlined above as a bottom-up programme design, means that much of the research that DARPA funds is directed in the attempts to solve areas of friction within national security and defense sectors. This includes having a clearly designed pathway for the outcomes of the funded research, should it yield the desired outcomes.

The creation of new ARPA programmes in the US, such as IARPA or ARPA-E¹², were an attempt to support areas of research with the hope that a handful of breakthroughs could make hugely significant impacts. These agencies have all been launched by individual Government departments, charged with tackling each department's areas of research and innovation interest.

It is incredibly difficult to discern the exact method by which US ARPA programmes were established or draw any single commonality. The programmes seek to provide breakthroughs in research, often in areas of friction within private sector development but not exclusively. That means that ARPA programmes were not always established to fill an identified gap in the US research portfolio, but to provide additional support to firms already carrying out cutting-edge research. The UK Government may choose to set the direction of a new funding agency to attempt to fill gaps it deems to be present in the existing public research funding portfolio. In doing this, however, a great deal of work must be undertaken to understand how the outputs of this research could be capitalized upon.

The UK's approach to risk in research funding

UKRI has thorough and robust mechanisms by which they distribute funding, which are necessary and appropriate in order to provide accountability over the decisions they make. Creating a new funding agency that is underlined by the four characteristics described by Azoulay would be a significant shift from the model of research funded by UKRI.

A crucial part of being able to make the most of the research funded through a new funding agency will require a brand new approach to risk, perhaps even redefining 'risk' and 'failure' with respect to a new agency. The Conservative manifesto states that the agency would fund "high-risk, high-payoff research"¹³. The term 'high-risk' will need to be well defined in the establishment of how a new

¹⁰ Goldstein, A.P., Kearney, M., 2018a. Uncertainty and Individual Discretion in Allocating Research Funds

¹¹ [About DARPA](#)

¹² IARPA was launched by the US Intelligence Community to work on research pertinent to the intelligence needs of the US. ARPA-E was launched by the US Department of Energy to research new early-stage energy technologies.

¹³ [Conservative Party Manifesto](#), 2019

agency will fund research. There is an important distinction to be made between funding 'riskier' research and funding bold and adventurous research while minimizing unnecessary risk such as misuse of funding¹⁴. It must be understood by policymakers, however, that 'high-risk' may increase the rate of projects not reaching their planned outcomes, and not to look poorly on these results or demand changes in the short-term.

A brand new definition of 'failure' for projects funded by a new agency will need to be defined to make decisions about where to persevere or where to end funding of projects. Research funded by a new agency may not lead to publications or patents, or even get close to reaching the initial hypothesis but may produce some positive outcomes. In areas of research with less existing literature, a negative result may be just as useful as a positive result. Those taking part in the research project will also gain invaluable experience and will have greater knowledge to draw upon for their future work. The value of these types of outcomes will need to be thought about to decide whether they can also be thought of as a successful outcome of a funded project.

If the UK seeks to closely emulate US ARPA programmes, much of the discretion will lie with the program managers on how to fund these type of projects when they show signs of missing out on initial aims. Program managers must make important decisions on when to withdraw funding from a research project that is not progressing as required, but also where to inject more investment to assist with overcoming obstacles. This flexibility and speed at which decisions can be made is crucial to the US ARPA model and would be pivotal to the success of a new UK agency.

We have heard anecdotally that in the UK, application processes and decision times for public funding grants are too long to meet the needs of small businesses in particular. In part, this is said to be the result of the extensive decision-making processes. Businesses can apply for a grant to support a research project, receive the funding up to 12 months later by which time their work has moved on. By affording more autonomy to program managers, projects will be funded almost immediately thereby alleviating some of these problems.

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

At time of writing, UKRI is two years old. UKRI has thus far been successful in integrating the constituent Research Councils, Innovate UK and Research England but remains in its infancy with regards to its long-term strategy. The organisation was also born from the Higher Education and Research Act, enacted into law well before any discussions about a new funding agency were being had. UKRI should be allowed time to set its own direction. The introduction of a new funding agency within UKRI's portfolio could overcomplicate an already significant shift in the UK's research funding landscape.

As discussed in the above section, the mechanisms in which research investments could be made in the new funding agency means there is no obvious place for such a body to 'slot in' to UKRI. It would be expected that a new agency and UKRI would have strong lines of communication, but the independence of the new agency is also important.

¹⁴ House of Lords Select Committee on Science and Technology: [Corrected oral evidence: Life Sciences and the Industrial Strategy, Q67](#); Tuesday 31 October 2017

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

This is another pivotal juncture with regards to how closely the UK seeks to emulate US ARPA programmes. US ARPA programmes were all launched by US government departments or conglomerations of arms-length, public sector bodies. The UK Government may decide to act similarly, having one department or a partnership retain 'parentship' of the agency.

One of the primary reasons DARPA works so effectively is because the DoD acts as the customer of research, supporting the implementation of new research through procurement. The DoD also attempts to support the commercialization of non-secret technologies and works to link military and commercial dynamics. The UK's own Defence and Security Accelerator (DASA), an offshoot of the Ministry of Defence (MoD), aims to support innovation to support the needs of the UK Defence sector. However, DASA contains no guarantees that the MoD will be a customer of the research that is funded.

The success of a funding stream in this model relies on a clearly identified market for the research born from projects, in order to pull the technology or innovation through to market. The 'market pull' for projects funded in the US has allowed research funded by DARPA to be capitalized upon. It is hard to imagine a positive outcome for a new funding agency in the UK without a comprehensive public procurement strategy developed alongside.

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

A new funding agency that is set out to fund research in the ARPA model will undoubtedly require a critical mass. The US ARPA programmes rely on a few research projects making significant impacts in disrupting existing markets or producing technological leaps. This means that in order to allow the few successes to be realised, a new agency needs to be at least a minimum size. The current budget should be under constant review. The proposed budget of £800m over five years would represent less than 1% of the UK's total public investment in research between now and 2024/25¹⁵.

In the early years of the DARPA programme, significant autonomy was given to allow funding to be carried over to the next financial year if unspent¹⁶. This means that yearly budgets can avoid the wastage of being forced to spend the entire budget when it may be used more effectively in subsequent years.

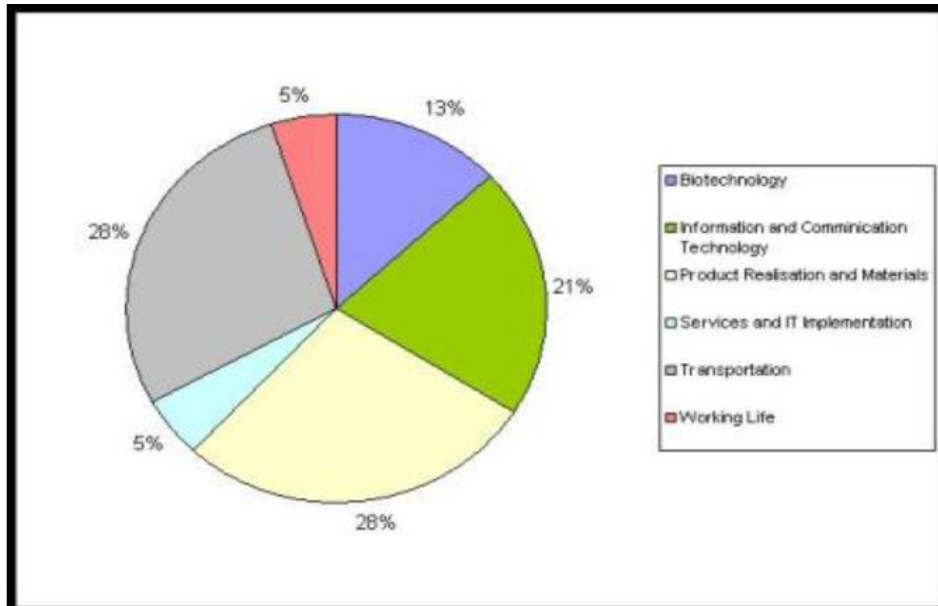
The occurrence of a truly disruptive or market-altering development is practically impossible to reasonably predict. The types of projects that will be deemed successful from an ARPA-style funding agency will also not necessarily be evaluated by more conventional methods of impact assessment such as publications or patents. DARPA, established almost 60 years ago, has been widely praised for its technological successes but newer ARPA funding agencies, such as ARPA-E, has yet to be associated with similar sized wins. This must be considered when setting up a new funding agency in this model in the UK. The agency must be protected with a longevity to succeed. It is unrealistic to expect that results will be born immediately and the benefits of research that is funded by the new agency may not be felt for decades.

¹⁵ CaSE analysis of the £800m commitment against the total pledged uplift to R&D of £22bn p/a by 2024/25

¹⁶ National Research Council, 1999. [Funding a Revolution: Government Support for Computing Research](#). Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications, Washington, DC.

What can be learned from ARPA equivalents in other countries?

While we have discussed at length the US ARPA programmes, more can be learned from VINNOVA in Sweden. VINNOVA has a slightly larger but more comparative budget to that proposed for a new UK funding agency, investing SEK 3 billion a year (roughly £260m)¹⁷. VINNOVA is an arm of the Swedish Government Department of Enterprise and Innovation but retains a broad oversight of projects it funds. Statistics produced by Taftie, The European Network of Innovation Agencies, shows the breadth of VINNOVA's portfolio¹⁸.



A 2012 review of VINNOVA concluded that the agency played a role in identifying and defining new needs-driven fields of research in dialogue with stakeholders, which neither peer review or industry-led consortia could perform alone¹⁹. Should the UK Government decide to establish the funding agency with a broad remit, it should consult closely with colleagues in Sweden.

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

Any new public funding stream should be assessed for impact that can be felt across the entire UK. An important distinction to make is that in the US and Sweden, the headquarters of the agencies are offices that house core staff and are not development labs. If the UK Government chooses to align with this model, which we recommend it should, it should be free to decide where the office is based but not to expect a direct correlation between distance to the head office and the number of projects funded.

It is not practical to fund research in the way intended by the new funding agency and demand that those who receive funding perform it 'in-house' at a central location. That would place immediate limitations on the types of research it would be possible to support, completely counterintuitive to the high degree of flexibility required for this new agency.

¹⁷ [VINNOVA Sweden](#)

¹⁸ Taftie : [VINNOVA Sweden](#)

¹⁹ VINNOVA Analysis: [Impacts of innovation policy lessons from VINNOVA's impact studies](#), 2012

Establishing a headquarters as an office rather than a development lab also means that there is the opportunity to base projects right across the UK. This is another reason why the autonomy afforded to program managers in the US is so important – allowing these individuals to travel and make connections to create research partnerships and see where excellent research is being carried out.

In the establishment of the new funding agency, the UK Government should also explore how Catapults can be of benefit to the agency. For examples, the High Value Manufacturing Catapult centres already act as anchors for innovation outside of the ‘Golden Triangle’. While the independent review of Catapults in 2017 showed that some Catapults have been more effective than others²⁰, these organisations have been supporting late-stage development of research.

A question that this leaves is about the physical infrastructure required to carry out research projects. While many organisations have the space required to carry out their research, wet and dry lab space is incredibly important for smaller businesses in particular who are looking to scale up their activities. The availability of space varies greatly across the country and is an important consideration for not only how to make the most of this new fund but for supporting greater research intensity across the UK generally.

About CaSE

The Campaign for Science and Engineering (CaSE) is the UK’s leading independent advocate for science and engineering. Our mission is to ensure that the UK has the skills, funding and policies to enable science and engineering thrive. We represent over 115 scientific organisations including businesses, universities, professional bodies, and research charities as well as individual scientists and engineers. Collectively our members employ over 336,000 people in the UK, and our industry and charity members invest over £32bn a year globally in R&D. We are funded entirely by our members and receive no funding from government.

²⁰ [UK SBS PS17086 Catapult Network Review, 2017](#)