Innovating UK Innovation Policy

Making the Advanced Research Projects Agency model work here and now

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An Advanced Research Projects Agency-inspired funding body could make a valuable contribution to the UK's innovation system if it takes a mission-led approach, genuinely reaches a wide pool of innovators and helps to rebalance the spread of innovation across the UK.

The Advanced Research Projects Agency (ARPA) was set up by the US government in 1958, a product of the race between superpowers. ARPA (which became DARPA when 'defense' was added to the name in 1972) played an important role in many of the great innovations of the last 50 years, from the Internet and the graphical user interface to GPS and self-driving cars. It makes big bets on breakthrough technologies – high-risk, high-payoff opportunities.[1]

ARPA looms large in the imagination of politicians and innovation policymakers worldwide, with several countries having aspirations to copy the model.[2] We've previously argued that despite its apparent successes, its large budget – DARPA spends nearly $3 billion a year on the projects it supports and has access to an even larger US defence procurement budget – and specific context make it very hard to replicate. The US Cold War model can't be transplanted wholesale to the UK in 2020.

But with the UK government gearing up to put a large injection of public money into research and development (R&D), there are ways in which an entity that takes some inspiration from DARPA – and its more recently established (and lower-budget) clones Advanced Research Projects Agency – Energy (ARPA-E) and Intelligence Advanced Research Projects Activity (IARPA) – could be of value to the UK's innovation system.

1. An ARPA-inspired funding body in the UK should take a mission-based approach

In the US, the three ARPA siblings each focus on a specific field – defence (DARPA), energy (ARPA-E) and intelligence (IARPA). With a deep understanding of their respective 'customers', the agencies envision technological breakthroughs that would help move these fields forward, then work backwards to find and support emerging technologies that might have potential to deliver these breakthroughs and make large-scale impact. In this sense they're mission-led – not just looking broadly for the next big thing, but trying to make great leaps forward in specific areas that the US deems important.

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[1] DARPA's focus on impact, rather than risk, is a key element of its model. However, its failure rate isn't clear - one study estimated that up to 85% of DARPA projects fail (Roland, A. (2010). Forum: 'Cloning DARPA' Vol. 26(2). Issues in Science and Technology Policy. National Academies of Sciences: Washington, DC)

[2] In 2013, for example, Japan announced the establishment of a new agency that would research, develop and adapt cutting edge technologies for possible military use. https://media.nesta.org.uk/documents/how_innovation_agencies_work.pdf

The UK government has committed to mission-oriented innovation and has also set some challenging targets that will require innovation – for example, achieving net-zero carbon emissions by 2050. But we don't have an adequate way of funding missions at the moment. The main 'mission-oriented' funding stream, Industrial Strategy Challenge Fund, is arguably spread too thinly over too many challenge areas and uses conventional R&D grant funding to pursue its goals. An ARPA-inspired entity would be valuable if it filled this gap.

A mission-based approach would also help with a UK-ARPA's political viability, demonstrating to the public that a large increase in R&D spending is being directed towards the solution of tangible problems and is conducive to the public good. Forthcoming Nesta research shows that the public are keen to see innovation tackling challenges like climate change and making people healthier.

In delivering its mission, a UK ARPA should learn from the US versions' approaches to building markets. DARPA has a ready-made first customer for the technologies it supports in the Department of Defense. But ARPA-E, without this advantage, has focused heavily on identifying and building first markets. Its Tech to Market team focuses full time on promoting implementation and commercial applications of ARPA-E technologies.[3] A UK ARPA shouldn't just focus on tech push but on creating market demand. Indeed in an area like energy, many working in the field comment that the real need is to commercialise and scale existing technologies, particularly if the UK is to meet (or even better, exceed) its targets on carbon reduction.

A UK ARPA should avoid the narrow focus on 'hard' technology that the US entities have taken. Both to deliver on societally-focused missions, and ensure new technological solutions can reach scale, it should be willing to support all forms of innovation that could help achieve the breakthroughs required, including business model innovation and innovations to change social behaviours. Tackling climate change, for example, requires investment both in technology and in new ways of organising society.

Coming up with a vision for the 'breakthroughs' that a UK ARPA will work towards shouldn't just be a technocratic or expert-led process. The public should be meaningfully involved. Nesta launched the Longitude Prize in partnership with BBC Horizon, giving the public an opportunity to vote for the prize theme from six options, each championed by a celebrity expert. This experience shows that getting the public to take part in selecting missions can create momentum, excitement and visibility, and that public engagement can be combined with expert judgement to define missions. We have recently researched 'participatory futures' exercises, a method of systematically imagining alternative, sustainable futures, another promising means of engaging the public on such questions.

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[3] Bonvillian (2018) DARPA and its ARPA-E and IARPA clones: a unique innovation organization model. Industrial and Corporate Change, 2018, Vol. 27, No. 5.

2. An ARPA-inspired funding body in the UK must reach a wider pool of innovators than existing funding mechanisms

The emergence of new, genuinely disruptive ideas and technologies would be aided by a greater diversity of innovators and, in particular, a greater number of smaller companies working to commercialise new technologies.

Currently, Innovate UK allocates funding for cutting-edge technological research and development with commercial applications. However, the relatively large amounts of money allocated and the conditions attached to their allocation make it unsuited for smaller firms with very disruptive, high-risk ideas.

One way a UK-ARPA could help to address this issue would be to make use of smaller grants, with fewer strings attached, alongside larger pots of money. Challenge prizes are a particularly good mechanism for this. In addition to this, challenge prizes provide a good way of managing the risks inherent in funding speculative R&D with public money – helping to resolve the tension between the need for a UK-ARPA to foster high-risk research and the need to use public money responsibly. DARPA uses challenge prizes, while IARPA uses a 'tournaments' model – funding multiple teams working on the same challenge, with an element of competition between them.

With a challenge prize, it is possible to engage a greater variety of early-stage solutions to a specified problem without committing a large amount of money to any of them. Rather than picking one team and providing a subsidy based on the most credible proposal (the traditional R&D grants model), challenge prizes incentivise multiple teams to compete to provide the most impactful solution. The result is a greater number and variety of innovators working on a topic, and hence an ability to support more radical or unproven technologies as well as the safe bets typically funded through grant mechanisms. Nesta's [Demand Driven Challenge](#) brought forward, among others, a new firm, Upside Energy, that was formed by a geophysicist in order to take part in the challenge. A company with no track record would have been unlikely to receive funding through traditional grantmaking processes. It's since gained £10m in investment and now has 35 staff.

To genuinely reach a wider pool of innovators, a UK ARPA will need to employ different kinds of people. Much is made of DARPA's relatively small team (around 220 staff), flat structure and empowered programme managers, who are brought in on short term contracts (incentivising them to make a difference in a short space of time), and work together in multidisciplinary teams. Reaching a more unusual set of innovators will require people with a wide range of backgrounds. And they will need to spot innovation from unusual places, too - more on which below.

3. A UK ARPA must help stimulate innovative economic activity outside of London and the South East

The new UK government has made a welcome commitment to 'level up' economic performance across different parts of the country. A UK ARPA could contribute to this ambition through an explicit aim to support the creation of clusters of innovative activity in particular regions.[4] While this ambition will require various complementary policy interventions, one means of encouraging the development of innovative clusters is through setting up real-world innovation testbeds. A UK ARPA could fund and support these.

In order to establish their scientific, business and regulatory viability, innovative new technologies and business models need to be tested in environments closely resembling those in which they will be deployed. Real-world testbeds[5] offer companies and innovators the opportunity to do just this within spatially bounded and controlled domain – and are likely to become increasingly important in developing and bringing to market transformative technologies and ideas.

As Nesta research shows, the presence of such an initiative in a particular place encourages companies, innovators and researchers to cluster around it, developing a competitive advantage as the place where the innovation could be best developed, tested and iterated.

To have maximum impact, testbeds should be placed in regions where there is already some degree of untapped innovative potential. Innovation mapping uses data science to give policymakers much more precise and timely data about innovation. Nesta's work has shown how innovation mapping can be used to identify emerging industries (such as the immersive economy) and their geographical spread. This is a powerful method to identify potential locations for testbeds.

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[4] For example, Richard Jones of Sheffield University advances arguments around regional hubs of translational research and innovation, or 'industrial commons'.
[5] We define real-world testbeds as "as controlled or bounded environments for testing innovation in real-world, or close to real-world, conditions in the manner (or close to the manner) in which they will be used or operated." See out report, Testing Innovation in the Real World.