

Written Evidence Submitted by Durham University

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

There are several shortcomings which an ARPA style agency could help to address.

- Maintaining and enhancing UK plc's ability to carry out world-leading and world-changing research requires long term investment in areas seen as traditionally too risky for R&D investment. The current R&D system leaves very little room to "fail forwards", which drives risk-averse behaviour and at times stifles innovation in the design and delivery of research programmes. An ARPA style agency offers the opportunity to embrace a more adaptable concept of what success is i.e. one which embraces risk, and values and learns from failure.
- The current UK R&D system supports initiatives across different Technology Readiness Levels (TRLs), however, this is concentrated on those stages which see the fastest impact. An ARPA agency could remedy this, funding emerging fields and initiatives at much earlier stages of TRL, whilst also facilitating quick routes to commercialisation through close interagency working to maximise the economic impact of innovations for UK Plc.
- Current funding structures supporting R&D are not responsive, and even if the funder provides a funding decision within a number of weeks, the post-award management required on the grant usually stalls work and leads to delays. ARPA could introduce a new model of funding which is agile and responsive, with quick turnaround on decisions and a new approach to post-award and accountability that would accelerate the innovation cycle.
- The current system is relatively rigid. Detailed plans must be submitted for projects and any significant deviation approved by the funder. This stifles creativity and innovation. An ARPA style agency could take a similar approach to the European Research Grant Scheme, the success of which (800 patents, 75 new ventures etc.) is widely attributed to the flexibility it provides through not prescribing an idea of what is "good" or "worthy" research, allowing work to be ideas-led as it progresses. The UK has benefitted disproportionately from the ERC scheme, meaning institutions would be well placed to lead on and support a similar model (re flexibility and ideas-led innovation) supported through ARPA.
- The current research funders tend to organise around highly structured funding calls. Whilst this level of direction supports political agendas and accountability for the benefit of the treasury, it does stifle some truly innovative proposals that do not quite fit an agenda or which are high risk

opportunities, irrespective of the size of the potential benefit. The UK has very few genuinely “blue-skies” research funding channels, and the research funding landscape is often fixated on legacy, rather than ideas and outcomes. An ARPA style agency with a specific remit to support ambitious high-risk-high reward, “blue-skies” initiatives would fulfil a critical but poorly supported need for the UK.

- The current approach to the UK R&D system has seen significant disparities between regions in terms of investment in R&D, and it is these regions which also show the lowest levels of productivity. There is an opportunity for ARPA to drive the ‘levelling up’ agenda, building capacity in emerging fields which will drive innovation and productivity, and create economic growth. This could be done through hosting ARPA in such a region, as well as considering funding specifically for such regions.
- Finally, an ARPA style agency could take a more flexible approach to the funding of project delivery, focussing less on large static projects and more on programmes of work delivered by key innovators, bringing together interdisciplinary areas of work. UKRI does not do interdisciplinarity well, and whilst there may not be gaps in specific UKRI portfolios, there are gaps between them, which is what ARPA could address.

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

The implications of a new funding agency for existing funding bodies and their approach may be considerable, though in some cases could be very positive. Effectively delivered they should be complementary and will potentially support a step change in the UK’s R&D ecosystem. Key implications include:

- The need for a clear differentiation between the missions of the different bodies. This could be effected by introducing a mechanism at UKRI level to ensure no duplication of mission/funding streams, with regular communication and information sharing (as appropriate) between the agencies. There are lessons that can be taken from existing bodies, such as the SCOR Board related to international-development related research. This was introduced to ensure investment in international development-related research was delivered as effectively as possible, to maximise the return on investment to all partners. It also allowed cross-funding governance issues to be dealt with through one body, rather than each funder having their own approach, offering clarity to the sector and allowing for easier implementation.
- This is particularly acute around the industrial strategy. UKRI has a distinct mission to support this, but given ARPA’s likely focus on transformational STEM research with industrial impact, there is potential for cross-over. If managed correctly, this could have a positive impact on the Industrial Strategy, with ARPA driving riskier endeavours, and UKRI picking up opportunities as they develop to support with more traditional funding means.

- The new agency would allow UKRI to focus on applied research streams aligned to the objectives of government driven funding initiatives (like the Industrial Strategy, or the Global Challenges Research Fund). It would ensure that UKRI continue to deliver high impactful research, aligned with the necessary government priorities and strategies, allowing them to show appropriate return on investment, whilst ARPA could have the freedom to support and invest in ideas that are driven by innovation and “blue-skies” thinking, and not key political agendas.
- Given ARPA’s likely focus on STEM R&D, there would be a need to ensure that existing funding bodies retained, and potentially ring-fenced, funding to support Arts, Humanities and Social Science endeavours, which could link to the newly announced SHAPE campaign. Below we discuss ARPA supporting R&D feeding into “missions in the public interest”, and such work cannot be advanced purely through technology, it requires work on topics such as social innovation, business models, and governance (for example). Such work could be supported through existing funding bodies, such as UKRI, which would be complementary to ARPA driving technological and scientific innovation in similar challenge areas.

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

The focus of the agency should be on supporting ideas which have the potential to drive world-changing innovation, increase productivity, feed economic growth, and which ensure that the UK remains a global leader in key sectors and emergent areas. We would welcome a similar approach to that which NESTA have suggested, where work would be driven by “missions in the public interest”. As mentioned above, there is a need, and opportunity, for ARPA to be truly “ideas-driven”, where there not constraints on what is to be funded, allowing colleagues to truly pitch “blue-skies” ideas for investment. We do not think it would be beneficial to have ARPA siloed into various agencies supporting thematic work.

A key element is to ensure that funds are prioritised for emergent fields, rather than pumping funds into existing fields, which traditional funding already supports. ARPA could, to paraphrase the original DARPA, “anticipate the unimagined technologies of the future”, through supporting emerging STEM R&D initiatives, including those that still require significant proof of concept development. The focus should be on what is “useful” for the future, which is a challenge to know definitively, but this is where a less risk-adverse funding model is needed to ensure such breakthroughs (much like GPS for example, which developed through work from DARPA).

Part of ARPA’s mission must include funding provision within programmes for PhD students, in order to train individuals and build pipelines of talent in new and emerging areas. This should not replace existing PhD funding models, but should complement them, and particularly drive PhDs hosted in industrial placements to drive innovation. New methods of assessment could be considered as part of this

training, including an increased expectation and emphasis on thesis by publication through such placements. This would ensure training is being provided for the “workforce of the future” in new and innovative areas, which are not supported through existing funding mechanisms.

It is essential that the new agency be distinct in both remit and operational practices, otherwise it will be redundant as it will replicate existing models. We would suggest that rather than having to report to a specific minister or the Prime Minister (given this would be political), that an external advisory board is established to oversee the performance and strategy of ARPA. Having an apolitical civil servant leading ARPA would ensure it is free from political bias, and help to ensure buy-in from multiple political parties in order to secure long-term investment.

As mentioned, we would not encourage ARPA to be silo-ed in any way. One structural model could involve Directors overseeing particular portfolios of work as they emerge, but we would avoid prescribing these portfolios themes in the first instance given it would stifle the “blue skies” approach to the funding. Such individuals would have significant responsibility and power. Supporting these portfolio Directors should be world-leaders in the respective area (a relatively small team), pulled from academia, industry, and the civil service, who have oversight of the portfolio and support the Directors with decision making, particularly on investments.

As mentioned above, any structure would need to be equipped to be agile and responsive, whilst also of course ensuring robust decision making is taking place. Current peer review mechanisms used by UKRI are not fit for purpose, particularly as reviewers are predominantly academics who are not the consumers of the research. Whilst progress has been made recently by UKRI to involve more non-academic reviewers, the process is still problematic. We would encourage ARPA to consider a new approach to peer review, which involves a truly multi-stakeholder approach, and appropriate reviewer training and development, to avoid replicating bad practice of existing funders. A robust and transparent process for funding decisions is essential to ARPA’s success. Without a robust process in place, the agency would risk issues of integrity, as well as drive negative behaviours in relation to equality, diversity and inclusion.

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

We welcome the £800m that has initially been announced to support the work of ARPA, however over a 5 year timeframe this equates to £160m per year which is not at the scale needed to ensure that ARPA is a success. The agency will not succeed without considerable funding. Moving forward, and in a post-pandemic world, it will be harder to justify larger investments without short-term return, but to succeed ARPA will require significant money and time (see below for further input on this).

Funding should be disseminated through open funding calls, with a tier-ed approach to investment including;

- Tier 1 – small (<£100k) proof of concept awards, which have low administrative requirements and are secured through a pitching process.
- Tier 2 - £1m - £5m programmes, which are stage-gated with break points for funding (after an initial 2 years). Teams would be required to initially put forward a plan for the initial 2 years, and then would be assessed on progress, before securing additional funding to support work coming out of the initial project. It would give ARPA the ability to pull the plug on those endeavours which weren't progressing as needed in terms of breakthroughs.

Non-academic bodies should be able to pitch ideas to ARPA, with academic teams then able to pitch for the opportunity to collaborate on such ideas. These could come not just from private industry, but also the public sector from agencies such as the NHS (for example). As well as pitching the idea, they could be a key part of the assessment process, and in reviewing progress when considering future funding.

Evidence has shown that smaller teams are underfunded in the current model of R&D support, and furthermore can produce more disruptive innovation and breakthroughs. We think any prospective funding model should recognise this and avoid duplicating the current investment model of supporting larger teams and consortia. A diversity of approach to team size would be welcomed, and based solely on what is required to drive the most impactful innovation and breakthroughs for the programme.

Whilst the science case is key, demonstrable potential to enhance national research, industrial and economic capacity is essential, and regional significance to increase productivity and support economic growth should be recognised when reviewing cases for investment.

What can be learned from ARPA equivalents in other countries?

- Any new agency will need time, at least 15- 20 years to demonstrate its value. It will take time to build the right culture within the organisation, for the sector to respond and for investments to show returns. It is vitally important that the agency receive support from across the political spectrum so that a future government does not see it as one parties 'project' and cut funding. Prioritising funding in areas of public interest would help to ensure buy-in, as would political oversight from multiple parties.
- There is a need for the agency to have a unifying mission. That this body will have a predominately civilian focus sets it apart from most similar efforts.
- The need for the right staff to run the agency. The model we support is one that gives significant freedom to the agency staff and therefore its quality is dependent on them. We recommend that talent be drawn from the broadest possible pool, not just scientists but also those from the private, public and creative sectors.
- Accountability is important given this is a potentially substantive amount of public money invested, however, the more successful agencies have been

those which have been given the greatest operational freedom and which have not become ensnared in bureaucracy.

- Embracing failure to ensure you have freedom to innovate provides significant return on investment and world-changing breakthroughs, as can be seen from examples funded through DARPA in the US including (for example) the creation of the internet, and invention of GPS.
- The *Établissement public à caractère scientifique et technologique* (EPST) in France supports various research units across the country, including INRIA, which is a world leader in AI. ARPA could seek to leverage additional investment from universities and partners in creating similar units in the longer term.

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

We strongly feel the office for ARPA should be situated outside of the Golden Triangle. Whilst of course those in the Golden Triangle would be well positioned to access ARPA funding, positioning ARPA in the North of England or Scotland would not only ensure autonomy from UKRI for the new agency, but would contribute to the levelling up agenda, and would be a significant political signal showing commitment to supporting innovation across the country.

The spill over benefits of having an organisation such as ARPA based in a region outside the Golden Triangle could be transformational for that region, and should not be ignored when decisions for location are being considered. The current COVID crisis has helped us all re-imagine new ways of working flexibly and remotely whilst still maintaining exemplary high standards. This should give confidence to any new emerging agency that physical proximity to the capital is no longer a necessary requirement for success.

The North East offers particular opportunities and economic challenges that the creation of ARPA could be hugely beneficial on. The north east region persistently lags behind other regions in key economic measures; the latest statistics from the NELEP show that R+D spend by business in the region represents just 36% of the levels experienced across the rest of England outside of London; patents per million population is 38% of the rest of England and higher education spend on R+D is 90% of that experienced in the rest of England. The role that the universities play in the local economy is therefore vital and more predominant than in any other region of England.

Establishing ARPA in this region would have a revolutionary impact on the local innovation ecosystem, encouraging and supporting enhanced innovation focussed research. The regional universities (including 2 Russell Group members) have a strong history of collaborating and leading innovative programmes to support the regional economy and are key actors in local policy evolution. In particular the regional universities have spearheaded the Northern Accelerator programme which has delivered a step change in how we support and encourage spin outs from the academic community. Northern Accelerator demonstrates how with focussed support

regions outside of the golden triangle can capitalise on commercialisable opportunities and accelerate business formation. This programme has almost trebled the number of spinouts from the partners in less than three years and has ambitions to deliver even more. ARPA located in the north east would significantly enhance this innovation ecosystem and the inherent spill over benefit to the local economy.

Durham University leads on the Northern Accelerator programme, and whilst as an organisation we are successful with traditional modes of R&D investment, Durham has particular strengths in several key areas that ARPA could seek to drive including (for example); quantum technologies (particularly quantum computing and imaging, and translation into industrial settings); decarbonisation and energy materials (geothermal heating, and energy from waste); data science and modelling (focussing on innovation, real-world application and service improvement); and disaster risk management.

If the North East was not deemed to be suitable then we would also welcome other northern locations, such as Yorkshire or Scotland, to host ARPA. Given the opportunities that currently exist in Manchester, and its perceived dominance in discussions relating to the Northern Powerhouse, we feel a different location in the north would be beneficial, and as mentioned would be a significant political signal.

As well as situating the physical presence of ARPA in the North of England or Scotland, consideration must be given to how the funding can drive productivity and economic growth in regions outside of the South East. Particular funding ring-fenced for such regions would be well received, with university-industry networks already established to capitalise on such opportunities. Long has proximity to the South East been an indicator of success for securing funding, and ARPA must ensure it is not just another body which predominantly funds work in the Golden Triangle. The R&D landscape of the Northern Powerhouse would lend itself well to an ARPA-model of funding, with key strengths in areas which are ripe for innovation such as Energy, Data Science and Climate Change.

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