

Written Evidence Submitted by BT

(RFA0101)

Summary

There is a role for a DARPA-style programme in the current UK R&D system. It will be critical for its success to make sure that there is:

- **a clear mandate with a strong risk appetite** to deliver benefits for the UK economy;
- **enough flexibility and agility to introduce a “DARPA culture”**: limited bureaucracy, empowered program managers and links in the wider ecosystem, etc.;
- **a seamless cooperation** with other elements of the UK funding system to ensure line of sight across TRLs and missions;
- **a direct collaboration with the UK’s industrial R&D labs** in both shaping and delivering its programmes in order to create a remarkable array of technology applications used for the benefits of the UK economy.

BT’s R&D Capability

BT contributes as much as an RD&I enabler as an actor. Our investments in digital infrastructure, skills and ideas help underpin productivity and innovation across all parts and sectors of the UK. During the covid crisis, we have helped the NHS, schools and Britain’s businesses stay connected and advance with new forms of digital delivery. Our R&D investment over decades has helped make telecoms one of the most productive sectors the UK has. We’re a top 10 UK R&D investor (£643m in 2019), pioneering in a range of technologies from 5G to QKD¹, Augmented Reality to Artificial Intelligence (where we are number 1 in the UK for patents registered), with the hub for this research - BT labs at Adastral Park² - a national strategic asset. Yet perhaps more importantly, our R&D majors in partnerships. The three central tenets to BT innovation are that it is purposeful, open and global. Purposeful because it marries academic breakthroughs with practical engineering to address real life needs. Open because we work collaboratively with businesses and over 40 universities across the breadth of the UK, starting with our R&D HQ which hosts a growing tech cluster of over 140 companies. Global because we look for the best ideas and talent wherever they are in the world, and now have four overseas research partnership centres from the EBTIC ICT³ and innovation centre in Abu Dhabi to the BT India Research Centre in Bengaluru⁴. This approach means BT operates across all the Technology Readiness Levels (TRLs) with partners of all types and sizes. Even in just one field, we’re often involved in many TRLs levels at the same time, as illustrated by our role in QKD.

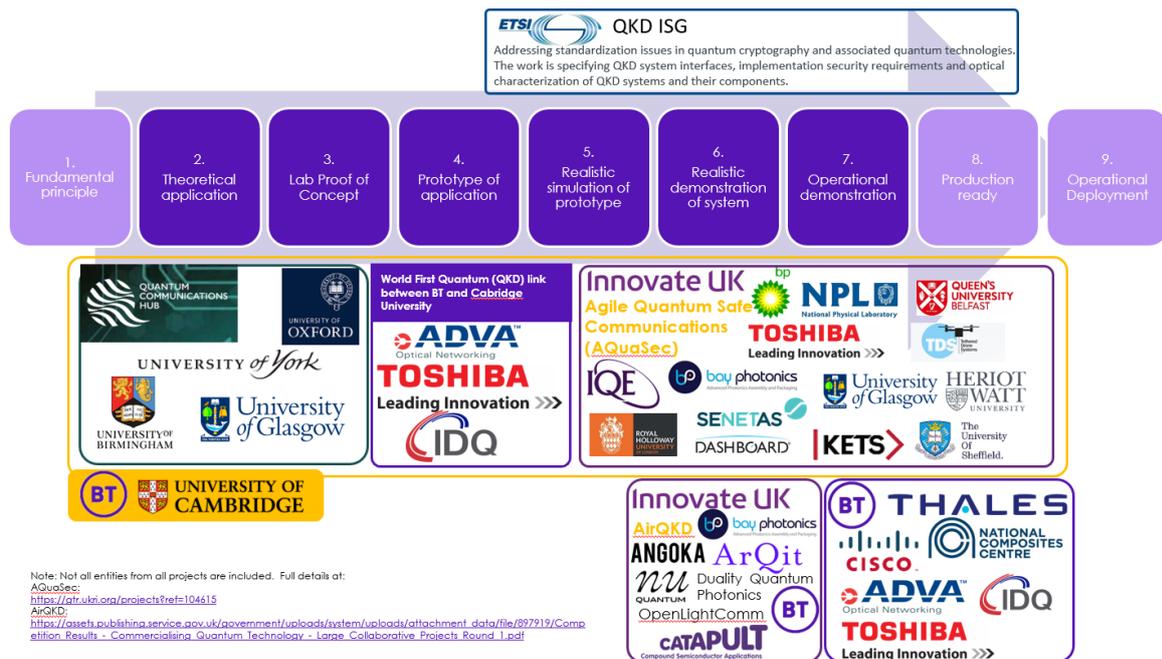
Figure 1: BT, partner and other activity across the TRLs in QKD

¹ Quantum Key Distribution

² <https://ataastral.co.uk/>

³ <https://www.ebtic.org/>

⁴ <https://www.globalservices.bt.com/en/aboutus/news-press/bt-and-india-institute-of-science-kick-off-new-phase-of-uk-india-research-collaboration>



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

The UK has developed, evolved and refined a broad range of support for science, technology and innovation activities across academia, industry and government. **Quality-related research funding, Research Council grants, and Innovate UK’s collaborative R&D programmes are established and well-understood mechanisms that have been successful in stimulating world class research and innovation.** In addition, programmes such as the UKRI Future Leaders Fellowships, EPSRC’s Prosperity Partnerships and Knowledge Transfer Partnerships strengthen the UK’s core capability and links between industry and academia. **The existing mechanisms should remain the core of the UK’s R&D system.**

Clearly, however, they are not sufficient particularly where leadership in strategic priorities areas requires concrete technological progress and outcomes. **The Industrial Strategy Challenge Fund (ISCF) set the right direction and there have been successes.** The National Quantum Technology Programme (NQTP) for example has galvanised the UK community and brought the UK from world-class science to the forefront of quantum technology products and services. However, ISCF Challenge Directors do not have the autonomy or mechanisms to hand to direct strategic R&D programmes as industry would understand them.

A UK ARPA is an opportunity to focus on long-term strategic opportunities & priorities for the UK. It should however adopt the same principles of DARPA, in particular:

Bold questions that matter – where DARPA has been most successful it has been not by investing explicitly in abstract capability building, but by posing and exploring bold hypotheses which catalyse new technological development and establish actionable technological feasibility. This is achieved through a clear mission focus from stakeholders who care about game changing outcomes.

Open and inclusive innovation – DARPA actively solicits involvement from across the innovation system, including specific provisions for SMEs through the SBIR (Small Business Innovation Research) and STTR (Small Business Technology Transfer) programmes.

Competitions, demonstrations and stage-gates – building, demonstrating, competing and sharing are critical to the DARPA model. High profile challenges (such as the autonomous vehicle challenges) are one of the mechanisms used.

Relatively short project timescales with long term impacts– even though they focus at low TRLs typical DARPA projects last around three years. This allows feasibility and direction to be established before the idea can be passed on to more sustained funding programmes, or the idea parked as not ready yet. Over time, a bold core idea or problem may be tackled several times from different directions.

Active programme management – the role of the DARPA programme manager has been extensively studied. These are technical or domain experts with a demonstrated passion for the domain who will return to their roles in industry, academia or government after their service.

Critical role of industry and industrial R&D– DARPA demonstrates feasibility by building things, often right at the boundary of technology. High tech industry plays a key role in providing specialist knowledge and capabilities as well as a bridge to impact. Industrial R&D labs and skunk works are a vital element of the approach.

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

The success of the DARPA system has been due to its ability to develop a distinctive way of working – very different from traditional science funding bodies such as the National Science Foundation, or tactical approaches of innovation focussed groups who are more concerned with applying existing capabilities to new problems.

A UK equivalent would need to balance

- Independence of thought and action, with
- Seamless cooperation with other elements of the UK funding system to ensure line of sight across TRLs and missions.

This cooperation will be critical if the UK wants to meet the 2.4% R&D target. BT recommends to the Government to:

- **give to an UK ARPA a clear purpose and mandate** to avoid re-introducing the issues UKRI was established to address (i.e. lack of strategic oversight, funding silos and overlap with other funding initiatives).
- consider carefully how to establish accountability and **make sure a UK ARPA is not perceived as substitutional. A UK ARPA should serve as an essential link in the broader RD&I system.**
- **review the relationship to the activities within Industrial Strategy Challenge Fund.** Some ISCF Challenges might reasonably have been considered as ARPA-style missions but have had to use the existing collaborative R&D mechanisms and been subject to lengthy Government

sign-off processes. Affording the same flexibility and autonomy to the ISCF Challenge Directors could make a real difference to their impact.

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

A UK ARPA should be focused on long-term strategic opportunities & priorities for the UK and adopt the same principles of DARPA, in particular:

- **the core philosophy should be mission-focused, challenge led programmes :** UK ARPA should address low-TRL research but it must be with clear long-term technology objectives; it should not be taken as alternative funding for blue-skies research, nor should it divert existing funding from blue skies research and the existing councils.
- **administration should be light-weight and based on the principle of programme managers:** to achieve transformational results will require active programme management with the authority to start and most importantly stop research
- **problems should be “DARPA-hard”** i.e. high-risk with a long-term time horizon : ambitions that can be, should be addressed by the existing mechanisms

We also encourage the Government to collaborate directly with the UK’s industrial R&D labs in both shaping and delivering its programmes:

- **Industry along with Government will be providing the pull for the technical innovation.** The UK is home to world-class, R&D intensive businesses in strategic sectors that have developed supply chain to drive long-term innovation.
- **Industry is a great source of knowledge along with universities to scout the strategic opportunities of tomorrow.** In the US, DARPA program managers are consulting with industry and other experts when choosing an area of “white space” in which to operate.

This collaboration should however not lead to an attempt by ARPA to address immediate market opportunities for UK businesses. It should instead consider the long-term strategic ambitions for the UK’s globally strategic industries.

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

An UK ARPA should:

- **support enough programmes to absorb early failures.** High-risk, long-term research will necessarily see more failures in the early days; major successes will come later as UK ARPA matures. Consequently, the level of funding should reflect the tolerance to risk and expected success rate. £800m should be efficient to start UK ARPA but should be reviewed as the operating principles for UK ARPA are stabilised.
- **allocate funding to the specific missions rather than divide it first between broad topics and themes of work.** Mission funding itself should be allocated at the discretion of the programme manager according to his/her strategy. The implications of active programme management will be most keenly felt within academia. The existing grant mechanisms involve considerable due-diligence up-front but then freedom is given to the researchers for

the duration of the grant. A DARPA-style project proposal may involve less initial due-diligence but will be reviewed actively for the duration and researchers should expect projects to stop mid-flight. This will have implications for university funding models and in particular hiring of post-doctoral researchers.

- **manage IPR in a way that maximise the impact of the work done by the industry and academia.** The general principles of collaborative R&D i.e. background IPR is retained by the owners and foreground IPR is shared between the contributing partners, should be retained.

What can be learned from ARPA equivalents in other countries?

International experience is that DARPA is difficult to replicate, even within the US. DARPA is unique in terms of its origins, its single key client, and the system it operates in. It is therefore essential to recognise that a UK ARPA is itself a long-term high-risk investment. However, we believe it is eminently achievable if we leverage all the UK's strengths: its world-class science base, world-class R&D-intensive industries, a vibrant start-up ecosystem.

A UK ARPA will have to operate effectively within UK's own system. It is not an alternative for the existing mechanisms that are successful at what they are asked (and allowed) to do. We should expect to see flexibility in how a UK ARPA operates and how UKRI flexes to accommodate it.

Establishing an equivalent 'innovation pull' dynamic at a national scale is critical. There should be a strong collaborative partnership with the UK's leading R&D intensive businesses (cf. question 3)

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

The critical elements of UK ARPA will be the programme managers and their authority to invest funds. In both cases we would expect UK ARPA to utilise the knowledge & skills from across the UK.

We recommend that

- **investments take into consideration the industrial capability within a region to develop and take on innovations.**
- **the location of the HQ does not suggest any prioritisation in the distribution of the funding.**

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