The Institution of Engineering and Technology response to the UK Research and Innovation Inquiry

About the IET

The IET is a trusted adviser of independent, impartial, evidence-based engineering and technology expertise. We are a registered charity and one of the world's leading professional societies for the engineering and technology community with over 155,000 members worldwide in 148 countries. Our strength is in working collaboratively with government, industry and academia to engineer solutions for our greatest societal challenges. We believe that professional guidance, especially in highly technological areas, is critical to good policy making. For further details on the evidence submitted, please contact policy@theiet.org.

Executive Summary

The IET welcomes the opportunity to comment on the areas where UKRI should prioritise their investment. To deliver an effective industrial strategy, and improve the UK's innovation sector, we recommend a three-horizon approach that provides milestones for success in the short-, medium-, long-term.

The first step should be to build on the current Science and Technology framework to plan for the short-term, as part of the industrial strategy. Investing in, and utilising, critical technologies can help meet government missions in key policy areas such as energy, planning, retrofit, and critical national infrastructure. However, consideration should be taken regarding the environmental impact of new technologies as some can be highly energy intensive.

In the medium- to long-term, UKRI can address national challenges by prioritising investment that will create opportunities, and support innovation, such as: enhancing intellectual property in the UK, assisting starts-ups, tackling tangible gaps in the skills pipeline, and ensuring sources of funding to commercialise and scale innovative technologies. Prioritising the fundamentals of robust data to ensure standardisation, interoperability and high-quality data usage for technology will be a key focus of the new data centres.

The IET recommends UKRI prioritises the following topics:

- **Entrepreneurship:** We are seeing a decreasing number of companies seeking investment for growth as pathways can be unclear and a lack of multi-sector support exacerbates financial and communicational disconnects. More support needs to be given to startups so they are able to scale up effectively.

- **Digitalisation:** Utilising emerging technologies and digitalisation is a facilitator to growth and can be a fundamental component to technological development. UKRI should encourage a high standard of cyber security across its projects, particularly when developing new tools that could have a wider impact in society.

- **Sustainability:** UKRI should continue to embed environmental sustainability across all its investment decisions and act as a springboard for innovative green energy solutions.

- **Partnerships:** UKRI should continue to look for international collaboration where possible between institutions, laboratories and universities to facilitate sector-wide, and inter-sector opportunities that optimise knowledge sharing. This should be paired with simpler acquisition of short-term (less than one year) visas for academics, professionals, and executives to relocate for short periods of time both into and outside of the UK.

UKRI should continue to invest in, and develop, diverse research and innovation programmes to support the skills pipeline. UKRI should also prioritise investing in upskilling and reskilling professionals with interdisciplinary and transferable skills that can be utilised across sectors; required transferable skills can often be found across the STEM sectors.

1. Entrepreneurship

Entrepreneurship and innovation is one of the key pillars of the UK economy, bringing ideas to life and presenting new ways for products, services and processes to advance society. Innovation is crucial to the engineering and technology sector, the wider business community and the UK economy as a whole. By the end of 2022 we had 33,955 scaleups in place that were contributing £1.2 trillion to the UK economy (Source: ScaleUp Institute).

The UK has one of the highest rates of business startups in the world. However, this does not translate when scaling up; nearly 660,000 companies were established in 2016 (Source: Centre for Entrepreneurs, 2016 Breaks Business Formation Records). According to the OECD, the UK ranks third in the national league table for producing startups, but only 13th on the list for number of successful scaleups. Scaleup businesses drive significant economic growth; they generate twice the turnover per head compared to the UK average (Source: London Loves Business). However, we are seeing a decreasing number of companies seeking investment for growth (Small Business Barometer, Q4 2023, Enterprise Nation).

Funding for entrepreneurship does not need to be direct, it can be a facilitator, such as guidance and mentorship alongside other funding. With additional support for startups, they can achieve the growth they need to be able to scale up. Without appropriate investment, access to international markets, talent development, integrated business planning, customer research and extended product innovation are negatively impacted. When providing funding to startups and spinouts an area of priority should be for lead investors in high-tech areas where due diligence is challenging, having access to the expertise in academia could position UKRI well to take this role, without having to provide high levels of investment and crowding in private capital.

While incubators, accelerators, government schemes, and regional initiatives can provide crucial support, more is needed to streamline the process of bringing innovative ideas to market and supporting them through their journey. Providing more SMEs with the opportunities and ecosystem to grow into scaleups could present a huge boost for the UK economy. Having this collaboration can lead to startups having access to mentors with in-depth knowledge of business environments across a range of sectors. Mentoring, local networking and showcasing innovation can all lead to strengthened partnerships across all sectors of the UK economy. UKRI can build on Innovate UK's Business Connect to help entrepreneurs find project partners and hold funding-specific webinars and events.

Utilising collaborative opportunities will allow us to showcase successful ventures and encourage a risk-taking mindset that will lead to further development. An example of this development is the United States (U.S.). The U.S. is ahead of the UK as it has an infrastructure that supports growth and development of startups. Massachusetts Institute of

Technology (MIT) not only produces cutting-edge research and innovation but also provides a steady stream of graduates who go on to become successful entrepreneurs, creating two-thirds of new jobs and contribute to 44% of U.S. economic activity (Source: U.S. Small Business Administration, Small Businesses Generate 44 Percent of U.S. Economic Activity). This is achieved through collaboration between academia, industry, and government entities, which provide entrepreneurs with access to cutting-edge research, technological advancements, and a highly skilled workforce.

Catapults can help navigate startups through the 'valley of death'. It would be financially and time beneficial if UKRI further collaborate with catapults to develop the current ecosystem. Whilst navigating the 'valley of death' usually requires significant scaling of capital, UKRI needs to ensure that government investments can produce a viable product. One stream of government funding would be beneficial when the technology risk is too high for other investors. This will be most effective at early Technology Readiness Levels (TRLs), having government invest in higher TRLs (where the valley of death lives) should only happen for key UK sovereign capability or clear areas of UK market advantage.

Academia has a crucial role in supporting spinouts and startups, so collaboration is critical. Universities have the right environment for innovation, having scalability and business sustainability built into university curriculums is important. By including this early in degrees before optional modules, this can provide entrepreneurs the key skills and knowledge across subject areas that would cultivate entrepreneurship in the future.

Building a cohesive infrastructure, that enables even just a small proportion of SMEs to overcome the barriers of scaling up, will result in a swift and measurable positive impact on the UK economy. The measures that will transform SMEs into scaleups can also be used to launch existing scaleups into the next stages of success.

2. Digitalisation

UKRI needs to focus its areas of funding for digitalisation to ensure they are going to gain a clear advantage, value for money and build on existing strengths.

Digitalisation should be seen as a facilitator for growth and a fundamental component of future technological development. Progress in digitalisation requires public trust, transparency, and increased education / literacy for emerging technologies. Investing in education and literacy through training will ensure many sectors are well-equipped to harness the benefits of digitalisation.

To maximise digitalisation, UKRI should invest appropriately into embedding strong cybersecurity across any digital research and/or products. This can be achieved through increased funding for newer legislation and tighter regulation that emboldens our digital security, digital safety and encourages a pro-innovation approach to digital technologies. Robust data governance and stringent security measures are crucial to data management and public trust. Using this funding to introduce an independent oversight body will contribute greatly to building public trust and data protection.

Artificial Intelligence (AI)

Despite AI being prominent in many aspects of our daily lives, there are still challenges that prevent the progress of AI as a technology. UKRI should focus on addressing these barriers in order to gain the most value from it.

Evaluating the final product to ensure it is safe, effective and fit for purpose remains a key challenge preventing the progress of AI. Prior to investment, UKRI should ensure that

projects have sufficient standards that show how products are developed and handed over to the end user. These standards should include an assessment of the efficacy and safety of the product. The IET recommends using the Responsible Handover of AI to provide further information as to how to successfully and safely adopt AI.

Funding for upskilling and reskilling for AI, and cybersecurity, should be a priority. Cybersecurity plays a huge role in the safe development of AI and therefore needs to be built into the curriculum and training programmes. This will increase awareness of what software code is doing, and its possible vulnerabilities which should be embedded across all research projects and products.

It is important to fully consider the environmental impact of digital technologies when funding projects. The environmental impact of using AI should be understood by developers and users and mitigated where possible. A 'traffic light system' for data centres based on their impact on the environment would ensure clarity of reporting. Red is harmful to the environment, amber is less harmful, and green are environmentally sustainable. Having funding requirements that align with this system will encourage applicants to work towards the removal of "red" data centres. This could help push for sustainable technological progress.

AI, particularly Large Language Models (LLMs), are currently being rapidly adopted by businesses across the world. There needs to be greater transparency around the training and operation of AI systems, this is especially relevant for publicly accessible LLMs, like ChatGPT, which trains its models in part on user data. UKRI should invest in pro-innovation approaches to regulation of emerging technologies, criteria for this regulation should include:

- Encouraging people to use AI confidently. Skills and knowledge exchange should be at the heart of this approach.

- Establishing a centralised repository of AI resources, tools, and guidelines for researchers and staff to access and learn from. This could include funding to deliver agile short courses (micro-credentials) for AI upskilling, given the fast-moving pace of the technology.

- Providing financial incentives or support mechanisms for businesses and researchers to invest in AI innovation, particularly for SMEs.

UKRI should investigate funding more technical aspects of AI, such as: safe autonomous systems, formal methods and software defined test methods, and model re-training / extensions. UKRI should also focus on frontier technology and beyond. Applications of AI to science and engineering problems could also be considered, for example: protein folding, or computer vision.

Quantum

UKRI should capitalise on the UK's strong background in systems engineering and global leadership role in developing quantum technologies (ranked 2nd for number of quantum companies).

UKRI should focus its attention to improving quantum literacy. This includes promotinga greater understanding amongst the general population but also ensuring that experts can explain quantum clearly and concisely to a wide range of audiences. Just under three in ten (28%) say their senior leaders believe their workforce will be adequately prepared for the use

of quantum technologies, while 35% say they believe they will not be and 36% say they are not sure (Sustainability & Digital Skills – 2025, The IET).

UKRI should ensure open-source quantum systems blueprints are available from relevant funded projects, in order to speed up innovation and application of quantum technologies in real life scenarios. We have recently published a paper on quantum systems engineering, which outlines the challenges quantum faces, and how to overcome these challenges to incorporate quantum into everyday use.

Digital Twins

Digital Twins (DTs) can be a key asset to achieving net-zero amongst other goals and help to ensure that the UK remains internationally competitive and support greater safety in industry, however, is often underutilised. By 2027, over 40% of large organisations worldwide will be using a combination of Web3, spatial computing and digital twins in metaverse-based projects aimed at increasing revenue (Top Strategic Technology Trends 2023, Gartner). UKRI should make use of best practice in DT technology to help support changes to national infrastructure, healthcare, new housing and energy targets and other sectors to ensure taxpayers money is used optimally and the final product is efficient and resilient.

One barrier to the greater use of DTs is a lack of clarity over what comprises a DT, a continuum between simulation / CAD to more advanced models. This affects the investment decision process. Much of the problem lies with software sellers labelling DT models incorrectly, which leads to varied definition. UKRI should champion standardisation in this area through digitalisation.

3. Sustainability

The IET welcomes UKRI's commitment to embed environmental sustainability across all its investment decisions. UKRI has an opportunity to create a positive investment environment driving growth and help the Government to deliver on the goals set out in the Industrial Strategy. Fostering risk-taking on new emerging technologies helps to deliver economic growth and science and technology leadership. Investment should look to ensure that emerging technologies within the sustainable energy sector at the UKs world leading research institutions are supported to get off the ground.

The Government must adopt a whole system approach to the energy network. National Energy Systems Operator (NESO) does good work in planning for this, but the responsibility sits with government to take the long-term decisions needed to deliver the significant infrastructure changes that are required. To maintain security and resilience while accommodating new demands and a generation mix, The IET recommends UKRI prioritise their funding towards green energy solutions providing a platform for the upcoming hydrogen strategy, nuclear fusion and innovative solutions to upgrading the electricity grid to deliver Clean Power 2030.

4. Partnerships

UKRI should continue to encourage interdisciplinary international collaboration between institutions, laboratories and universities, facilitating collaboration opportunities within sectors and inter-sector ensures maximum knowledge sharing. This should be paired with increased ease of acquiring short term (less than one year) visas for academics, professionals, executives etc. to relocate for short periods both into and outside of the UK.

This can be achieved by collaborating with professional engineering institutions (PEI's), such as: the National Engineering Policy Centre (NEPC), or the IET. PEI's can be utilised as both a source for insights and collaborative policymaking, but also as a route to any of its partners to connect with their specific and extensive expertise, many of whom have international footprints.

Engineers and policymakers working together can employ systems approaches to better understand and intervene to solve challenging policy problems. Engineers tackle complex challenges, including through examining whole systems and how their elements interact with one another to optimise outcomes that consider a range of stakeholder approaches. When these principles are applied outside the world of engineering to tackle the societal challenges, they can have transformational effects, as already recognised in the health and care sector.

Conclusion

The IET recommends UKRI prioritise funding for entrepreneurships through clear pathways and communication, cybersecurity frameworks and standards for digitalisation, and developing international collaboration. UKRI should continue to embed environmental sustainability across all its investment decisions and act as a springboard for innovative green energy solutions. However, this should not detract investment into the skills pipeline, upskilling and reskilling.

There is a wide range of organisations that would be willing to assist with expert advice.

Please let us know if you would like any further clarification on these points, we would be happy to have a meeting with you to discuss anything further.