THE ROYAL SOCIETY

18 February 2022

Royal Society submission to the research, development and innovation organisational landscape review

The Royal Society is the national academy of science for the UK. It is a fellowship of many of the world's most distinguished scientists working across a broad range of disciplines in academia and industry. The Society draws on the expertise of its Fellows and Foreign Members to provide independent and authoritative scientific advice to UK, European and international decision makers.

This document contains the Society's submission to the research, development and innovation (RDI) organisational landscape review led by Sir Paul Nurse. For further information or queries, please contact public.affairs@royalsociety.org.

Introduction: a long-term vision for UK science

The UK has considerable strengths in RDI driven by the ambition and curiosity of talented people in a range of organisations. Building on these strengths while adapting to new developments and challenges is critical to maximising the benefits of science to the economy, to people's lives, to handling climate, pandemic and biodiversity crises, and to meeting the ambitions of the UK as a global leader in science and a nexus for talent and investment.

Currently, these ambitions are hampered by the lack of a long-term vision, and by short-termism in political priorities and funding cycles. Many talented researchers spend their most productive years living hand-to-mouth on short-term projects and contracts. Funding incentives militate against the establishment of productive research teams with efficient technical and infrastructure support. A meaningful perspective on the significant sums invested in RDI infrastructure requires a strategic approach to science which considers areas for growth and where the seeds in curiosity are for new and disruptive sources of innovation.

To get the most from the organisational landscape, the UK needs a coherent strategy which allows it to stay at the forefront of critical fields, and adapt as new ones emerge. This should take a long view of the UK's RDI priorities and opportunities – at least 10 years ahead with a regular review cycle – and consider the system as a whole.

Although the organisational landscape review is separate to Sir David Grant's review of UKRI and Professor Adam Tickell's research bureaucracy review, the three are closely linked and should feed into a single overarching strategy for optimising the system. Similarly, the UK government should consolidate the work of various departments on innovation, infrastructure, and people and culture (for example, bridging the gulf between education and science policy to strengthen the RDI skills pipeline) and ensure join up with the devolved administrations and local and regional government.

The landscape review should consider the extent to which the UK adequately supports:

- bold, long-term research
- the people, skills and organisations necessary for a high performing RDI ecosystem
- access to RDI infrastructure
- interdisciplinarity
- translation and industry collaboration
- international RDI collaboration
- excellence outside London and the Greater South East

What are the current strengths of the UK organisational landscape?

- The UK has some world-class institutions with world-leading scientists. It has ranked first on field-weighted citation impact in the G7 every year since 2007 and has the highest proportion of publications that are highly cited out of any country[1].
- Independence from government via the Haldane principle is a unique and important asset of UK RDI policy. Research councils have been able to adapt to the needs of researchers.
- The existence of dual support has generally been a positive feature of the UK RDI system. The UK has the highest percentage of performance-based research funding (52%) out of all OECD members[2].
- The UK is attractive to globally mobile talent. In 2017, it received 14% of mobile doctoral students from OECD countries, second only to the USA[3]. Non-UK nationals comprise two-fifths of the UK's academic workforce in science, technology and engineering and more than half of the postgraduate student population[4]. The estimated proportion of overseas researchers in industry ranges from 10-50%[5].
- There are many opportunities for early career researchers to establish independent careers – for example, University Research Fellowships (URF), Future Leaders Fellowships, Dorothy Hodgkin Fellowships. The UK has the second highest number of fellowships available for early career researchers in the world[6].
- The UK has a number of high-quality central facilities such as the Diamond Light Source, Central Laser Facility and European Bioinformatics Institute.
- The UK's RDI organisations are a delivery partner and magnet for high value industry – for example, Arm (Cambridge), Boeing (Sheffield and Strathclyde), IQE (Cardiff), Jaguar Land Rover (Warwick), Rakuten (Belfast), Siemens (Lincoln), and Unipart (Coventry).
- The UK is also home to elite research institutes such as the MRC Laboratory of Molecular Biology and the Culham Centre for Fusion Energy.

Areas for improvement in the organisational landscape

1) Short-termism

Many of the innovations that have saved lives and rescued economies during the pandemic originated from basic research more than 50 years ago. Short-termism hinders the efficient use of resources and is an unnecessary brake on global potential.

The current prevalence of short-term RDI funding discourages people from choosing science as a career, yields less in the way of results, and discourages bold and long-term projects. This inhibits the UK's ability to pursue ideas, technologies, and innovations that could deliver transformative change over time. While the launch of the Advanced Research and Invention Agency (ARIA) is an interesting development, action is needed on a much wider scale. The perception within the community is that too much time and energy is being wasted chasing too little money.

---

[1] BEIS (2019), 'International comparison of the UK research base: accompanying note', available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/815400/International_comparison_of_the_UK_research_base__2019._Accompanying_note.pdf

[2] Technopolis (2019), 'International Landscape Study of Research and Innovation Systems', available from https://www.technopolis-group.com/report/international-landscape-study-of-research-and-innovation-systems/

[3] OECD (2019), 'Education at a glance: OECD indicators', available from https://read.oecd-ilibrary.org/education/education-at-a-glance-2019_f8d7880d-en

[4] Royal Society (2019), 'UK science and immigration: why the UK needs an internationally competitive visa offer', available from https://royalsociety.org/topics-policy/publications/2019/uk-science-and-immigration-why-the-uk-needs-an-internationally-competitive-visa-offer/

[5] RAND Europe (2017), 'International mobility of researchers supplementary report: perspectives from industry', available from https://royalsociety.org/-/media/policy/projects/international-mobility/international-researcher-mobility-industry.pdf

[6] Early Career Researchers (ECR) Central available at https://ecrcentral.org/fundings

These issues are compounded by a broken full economic costings (FEC) model. Many public and non-profit research organisations, as defined by the Royal Society[7], suffer from a lack of core support, equivalent to quality-related (QR) funding for universities, to cover the full costs of research.

2) Narrow incentives

The formula used to allocate QR funding incentivises institutions to recruit principal investigators (PIs) and others with peer reviewed publications who can be submitted to the Research Excellence Framework (REF). There are few incentives to recruit individuals on open-ended technical or research associate contracts or at the interface of academia and industry, even though such people are essential for a high performing ecosystem for discovery, innovation, and teaching and learning. At £230 million, Research England's block grant allocation for higher education knowledge exchange activity represents just 13% of the total allocated annually through QR (£1.776 billion)[8]. The REF also perpetuates the need to publish and win more grants, causing stress and short-termism.

3) Inadequate access to infrastructure

Researchers in universities often lack the core facilities and technical support available within institutes. Some initiatives exist to address the problem – for example, Research Innovation Scotland facilitates multidisciplinary research pools, networking, and equipment sharing across the higher education and research sector – but more needs to be done to facilitate shared use of high value infrastructure across regions and nations. Beyond this, overheads on grants and QR should be ringfenced for infrastructure. At present university managers have little to no incentive to ensure adequate infrastructure to support internationally competitive research.

4) Interdisciplinarity

Current mechanisms for reward and recognition (see 2 above) discourage team science across disciplinary boundaries. Interdisciplinarity initiatives, where they exist, can be seen as box ticking with descriptions of who counts in what discipline. Interdisciplinarity is not a goal in itself but a means to meet the biggest challenges as a source of discovery and innovation. UKRI has not yet solved the problem of funding interdisciplinary science that falls between research councils but should address this as a priority.

5) Translation and industry collaboration

Links and movement between discovery research and translational, applied, and mission-driven research need to be better promoted and incentivised. Intersectoral mobility supports innovation and is an important tool in increasing the effectiveness of research[9]. The Dowling Review in 2015[10] found that the UK lags behind countries such as Germany and the USA on this measure, and though efforts have been made more recently to bring about changes to research culture, the lack of porosity between industry and academia remains a significant challenge. More should also be done to address the current shortage of scientists in the civil service, government and parliament to strengthen scrutiny and decision-making.

6) Absence of an international RDI strategy

The UK's success as a leading science nation depends on being open to the rest of the world. As well as maintaining a strong scientific relationship with the EU through association to Horizon Europe and other programme commitments in the Trade and Cooperation Agreement, the UK must broaden the range of instruments for collaboration with countries elsewhere and deploy these strategically alongside existing

---

[7] Royal Society (2020), 'The role of public and non-profit research organisations in the UK research and innovation landscape', available from https://royalsociety.org/topics-policy/publications/2020/uk-research-organisations/
[8] Research England (2020), 'Research and knowledge exchange funding for 2020-21', available from https://re.ukri.org/sector-guidance/publications/research-and-knowledge-exchange-funding-2020-21/
[9] Technopolis (2019), 'Analysis of intersectoral mobility', available from https://www.technopolis-group.com/wpcontent/uploads/2020/06/SSF_Intersectoral-Mobility_Final-Report-191002.pdf
[10] Dowling Review (2015), 'Business-university research collaborations: final report', available from https://www.gov.uk/government/publications/business-university-research-collaborations-dowling-review-final-report

multilateral, bilateral, national and regional mechanisms. An international strategy is needed to maximise the coherence and impact of the UK's RDI collaborations through individuals, teams and organisations.

7) Supporting excellence and growing RDI capacity outside the Golden Triangle

Finally, the UK lacks a sufficient portfolio of place-based investments aimed at improving regional productivity and addressing spatial disparity in the UK's absorptive capacity for research and innovation. Successor funding to European Structural and Investment Funds (ESIF) is needed to continue growing capacity across the UK. As part of the levelling-up agenda, the government should articulate a clear role for RDI in creating opportunity in regions that lag behind on productivity, innovation and skills, without setting an agenda that risks or 'levels down' established and globally successful innovation economies in London and the Greater South East.

Annex: International examples and the role of the National Academies

The following reflections were provided by Royal Society Fellows who provided input to this submission.

Examples from other countries

Some of the best research in Germany is being done in institutes or in university centres of excellence that have a critical mass of PIs in related areas and excellent research facilities. Max Planck Institutes and the Fraunhofer network are strong and internationally regarded, while the Leibniz Association 'connects 97 independent research institutions that range in focus from natural, engineering and environmental sciences to economics, spatial and social sciences and the humanities'[11].

In addition to Germany, Taiwan's Industrial Technology Research Institute is central to Taiwan's transition from a middle-income country focused on mid-level exports such as textiles and bicycles to a leader in ICT hardware[12,13]. SIMTech in Singapore is another example[14,15]. Regionally focused institutes elsewhere include the Kosetsushi Centres in Japan[16], and the Manufacturing USA centres[17]. There is also much to learn from Scandinavia, including VTT in Finland[18] and RISE in Sweden[19].

Role of the National Academies in the organisational landscape

Through their independence and convening power, National Academies can get people who need to talk to each other (literally) into the same room. This might include politicians with PhD students, key regional players with each other, and so on. Academies can set the tone for research culture, and through their wide web of contacts, spot issues with the science system as they emerge and press them with government on behalf of the whole system. By supporting people, the Royal Society URF and Dorothy Hodgkin schemes have benefited UK research hugely—they are now much imitated. The ability of the Academies to provide independent advice to government is crucial, especially now that some of the independence of research councils has been removed. Stronger links between science and humanities academies will be increasingly important to help address complex scientific challenges like climate change mitigation and artificial intelligence.

---

[11] Research in Germany available at https://www.research-in-germany.org/en/research-landscape/research-institutes.html
[12] Industrial Technology Research Institute (ITRI) available at https://www.itri.org.tw/english/index.aspx
[13] UK Science and Innovation Network (2020), 'SIN snapshot: Taiwan', available from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918533/SIN_Taiwan_snapshot_Sept_2020_final.pdf
[14] Singapore Institute of Manufacturing Technology (SIMTech), available at https://www.a-star.edu.sg/simtech
[15] Ministry of Trade and Industry Singapore (2019), 'Returns to research and development (R&D) among firms in Singapore', available from https://www.mti.gov.sg/Resources/feature-articles/2019/Returns-to-Research-and-Development-R-n-D-Among-Firms-in-Singapore
[16] Nobuya Fukugawa (2016), 'Knowledge creation and dissemination by Kosetsushi in sectoral innovation systems: insights from patent data', Scientometrics, Volume 109, Issue 3, available from https://dl.acm.org/doi/abs/10.1007/s11192-016-2124-x
[17] Manufacturing USA available at https://www.manufacturingusa.com/institutes
[18] VTT available at https://www.vttresearch.com/en
[19] RISE Research Institutes of Sweden available at https://www.ri.se/en