Delivering a UK Science and Technology Strategy (March 2022)

Background:

The Physiological Society (The Society) is Europe's largest network of physiologists, at the forefront of science for 145 years. Physiology is the science of life, and research in physiology helps us to understand how the body works in health, what goes wrong in disease, and how it responds and adapts to the challenges of everyday life. The Society's membership is made up of researchers in all of these areas, from neuroscience through to endocrinology, nutrition and sport and exercise science with the science ranging from the mechanistic to the applied, from molecular to whole body.

The House of Lord's Science and Technology Committee conducted an inquiry into the Government's plans to deliver a UK science and technology strategy. The Committee has issued a call for written evidence about what such a strategy should look like and how the UK's research and innovation system can deliver it. The Society's response to the inquiry is based on our reports *Future of Interdisciplinary Research Beyond REF 2021* and *Translating UK Knowledge and Research into Impact* published in this area.

Consultation response:

What would it mean for the UK to be a "science superpower?"

What measures should determine whether the UK has become a "science superpower"?

Measures for determining whether the UK has become a 'science superpower' should combine both input and output metrics.

On input metrics, the Government has a target for total R&D investment to reach 2.4% of GDP by 2027 and the Chancellor's announcement in the 2021 Comprehensive Spending Review of £20bn of public spending on this area is to be welcomed. It should be noted however, that the 2.4% target by 2027 addresses historic underspend over a number of decades and only brings the UK to just below the OECD average for equivalent expenditure. To really consider itself to have achieved 'science superpower' status, the UK should commit to spending 3% as a proportion of GDP by 2030 which would put it in the top 10 countries of R&D spend as a proportion of GDP globally.

Similarly, there is a risk that increased R&D spend reinforces current concentrations of research funding in London and the South East of England. Innovation needs to happen right across the UK, not just in certain historically successful regions of the UK. The Golden Triangle will undoubtedly remain hugely significant in UK R&D given its long-standing history as a centre for business and academic excellence. The South-East is connected by six of the top 20 busiest airports in the UK (including four of the top five) and receives a significantly large amount of infrastructure spend.

As a result, while short-term investment in London and the South-East of England is highly attractive, other regions of the UK have both short and long-term benefits for investors, for example, project costs are often lower outside the 'Golden Triangle'. It is right that R&D supports excellence in science but this should apply equally to excellence both within, and outside, the 'Golden Triangle'.

On output metrics, the UK should look to current measures of higher education output to assess its 'science superpower' status. These output metrics include assessment of research outputs through the Research Excellence Framework (REF) (and its successor); increases in private R&D investment and improvements in KE through the HEB-CI survey and Knowledge Exchange Framework (KEF).

More broadly, the UK could also re-examine a mission-led approach to 'science superpower' status, using clearly defined aspirations and targets so that the research community knows how the Government would like to see 'superpower' status achieved and in what areas. 'Net Zero' is one example of this that the UK is already using cross-departmentally. Healthy ageing would be another powerful example, given its potential impact on policy areas such as employment, health and social care, taxation and spending and education and skills.

What could be done to ensure that the Government's science and technology strategy is long-term and pursued across administrations? What have been the consequences of a frequently changing science policy?

Despite changing nomenclature and targets, the UK Government's science and technology strategy has been broadly consistent since the 2017 *Industrial Strategy*, born of a recognition of the need to:

a) Address long-term health, climate and energy challenges

b) Build on the existing strengths of the UK's innovation landscape

c) Close the regional inequality gap that exists between the 'Golden Triangle' and the rest of the UK

d) Define the benefits of a post-Brexit UK economy

Regardless of administration, these challenges are deep-seated, multiple dimensional and will need to be addressed. The need for solutions to these problems are not denied by the mainstream political parties in any of the four-nations of the United Kingdom, the challenge remains identifying language and approaches which can be consistently applied regardless of the political weather. This is the role of effective science communication from researchers who enjoy unprecedented levels of trust in the post-COVID-19 world.

Are the right structures in place in Government to implement a science and technology strategy?

How should Government coordinate science policy across different departments, with different strategic priorities such as levelling up? What role could the National Science and Technology Council play?

On the issue of coordinated science policy across different departments, the Government's approach to in vivo policy is an insightful one. The Government has recently announced the formation of a policy unit for animals in science based temporarily in the Home Office. It will be the responsibility of the department to develop cross-departmental policies for issues affecting the Home Office, Department for Business, Energy and Industrial Strategy (BEIS), Department for Environment, Food and Rural Affairs (DEFRA) and the Department for Health and Social Care. This is to prevent confusion and contradictions in areas such as animal sentience and ensure that departments do not give conflicting or confusing advice. A similar approach could be taken with the science and technology strategy involving BEIS, the Department for Education and the Treasury to ensure that research funding, higher education policy and R&D incentives are harmonised to meet the 'science superpower' targets.

In order to meet the Government's commitment to 'enable regions right across the UK to realise their potential to drive innovation-led economic growth' and fulfil its objective to 'embed equality, diversity and inclusion at all levels', investment outside the Golden Triangle should be encouraged as a means to identify the most promising research and researchers from across the UK.

What ministerial representation should science and technology have?

With higher education and R&D and innovation separated between two ministerial portfolios and UK Government departments, there is a risk that policies designed to improve R&D culture and innovation could conflict or work at cross purposes. Similarly, both junior ministers are still beholden to the Treasury for funding and a supportive R&D tax credit environment which may run into macro-economic shifts and challenges such as the cost of living crisis.

Does the introduction of a science and technology strategy challenge the Haldane principle and UKRI's commitment to fund outstanding research?

How should the Government balance support for bottom up, curiosity-driven research with support for research focused on its strategic priorities?

In order to maximise knowledge and understanding through research, equal emphasis must be placed on both applied and fundamental research. Ensuring that the R&D pipeline is maintained throughout the innovation cycle will be crucial. Research and innovation rarely follow political timelines and applied knowledge can only be developed by understanding the mechanisms that underpin it.

As the COVID-19 epidemic has demonstrated, the UK must recognise the importance of backing up applied research in the emergency response, with mechanistic research to gain a better and more translational understanding of problems. This is a much more cost-effective approach in the medium to long term and demonstrates the need for a balance between discovery and applied research funding.

Is the UK realising the potential of its research investment?

Do bureaucratic processes hinder research and development in the UK? Are there examples of where these could be removed without compromising oversight?

On animals in research, our members have recently noticed a trend for Home Office Project Licence applications to be approved for a period shorter than the standard of 5 years based on whether funding is in place, or not, for the project. In the cases of which we aware, the PPL has been awarded only for 1 year. The Animals (Scientific Procedures) Act 1986 (ASPA) does not stipulate funding as a condition for holding a PPL.

In the situations where this occurs, researchers could be in a situation where funding is dependent on having a PPL in place, and the PPL approval is dependent on funding, leading to a Catch-22 situation where a researcher has to apply for a PPL which is given only for a short time, then generate preliminary data, and apply for funding by which time the initial PPL may have run out. As funding and PPL applications could both take ~1 year (if successful) to secure, this massively increases the workload and bureaucracy for researchers using and training others in vivo research skills, which are recognised by the APBI as being in short supply in the UK.

This leads to unnecessary delays and bureaucratic waste, particularly for early career researchers. Our concerns are threefold: that this increased barrier and bureaucracy will lead to outsourcing animal research to collaborators in other countries where welfare standards are not as high as the UK; the loss of training in highly sought after research skills, and the loss of researchers to other countries where barriers to research progress are not as high.

Additionally, the serial processing approach of Home Office Project Licences (where local Animal Welfare and Ethical Review Bodies (AWERB) review has to be completed before the Home Office will review licence applications but then Home Office feedback has to be resubmitted to local AWERBs) stifles progress and is present at both application and amendment stage. Some of our members have reported the Home Office quoting 20 working days for a response on often minor amendments such as specific information on materials used.

The Physiological Society also supports the development of clearer guidance to stop bureaucratic creep occurring as a consequence of institutional non-compliance. Some members have reported duplication of PPLs and

amendments in equivalent local paperwork. Members have also reported delays on 'pre-study briefing' (PSB) approval to order animals as a result of the briefing not including certain procedures despite those procedures being covered by PPL protocols.

Overall, in order to address bureaucracy in licence processing and issuing, the Home Officer's Animals in Science Regulation Unit (ASRU) should engage fully with the regulated community to ensure bureaucratic processes are proportionate and fit for purpose.

Additionally, The Physiological Society members have identified the NIH model of funding as an example of a funding model and process that could support the goal of reducing unnecessary research bureaucracy. The NIH funding model includes expert panels, transparent ranking of proposals, clear funding cut-off points, publication of the cut-off and communication to the applicant of the centile in which the proposal sat along with the ability to revise and resubmit in response to reviews, rather than having to make the project 'substantively' different for resubmission.

These processes clearly allow funding in the USA to be more widely spread, not only concentrated in the elite and are not based on applicant track record but on the merit of the project. Provided efforts are made to minimise bias in review and panels, it can also address the known inequalities in funding award for women and underrepresented groups.

Could the bureaucracy reducing principles of the Advanced Research and Invention Agency be extended to other public sector research establishments?

Public funding is needed to develop high-risk, high-reward, fundamental biological research that requires significant financial input and time to be allowed to reach fruition. This will feed new ideas, discoveries and technologies in crucial areas such as health and ageing. There is a huge appetite and need for more discovery research funding in the UK research community.

The distinctive feature of ARIA would be its focus on pursuing innovations with transformative potential, combining high-risk with high-reward. Existing funders must continue to support work on fundamental and applied science, the UK's excellence in which provides the underpinning that will be necessary to make a success of ARIA. For ARIA to be successful and avoid competing with existing funding bodies, it will need to have success criteria and a culture that are distinct from them, such that there is no confusion or overlap about which funder would be appropriate for a particular idea.

How can the Government better incentivise and support interdisciplinary research and innovation?

The role of interdisciplinary research to address research questions posed by global social, economic, ecological and political changes is widely recognised. However, the RDI landscape in the UK often stifles rather than supports interdisciplinary research.

In 2021, The Society explored how the UK could better support interdisciplinary research, with a specific focus on the next iteration of the Research Excellence Framework (REF). We brought together a range of sector organisations including Research England, The Royal Society and Russell Group. The work and recommendations were informed by a representative set of participants drawn from across the research community, these included academics and institutional research leaders, research managers, representatives from funding bodies, publishers and industry. Over time interdisciplinary research can re-shape the RDI landscape creating new fields that build from interdisciplinary origins and combine skills that were previously disparate. Our review identified a number of underpinning issues affecting the RDI landscape for interdisciplinary research related to Government activity, including:

- Longstanding concerns over interdisciplinary research including within national research assessment in the UK (dating back to research assessment exercises in the 1990s).
- A growing imbalance between the significance and pervasiveness of mission- or challenge-led research in the wider funding landscape and the extent to which this is reflected in the discipline-led REF.
- That interdisciplinary research is complex with many sub-types and features that influence the risks researchers face in undertaking it, and our ability to understand and segment issues with greater focus.
- The need for a better understanding of interdisciplinary research and research teams for effective review and assessment.

Building on the wider evidence and perspectives on interdisciplinary research, the report identified a number of recommendations for Government action to improve the RDI landscape for interdisciplinary research in the UK, including:

- Addressing ongoing perceptions of negative impacts on career development for researchers involved in interdisciplinary research. There is a lack of evidence that provides an up-to-date perspective on this.
- The next REF should adopt a structure which explicitly identifies and rewards interdisciplinary research. It should introduce flexibility to allow individuals whose research and outputs straddle discipline-based assessment structures to be returned to multiple units. This recognises the breadth of the research teams in which they operate and the outputs generated from this.

6. What more should be done to encourage private-sector investment in research and development in the UK?

What more could be done to incentivise collaborations between academics and industry? Are there barriers preventing this collaboration that could be removed?

There is no doubt that research and teaching make a huge contribution to society and the economy well beyond the laboratory. The Society welcomed UKRI's *2020-21 Corporate Plan* in which collaboration across disciplines and challenges was emphasised, stating that *'the research and innovation system is complex and multidimensional and must be considered holistically'*.

In order to ensure that the UK is best placed to lead the response to future challenges, now is the time to foster networks between universities, industry and the whole RDI ecosystem. By focusing investment on improving these partnerships, the interdisciplinary networks essential to knowledge exchange will be catalysed to maximise its societal and economic benefit.

In 2021, The Society carried out a research project in partnership with the National Centre for Universities and Business (NCUB) into knowledge exchange activity. The project assessed the impact that physiology makes to knowledge exchange. To this end, it can be said that physiology is a significant contributor to knowledge exchange income for those institutions that provided us data, with an average of 11% knowledge exchange income related to physiology.

The Society has been able to work across the RDI landscape to respond accordingly to address specific areas of opportunities and weakness with respect to physiologists conducting knowledge exchange. We are working in partnership with NCCPE and NCUB to establish a network of physiologist Knowledge Exchange Academic Champions to promote knowledge exchange opportunities. There are also broader lessons for the system as a whole. For example, it was clear from data gathered for this project that institutions having staff in departments with a clear responsibility for knowledge exchange and external impact had a better understanding of both strategy and operational context.

We also recommended that UKRI should foster cross-council translational funding, building on successful schemes such as the Biotechnology and Biological Sciences Research Council's (BBSRC) Follow-on Funding Scheme, the Medical Research Council's (MRC) Biomedical Catalyst, and Innovate UK's Healthy Ageing Trailblazers.

What stage of the pipeline, from innovation to industry, is presenting the most significant problems for commercialising discoveries in the UK?

As part of the *R&D Roadmap*, it is pleasing to see that the Government recognises the existence of the 'valley of death' between early-stage seed funding for commercialisation and more significant investment for research which has returned positive clinical trial data. This is a long-standing problem for researchers endeavouring to commercialise the outputs from their research and the Government should work with researchers to ensure that this is remedied through direct funding being made available or a risk-sharing mechanism for investment with the private sector.

How well does the UK collaborate on research with international partners and what can it learn from other countries?

In which areas of science and technology is collaboration, or negotiating access to existing projects, more appropriate than competition or seeking comparative advantage?

While the Minister's commitment that UK science will not miss out on funding as a result of the UK not participating in Horizon Europe, is welcome, the fact remains that European collaboration is more than the UK's reliance on European funding and more about embedding collaboration and the sharing of ideas and approaches cross-border with other research cultures.

Related reading

Translating Knowledge and Research into Impact: Physiology and knowledge exchange

The Future of Interdisciplinary Research Beyond REF 2021

Sport & Exercise Science Education: Impact on the UK economy