UKRI leaves the starting blocks: the management of government funding of research and innovation

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Chair: Professor The Lord Mair CBE FRS FREng
                    Council Member, The Foundation for Science and Technology

Speakers: Sir Mark Walport FRS FMedSci HonFRSE
                    Chief Executive, UK Research and Innovation (UKRI)
                 Sir Alan Wilson FBA FAcSS FRS
                    Chief Executive, The Alan Turing Institute

Panellists: Kirsten Bound
                    Executive Director of Research Analysis and Policy, Nesta
                 Jonathan Neale
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Sponsors: Association for Innovation, Research and Technology Organisations (AIRTO),
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Audio Files: www.foundation.org.uk

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SIR MARK WALPORT opened by describing the drivers behind the creation of UK Research and Innovation (UKRI) and its new strategy. The world was changing: population growth, rising from 7 to 9 billion over the next 30-40 years; changing demographics, with growing younger populations in Africa, South Asian and South America driving new patterns of migration; the indelible impact of the Anthropocene era on the globe itself, including, for example, the emergent issue of plastics waste. All these presented grand challenges for science and innovation. The world of science itself was also changing with new research tools, big data, an increasing emphasis on interdisciplinarity and the scope for international collaboration all combining to offer the prospect of solutions to those grand challenges.

The world of business was changing. We were in the throes of what was, arguably, the fourth industrial revolution: characterised by the fusion of physical, digital and biological science, the power of data, the blurring of manufacture and services and what was sometimes described as the 'circular economy' in which waste was converted into positive resources. All this had pointed up the need for a new industrial strategy, founded on strong science.

Finally, society was changing in ways which mean that public engagement would be a key issue for UKRI: establishing trustworthiness at a time of increasing mistrust of the establishment and of experts; engaging with the role of social media and the implications of globalisation; and facing into the ethical challenges often posed by science – where 'science meets values'.

UKRI had therefore set itself two high level objectives: delivering economic impact and social prosperity; and an enriched, healthier, more resilient and sustainable society. Everything UKRI delivered had,

in the end, to contribute to one or both of those objectives. They were, however, supported by three other objectives: pushing the frontiers of human knowledge and understanding; creating the best environment for research innovation; and ensuring that UKRI itself was an outstanding organisation.

Sir Mark then outlined (in alphabetical order) nine early priorities for UKRI. The first related to the Industrial Strategy Challenge Fund (ICSF). Six challenges had already been announced against a funding commitment of £725m for a second wave of the ICSF: prospering from the energy revolution; transforming constructions; transforming food production; data and early diagnosis in precision medicine; healthy ageing; and the audience of the future. Pioneer challenges had also been launched on next generation services and quantum technologies; and expressions of interest had just been invited for a third wave of ICSF – calling for industry led consortia to come forward with major industrial and societal challenges.

An 'Infrastructure Roadmap' was being created looking ahead to 2030, based on existing UK infrastructure and future requirements. It would be a collaborative exercise covering all disciplines and key assets supporting research and innovation, including publicly funded and accessible infrastructure supported by UKRI and beyond.

'Innovation and Commercialisation' was clearly a priority for Innovate UK, but not exclusive to that arm of UKRI. It would involve cross cutting funds which spanned research and innovation; navigating the complex knowledge exchange landscape; facilitating collaborative partnerships between business, universities and teachers; and developing business support mechanism and the Catapult network.

Another priority for UKRI was on 'International Collaboration'. A new 'International Research and Innovation Strategy', on which UKRI had worked closely with the Department for Business, Energy and Industrial Strategy (BEIS), would be published shortly. There was a £110m fund for international collaborations; and within UKRI, international strategy and policies (including cross-council activities such as Global Challenges Research Fund (GCRF) and the Newton Fund) would be managed centrally.

'Regional innovation and growth' would be driven by a £115m 'Strength in Places Fund', reflecting the growing importance of the place agenda in the light of the uneven geographical distribution of research and innovation resource within the UK. The aim would be to support regional growth by identifying and supporting areas of emerging R+D strength and to grow the capacity of existing research excellence and high quality innovation in identified areas.

Two further priority areas were the 'Strategic Priorities Fund', and supporting research and 'Research Talent'. The former built on Sir Paul Nurse's vision of a common fund, aimed at supporting high quality strategic R+D priorities which would otherwise have been missed and working with researches and businesses to identify multi and interdisciplinary programmes. The latter would see £300m invested over the next three years in world class talent. This would provide for new cohorts of PHDs and what were being described as 'knowledge transfer partnership positions' with the emphasis was encouraging combinatorial inter-disciplinary research where the whole was greater than sum of its parts.

'Supporting societal impact' was a key priority, emerging from the cross cutting challenges to which he had referred and would cover programmes which had cultural, economic and global impact. There would be a particular focus on health, wellbeing, resilience and security; and UKRI would be working closely with government policy makers in developing programmes in these areas – in fact honouring Lord Haldane's recommendation to this effect while upholding the fundamental principle to which he had given his name.

Finally, UKRI was committed to working towards the Government's target of reaching 2.4% of GDP investment in R and D by 2027 and 3% in the longer term. This would include additional investment of £7bn by 2021/22.

In conclusion, Sir Mark reminded the audience that in January 2016 the Foundation had hosted a debate at which Sir Paul Nurse had presented the findings of his review of Research Councils. The conclusions of the debate had been that UKRI should pursue the benefits of bringing research and innovation together, while retaining the distinctiveness of both parts; that Research Councils must continue to attract high quality leaders; that UKRI's governance should reflect the autonomy of its component parts; and that UKRI should be a strong advocate for research and innovation to Government.

What had UKRI done in response to those challenges? It was delivering the ISCF, bringing researchers and businesses together. Seven executive chairs had been appointed: a mixture of current council CEOs and new high calibre senior leaders in their fields. Its governance struck a balance between

council autonomy for matters within their natural remits and greater strategic co-ordination on cross-cutting matters. And UKRI had successfully advocated for an additional £7bn in research and innovation funding and supported a Government commitment to reach 2.4% of GDP in R and D by 2027 (of which, it was important to recognise, two thirds would need to come from industry).

SIR ALAN WILSON said that UKRI was a key node in a complex UK – indeed international – research ecosystem. He had himself been fortunate to work at most of the kinds of nodes to be found in that ecosystem and that experience was itself a pointer to the range of institutions involved. He had worked as a researcher (which he still was), first in a national institute, and then as a university professor building research teams on research council grants. He had been a founder and director of a spin-out company, a university vice-chancellor, a Chair of a Research Council and most recently and currently, a CEO of a national institute – The Alan Turing Institute. He also chaired a small UCL spin-out supported by Innovate UK.

In all these situations, there had been common questions and challenges: acquiring a knowledge of the current landscape; what to invest resources in; how to build capacity and skills; and how to connect a top-down strategy with the potential creativity of the bottom-up. These were all challenges for UKRI.

Responses to these challenges would require the identification of potential game changers – 'blue sky research, the moon shots – the known unknowns, bearing in mind there were always unknown unknowns. Some game-changers would be rooted in pure science, some in real challenges. It would also involve answering a second kind of question. Where could we 'apply' known knowledge? (Which could be taken as a working definition of 'innovation').

In formulating strategy a systems perspective was nearly always valuable: identifying the system of interest and how it was embedded in other systems - which in turn had the merit of forcing both an interdisciplinary perspective and a focus on the scale at which research was to be conducted. Any system of interest was in fact embedded in a hierarchy of suprasystems and subsystems; and most innovations came in practice from the lower reaches of the hierarchy. Discovery in those reaches could then often be transferred to other domains. For example, computers had been invented as calculating machines but were now ubiquitous in a wide range of systems.

On either of these main dimensions – game-changing research or applied innovation – we had to be concerned with impact. This should include transformative change in disciplines and interdisciplinary coalitions as well as in industry and the public sector. Perhaps, recently, we had been too narrow in our definition of impact.

Formulating these challenges, questions and approaches constituted the groundwork. They had to be addressed at each node in the ecosystem; and then the nodes had to be effectively connected. Finance, for example, had to flow in the direction of the potential game changers and the high impact innovations. Each node, from the individual research upwards to UKRI and beyond had to have a strategy, grounded in experience, horizon scanning and imagination.

There was a long standing view that, expressed in these terms, the ecosystem was not functioning effectively – notably in the respect of transferring research findings into industry and the public sector. Herein lay the challenge for UKRI. It had to have its own strategy, to be open to the 'bottom-up' and to incentivise research councils, Innovate UK, the universities and research institutes – and, far from least, industry – to have a chance of delivering game changers and the path-breaking innovations.

So how could UKRI, and its component elements, build a strategy? On the positive side it should build on existing strengths (the people with track records) and opportunities (for example early career researchers with skills, imagination and ambition).

More negatively, it should seek to find ways of avoiding the conservatism of peer review and the REF. Universities did not always provide the right incentives (partly REF-driven) - insisting on both volume of publication and focusing for purposes of promotion on 'top journals'. This had skewed the motivation of researchers, particularly by neglecting applied research whose outputs did not qualify for the appropriate journals.

Industry also has its own role to play. Where, for example, were the modern equivalents of Bell Labs? How much of the R and D was now being done in start-ups. SMEs, some funded by Innovate UK with the big players relying on purchasing success? There were many excellent examples of industry-university joint working. Could there be many more?

A different strategic discussion which demanded sensitive judgement related to the size distribution of research groups. What should be located at the 'big science' end of the spectrum? There were established

successes, from CERN to SANGER. There were new Institutes like Turing and Diamond – and those being developed like Faraday and Rosalind Franklin. But was the average size of a research group in a university too small? Were there potential 'big science' areas that were not funded as such? (He had long argued that his own research field of 'cities' fell into that category).

Another question related to the value given to different fields of research for public funding. Health, education and justice were all obviously important. But was there a case for applied research nearer to the coal face – whether industry or the public sector?

Finally, should there be radical shifts? In the 1950s, Warren Weaver, the Science Vice-President of the Rockefeller Foundation had argued that systems of interest fell into three categories: simple, disorganised complexity and organised complexity. The first two represented the physical sciences of the time, the third, biology. He switched his funding from physics to biology: a prescient decision. Was there an equivalent diagnosis to be made now?

All of this needed to be connected to the social questions of our time: climate change and sustainability, the future of work and incomes, growing social inequalities together with what Otiline Leyser and her colleagues on the British Academy/Royal Society 'Data Governance' group had called 'human flourishing' (which also connected us to the arts and humanities.) Did this agenda – connecting social questions to the rest of science - demand a Weaver-like shift?

These were questions for UKRI strategy. But in fact, every element of the research ecosystem needed strategic thinking: universities, university departments, Institutes, industry, government departments, through to individual researchers. All this had to be strongly connected to translational and development ecosystems. These were big questions, with no easy answers.

The two panellists then joined the speakers for the discussion period. In her introductory remarks **KIRSTEN BOUND** said that she was excited by the ambition and potential of UKRI. Analysis had shown that the best models of design were those that put a high premium on experimentation, adaption and re-invention. She proposed three areas for bold experimentation that UKRI should explore. The first was to harness the thinking power derivable from the huge pool of data and evidence now available to form a stronger collective intelligence to support smarter decision making – one voice from many brains. She felt the UK was, if anything, behind the curve in capitalising on these methodologies.

Second, there was scope for a genuine revolution in terms of public engagement with science and research. This was an area where the UK had led the field. There was a risk we were falling behind. But NESTA's experience – for example – in the response to their work on microbial resistance – demonstrated a clear public appetite for such engagement. Their polling had also confirmed strong public support for investment in research and innovation; but the evidence showed that the public's priorities for investment might also be different. For example, they supported investment on health, but also wanted priority to be given to education. More dynamic, effective public engagement was the way forward: to support priority setting, to test and inform evidence, and where appropriate to set a higher bar for evidence.

Third, UKRI should be seeking to set an international agenda worthy of a post-Brexit era. There was real scope for forging new international partnerships – towards which the recent agreement with China was an encouraging step.

So for her, experimentation was the key to answering the question of how to design and implement the 'strategic brain': pooling resources from across the current landscape, but combining them in new and exciting ways – not just through technology but engaging the right talent from across the globe.

JONATHAN NEALE said that, speaking from his perspective in the world of applied technology, the challenge for UKRI's external agenda was how to build on the UK's existing strengths by differentiating through research and innovation. Its internal challenge was to make the ecosystem to which Sir Alan had referred more negotiable. In that respect his own company's recent experience had been positive. Working with Innovate UK – and with local institutions – had led to significant investments in advanced technology production in Sheffield and Coventry.

He posed two open questions for UKRI. First, as the UK's relationship with Europe was in the process of changing, what could UKRI hope to achieve, both in terms of future co-operation with European partners and of new opportunities for partnerships with other countries? Second, his own company's positive

experience notwithstanding, the view persisted that some of resource spent on governance was not spent wisely. Feedback from some of the Catapults, for example, suggested that they had encountered obstacles in getting things done. There was always a risk of 'creeping bureaucratisation'. How could UKRI ensure a high level of execution in delivering its programmes – with a strong emphasis on getting things to happen?

DISCUSSION

In the discussion a number of contributors welcomed the emphasis in the presentations on the importance of public engagement. This was not a question necessarily of getting the public involved in the 'how' of research; and caution had to be exercised in relation to the 'wisdom of the crowd'. To get the best research done it was necessary to look for the most imaginative researchers, often the mavericks.

But a revolution in public engagement with science could be energising. It presented opportunities to contribute to 'setting the bar' on funding decisions. It could force a focus on interdisciplinarity, particularly with the social sciences (as had been evidenced in the Foresight programme on cities). It could provide a platform for interpreting science to the public. It could be used to support societal engagement through international collaboration on a global as well as on a national or more local basis, vital given the huge societal impact that innovation would have in every country. It was suggested that UKRI might take learning from some charities as public engagement – and also work through them, recognising that it was by definition at arm's length itself from the public and would not want to replicate or duplicate what they, or indeed governments, were doing in this field.

A further dimension to the issue on public engagement was the need to create understanding that some research and innovation would honourably fail. A misleading impression could be given by media headlines dominated by apparent breakthroughs in science. But this was also a cultural problem within science itself. A negative conclusion to a piece of research could be as significant – and as worthy of recognition – as a positive one. But there were perverse incentives in the system in terms of what found its way into the leading journals for example, which ran counter to that. The speakers' support for mavericks and their structures on the conservatism of peer review, the REF and other mechanisms were specifically welcomed.

There was also the issue of using sound science responsibly. Public debate in recent years had been scarred by politicians, commentators and media outlets giving credence to bad science (for instance in relation to climate change). Moreover science needed to contribute not only to the question of what could be done but, through the social sciences aligned with informed public debate, to what should be done. In the field of artificial intelligence and deep machine learning for example, where systems could be applied to operate in an unfair way, transparency was vital and ethical questions had to be addressed. Evidence reviews had an important part to play here; and UKRI's role in supporting the trustworthiness of research and innovation was endorsed.

It was also suggested that current societal developments – the differential impact of investment in terms of place and the growing societal inequalities which had driven Brexit and similar indications of public disaffection elsewhere in the world – pointed to a missing, ignored audience and to a need for science, as well as government and society more generally, to reach and engage blue collar workers. Examples were given of the evidence of benefits that could be derived from new technologies such as machine learning. The key was to find better ways of communicating the achievements of science to this audience.

In this context, contributors agreed on the importance of supporting regional growth in the UK through investment in research and innovation. This did not mean stripping out investment from existing centres of excellence. It was not either/or. But greater diversity was imperative. There should be no 'no go' areas for scientific excellence. To make that a reality would require radical thinking, looking for a different kind of research. Genuine success stories were emerging, particularly where industry, local authorities and other agencies were collaborating on new initiatives, though it had to be recognised that getting the right talent to some geographies remained a challenge.

There was some discussion about the role of politics in science and innovation. That it was increasingly on the agenda of all political parties was welcomed; and indeed there were issues salient to science which had to be addressed at a political level, such as the affordability of innovation in areas such as health. Equally, science

had a vital role to play in framing issues relevant to the societal and political agenda. But an organisation such as UKRI had to take a longer term view than was consistent with usual political timescales.

That raised the question of whether the current industrial strategy could have a longer life or be more successful than its seven post-war predecessors. It was argued that this was not a binary issue. Benefits had usually been derived from industrial strategies in the past. Certainly the challenges that the industrial strategy was addressing were long term issues – as were UKRI's wider objectives. The response would go a long way to determining what place the UK would have in the world; and the aim was to support a cohort of research and innovation, bound to be disruptive in its effect, to lever change that as far as possible delivered benefits and no harm.

One area where it was argued that government could do more to support both the industrial strategy and to incentivise industry investment in research and innovation was in encouraging risk taking, particularly through support for patient capital. UKRI was not set up to be an investment bank. However, getting small companies to grow into medium sized companies (and not just absorbed by big ones) was certainly an issue for the UK economy and one that needed to be addressed. Smarter procurement was another area where government could act to support small, growing businesses, both in stimulating demand and reducing bid costs.

Other contributors emphasised the importance for UKRI of driving international collaboration and linking its industry partners in the UK to such wider international industry partnerships. There was a risk that a more restrictive approach to international recruitment could have severe consequences for the talent pipeline in the UK. The field of research and innovation and related fields of advanced technology were international, both in reach and it terms of the talent pool. Barriers to bringing that best talent into this country from Europe would be wholly self-defeating.

It would also be important for UKRI to support the efforts to, broaden the diversity of the talent pool within the UK. That meant addressing elements for the research culture in this country – and needed engagement at every level, from national academies, universities and schools through to direct engagement with students and parents.

Other challenges posed to the UKRI were to make the process of innovation less linear and more joined up; to encourage inter-disciplinarity globally (on issues such as climate change) and nationally (where it was suggested that the research councils were doing better on connecting deep speciality interests with other disciplines, but where more progress was needed at university level); and to support a diversity of funding sources, including the dual funding system , which was now embedded in statute.

Perhaps the biggest challenge facing the UKRI was to ensure that the increased funding that research and innovation had been awarded was wisely spent and seen to be so.

Sir Hugh Taylor KCB

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Industrial strategy and statistics

Department of Energy, Innovation and Industrial Strategy
www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

Office of National Statistics - gross domestic expenditure on research and development (GERD)
(Enter GERD in the search box)
www.ons.gov.uk

UKRI:
Arts and Humanities Research Council
www.ahrc.ac.uk

Biotechnology and Biological Sciences Research Council
www.bbsrc.ac.uk

Engineering and Physical Sciences Research Council
www.epsrc.ac.uk

Economic and Social Research Council
www.esrc.ac.uk

Innovate UK
www.gov.uk/government/organisations/innovate-uk

Medical Research Council
www.mrc.ac.uk

Natural Environment Research Council
www.nerc.ac.uk

Research England
https://re.ukri.org/

Science and Technology Facilities Council
www.stfc.ac.uk

UKRI
www.ukri.org

Companies, Research Organisations and Academies:
Association of Innovation, Research and Technology Organisations (AIRTO)
www.airto.co.uk

Academy of Medical Royal Colleges
www.aomrc.org.uk

Academy of Medical Sciences
www.acmedsci.ac.uk

British Academy
www.britac.ac.uk

Building Research Establishment
www.bre.co.uk

Catapult Programme
www.catapult.org.uk

CBI
www.cbi.org.uk

Department for Business, Energy and Industrial Strategy
www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

Department for Education
www.gov.uk/government/organisations/department-for-education

Government Office for Science
www.gov.uk/government/organisations/government-office-for-science

Knowledge Transfer Network
www.ktn-uk.co.uk

Learned Society of Wales
www.learnedsociety.wales

Lloyd's Register Foundation
www.lrfoundation.org.uk

McLaren Technology
www.mclaren.com/technologygroup

National Physical Laboratory (NPL)
www.npl.co.uk

Nesta
www.nesta.org.uk

Royal Academy of Engineering
www.raeng.org.uk

The Royal Society
www.royalsociety.org

The Royal Society of Edinburgh
www.rse.org.uk

The Royal Society of Medicine
www.rsm.ac.uk

Russell Group
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