Scientific Infrastructure

House of Lords Science and Technology Committee

House of Lords Science and Technology Committee inquiry into Scientific Infrastructure

The Royal Academy of Engineering

The Royal Academy of Engineering welcomes the House of Lords Science and Technology Committee's inquiry on Scientific Infrastructure, which covers some very important issues. It would be useful if the committee identified what they consider to constitute the current UK Scientific Infrastructure and how they foresee it changing over the next ten years. This would better focus the inquiry.

It was noted that the questions in the call for written evidence do not cover the issue of skills and the critical inter-dependency of skills and infrastructure. This would be in terms of skills created by the facilities and skills required to develop and manage scientific infrastructure. There was also no reference to 'big data' and its relevance to scientific infrastructure.

1. Current availability and status of scientific infrastructure

1.1. What scientific infrastructure is currently available in the UK, do UK researchers have sufficient access to cutting edge scientific infrastructure and how does this situation compare to that of other countries?

The UK has some good quality scientific infrastructure, but it is spread rather thinly and not shared as fully as it might be. A greater focus on creating Centres of Excellence, linked to international hubs of excellence, would help to promote co-working between Higher Education Institutions, and the sharing of facilities between universities and industry groups. A good example of this is the Francis Crick institute, jointly established between the MRC, the Wellcome Trust, Cancer Research and UCL.

The new 5G Innovation Centre at the University of Surrey, geared towards high speed Mobile Broadband, is an attempt at providing a focus in ICT research. However, similar attempts to focus such activities in the past have dissipated in time after the initial injection because of pressures by the wider community for better access. Thinly spread infrastructure, such as the nanotechnology infrastructure managed by the RDAs in the 1990s, does not tend to have long term value. Funding must be sustainable over a suitable period of time, with excellence dictating the central hub.

The UK is in a similar position to most other countries in that it is not able to have world class facilities in every scientific area and therefore needs to specialise. For example, the UK has very good astronomy facilities and as a result has developed many world class astronomers. Once a thriving scientific community is established it is difficult to divert investment to other, emerging research areas. As a result the UK's areas of strength have been significantly determined by past decisions and developments.

1.2. Is sufficient provision made for operational costs and upgrades to enable best use to be made of the UK's existing scientific infrastructure? Is it used to full capacity; and, if not, what steps could be taken to address this?

The approach of funding capital equipment via the Research Councils may not have fully factored in the necessity for recurrent resource expenditure to ensure the proper utilisation of the equipment. It is obviously crucial that funding is available for maintaining the infrastructure, and providing the expert technical support needed to use it effectively, in addition to the capital investment.

The pull of new science often outweighs the full exploitation of existing facilities. Research Councils need to be business-like, both in extracting the full return from existing facilities before investing in new, and also ensuring that a proper balance is struck between investment in the facilities and research grants for their exploitation. Creating Centres of Excellence would also help in ensuring that the scientific infrastructure in Higher Education Institutions is used to its full capacity. The role of the independent advisory board to maximise benefit to the UK in all such investments is imperative.

1.3. What substantial increases in scale would allow new areas or domains of science to be explored (analogous to Large Hadron Collider and Higgs boson)?

To create facilities at this kind of scale, the UK needs to find better ways of collaborating with Europe. The UK currently seems subscale in many areas in contrast to huge programmes in countries such as USA and China.

Note that the focus of the question need not be restricted to scientific exploration. For the built environment engineering sector, facilities such as large on and off-site automated manufacturing pilot plant (Building Information Modelling to Computer Aided Manufacture - BIM-CAM) could help to support the development of disruptive technologies. The privatisation of the previous national research labs (such as TRRL, Post Office Research Labs, CEGB Research Labs, the National Gas Turbine Establishment and the Railway Technical Centre) represented a loss of large scale R&D facilities that filled the gap between university research and industrial exploitation. There continues to be a gap in facilities to support technologies in TRLs 3-5, which is a barrier to developing potential breakthrough, disruptive technologies.

2. Long-term needs, setting priorities and funding

2.1. What role should the Government play in ensuring that there is an effective long-term strategy for meeting future scientific infrastructure needs?

Research Councils, the national Academies and TSB should work together on a roadmap for the UK's knowledge opportunities and needs, in order to identify gaps and emerging trends which present achievable opportunities for quality research that can create value for the UK. The on-going Research Excellence Framework can be used to identify key assets, human and infrastructure, as the basis to ensure skills are present to maximise the opportunities created.

An important prerequisite for a strategy for research infrastructure is to have a long-term strategy for UK industry, and this is where government can play a specific role. For example if there was a national priority to adopt CCS, or to develop low-head hydro turbines for barrages, this would influence what scientific infrastructure was needed to support the necessary research and development.

In the long term, there is a need for an impartial group to identify areas in which more infrastructure needs to be established based on available skills as well as national future needs. This must be knowledge-economy driven. The EU created a similar scheme via the Flagship programmes.

2.2. What are the long-term needs for scientific infrastructure and how are decisions on priorities for funding usually made?

Priorities for funding are traditionally made by Research Councils according to their strategic plans. The Research Councils have a very challenging task balancing their budgets across a huge science base especially when there is little visibility of long term strategy for national investment and international partnerships. As suggested in the answer to 1.1, funding tends to be attracted to the larger and more successful scientific communities which inevitably are the ones that already have good facilities to exploit (and which require on-going support in terms of expert technicians and equipment maintenance).

Unless long term infrastructure funding is protected in some way, it inevitably competes against more pressing short/medium term needs, and with austerity measures, this has the inevitable impacts on the infrastructure programmes. The timescales for major equipment spend and associated development projects cross the lifetime of a number of parliaments, requiring long term policies agreed across parties, with commitments made and maintained by successive governments wherever possible.

2.3. Is it more important to invest in large, national infrastructure or medium infrastructure?

Scientific progress and discovery are essentially uncertain so it is arguable that it would be better to spread the investment more thinly over a larger (but not too large) number of bets, rather than invest in large infrastructure projects that may not yield useful outcomes. However, large infrastructure does tend to provide opportunities for smaller research groups (as evidenced by Diamond and ISIS) so there is not a clear cut distinction between large and medium infrastructure in terms of the value that they provide.

Research facilities should be spread geographically, to make the most of opportunities outside the “golden triangle” of Oxford, Cambridge and London. The N8 northern belt of universities (Liverpool, Manchester, Lancaster, Leeds, Sheffield, York, Durham and Newcastle) has large numbers of scientific researchers but is sometimes overlooked.

It is important to consider the number of scientists that the investment will support; different facilities might employ different numbers of UK scientists for the same cost. Arguably the maintenance of a large pool of PhD students, postdoctoral and university researchers could be as important for the economy as the science that they are actually undertaking. Whether on a large or medium scale, laboratories of national or regional importance should be provided with up-to-date, quality equipment, matching the quality of international academic competitors.

2.4. Since the last Comprehensive Spending Review, a series of additional announcements have been made on investment in scientific infrastructure. How were the decisions on investment reached and what have been the impacts of this approach to funding scientific infrastructure?

While these tranches of funding were welcome, the short period of time between announcement and deployment made it challenging for Research Councils to ensure that the funding was properly allocated. It is not clear that the spending decisions by government were based on detailed and validated consultation or evidence collection. 'Stop-go' investment is likely to favour established groups which happen to have a list of desired facilities waiting for such opportunities. There must be short-medium and long term investments available to ensure the UK and its knowledge economy stays abreast with international competitors in this fast moving environment.

2.5. What impact has removing capital spend from the ring-fenced budget had on investment in scientific infrastructure and should the ring-fenced science budget be redefined to include an element of capital spend?

Predictability of capacity for research, and the recurrent costs associated with operating scientific infrastructure have suffered as a result of capital falling outside the ring fence. Given that it is a core component of the budget it may be beneficial for it to remain within the ring fence.

2.6. If the current funding level is maintained or reduced, what would be the longer term impacts on scientific infrastructure in the UK?

If funding levels remain flat or are reduced, the UK would fall behind our rapidly developing international competitors, and lose a significant number of UK researchers as they sought to work in better-found labs abroad.

3. Governance structures

3.1. Does the UK have effective governance structures covering investment in scientific infrastructure, how do they compare to those of other countries, and are there alternatives which would better enable long-term planning and decision-making?

Governance structures could be improved by greater interaction with the private sector and industry to support partnerships with both large and small companies where they add value. Whilst freedom to innovate should be maintained all major facilities should have impact statements.

3.2. Are effective and fair arrangements in place for access and charging for public and private scientific infrastructure?

Access is generally good but there needs to be better data sharing between infrastructures. Charges are usually reasonable and it is important that fees are not raised without wider consideration of impact on the full range of users, including SMEs, who make use of facilities.

3.3. Are effective structures in place for funding of medium-sized scientific infrastructure and enabling sharing among Higher Education Institutes and Research Institutes?

Not currently. Such joint funding could be encouraged by funding joint Centres of Excellence across Higher Education Institutions.

3.4. Are regional research alliances proving effective in enabling access to funding for medium-sized infrastructure? Should more be done to support or incentivise approaches to collaborative funding and sharing of medium-sized infrastructure?

The rise and fall of the RDAs and the periodic nature of the strategic equipment awards from the Research councils have not been helpful for medium sized infrastructure. As mentioned above, the N8 can sometimes struggle to compete with Oxbridge and London.

It is obviously sensible to have regional facilities available to the science base and industry, but some level of national co-ordination would be beneficial. It is important to have clarity on the role of National Labs such as NNL and NPL and their funding sources.

The Catapult centres do seem to be a positive initiative in terms of building networks of medium-sized infrastructure. The advanced manufacturing catapult for example brings together a number of regional developments in Sheffield, Manchester, Bristol, Glasgow and Coventry.

4. Partnerships

4.1. To what extent do funding structures in the UK help or hinder involvement in EU and international projects, and should the level of UK involvement be improved?

EU funding is used effectively by many UK universities, but there would be benefit in finding better ways to partner with the EU on major infrastructure projects. It might further promote the leverage of national research funding if RCUK was more deeply engaged in Europe as a hub for identifying and developing research consortia. This could combine with UKTI inputs to muster industrial collaboration.

The test for whether funding structures in the UK help with involvement in the EU is whether the UK is able to participate in its chosen collaborations and whether our influence and contribution in those collaborations is proportionate to our subscription. Generally the UK has been able to engage in the desired collaborations and the UK influence and scientific contribution has almost always been greater than its proportionate subscription.

4.2. To what extent are EU and international programmes effective in promoting collaborative investment in scientific infrastructure projects?

For large programmes like JET, international collaborations have been essential to providing investment in infrastructure. International programmes can also have the ‘side effect’ of encouraging trade and better EU understanding. Better partnering, data sharing and infrastructure linkage with EU programmes by the Research Councils would be valuable.

4.3. What impact does publicly funded scientific infrastructure have in terms of supporting innovation and stimulating the UK’s economy?

The existence of a vibrant UK based scientific community is an essential ingredient for high tech and medium tech businesses to thrive and to encourage overseas companies to base themselves in the UK. Publicly funded facilities can create step-change capability and access to new business opportunities (e.g. the Diamond Light Source).

4.4. How accessible is publicly funded scientific infrastructure in the UK to industry and small and medium sized enterprises? Is there room for improvement?

Improvement could come from regional co-creation centres where SMEs and larger industry can work with academic collaborators, with acknowledgement through the REF or other measures of the value of these collaborations.