Setting science and technology research funding priorities

Response from:

- The Royal Academy of Engineering
- The Institution of Chemical Engineers
- The Institution of Civil Engineers
- The Institution of Engineering and Technology
- The Institution of Mechanical Engineers
- Engineering Council UK
- ETB

House of Lords Science and Technology Select Committee

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The Royal Academy of Engineering, the Institution of Chemical Engineers, the Institution of Civil Engineers, the Institution of Engineering and Technology, the Institution of Mechanical Engineers, Engineering Council UK and ETB are pleased to submit a joint response to the House of Lords Science and Technology Select Committee inquiry into 'Setting science and technology research funding priorities'.

The response was formulated by consulting with experts in the field representing the membership of all the organisations listed above as well as building on the organisations' previously expressed policy positions. It approaches the Committee's questions from the point of view of the professional engineering community and, accordingly, concentrates on engineering research in particular and more applied research in general.

1. Introduction

1.1. There has been significant debate during 2009 over the potential impact of recession and the scale of public spending on stimulating the economy on the science budget in future years. In addition, there have been a number of high profile political speeches pointing towards a Government desire to see more economic benefit from research spending.

1.2. This response to the Committee's call for evidence is based partly on work that the Royal Academy of Engineering carried out in partnership with the Royal Society and the British Academy, precipitated by Lord Drayson's speech to the Foundation for Science and Technology on 4th February.

1.3. A speech by Rt Hon John Denham, MP, Secretary of State (DIUS), at the Royal Academy of Engineering on 19th February built on Lord Drayson's speech by catalysing a debate about the balance of investment in science and innovation to favour those areas in which the UK has a clear competitive advantage. The Secretary of State also defined the nature of the debate as not whether a balance should be sought but how it should be achieved. The Prime Minister contributed to the debate with his Romanes Lecture in Oxford on 27 February, emphasising an increasingly economic role of scientific research as well as its potential contribution to tackling and mitigating climate change.

1.4. There appears to be a strengthening of the long-standing desire by Ministers to take advantage of a decade of investment in the science base by encouraging the commercialisation of the scientific ideas and concepts produced by it. All these political speeches to date on the subject have stressed that this vision is about reaping the benefits of research already funded and that the commitment to curiosity-driven research funding remains unaffected.

1.5. We believe that there will always be serendipitous economic benefit from some blue sky research conducted primarily for the purpose of the pursuit of knowledge and it is important to ensure that curiosity driven research remains healthy and attractive to new entrants. However, the scale of the challenges we face as a society and economy calls for much closer alignment of research with clear objectives and better processes for creating products and services from ideas. In general, there is a continuing funding gap from the point where research ideas move out of universities through to their becoming commercially-ready technologies that industry sees as sufficiently developed to take on. Translational research bridges the gap between pure research and applied research and much has been achieved to improve this transition, particularly in the biomedical fields. However, the bridge between applied research and commercially exploitable products and services remains weak. The same applies to research which supports existing UK industrial strengths.

1.6. Publicly funded research forms the basis of a particular innovation pathway and its success, or otherwise, should therefore be examined in the wider context of the UK's success in generating wealth from scientific research. One of the biggest obstacles to getting innovation moving 'up the chain' is the way the stock exchange and investment community behave with small and medium size technology companies in the UK. In the USA, where small companies routinely grow into big companies, this happens because of a

more tolerant and supportive investment philosophy (coupled with easier flow of funds and Government support through schemes such as SBRI). This has never been the case in the UK and even Vice Chancellors are focused on relatively short-term investments with IPO or trade-sale. Similarly, there can be a mismatch between the timescales in which investors require a return and the development period needed for the product whereas more US investors are prepared to taker a longer view These factors are probably a bigger issue than the university technology transfer gap which, in recent years, has improved greatly with the help of funds such as HEIF and the TSB schemes.

1.7. While our comments make generic points it is also important to note that innovation models can differ between engineering sectors. If Government's overarching goal is to improve UK economic performance as part of an active industrial strategy which includes a strong connection with scientific research strategy, policy needs to be flexible enough to reflect these differences.

2. What is the overall objective of publicly-funded science and technology research?

2.1. The long-term overall objective should be to generate wealth and enhance the quality of life in the UK but the benefits should not be exclusively for the UK.

2.2. In order to achieve this long-term objective, there is a need to ensure that the vibrancy of the research base is maintained, that the pipeline of researchers can deliver the numbers and skills required and that world class research activities attract inward investment from international technology companies. As well as ensuring the supply and quality of researchers, it is the quality of the intellectual infrastructure within our universities and infrastructure that encourages international companies to wish to take advantage of it.

3. How are public funds for science and technology research allocated? Who is involved at each level and what principles apply? Where appropriate, is the Haldane Principle being upheld?

3.1. There should be at least two ways of allocating funds: a formula-driven allocation and a competition-driven allocation. The former is history orientated and provides for a stable research base which allows the free exploration of ideas. The latter funds specific projects which may be proposed in a response mode or as a result of managed programmes. Independent (i.e. non-governmental) Higher Education Funding Councils and Research Councils are best placed to administer both types of allocation.

3.2. There are many and varied interpretations of the Haldane Principle and these were exposed in the recent House of Commons IUSS Select Committee report "Putting Science and Engineering at the Heart of Government Policy"[1]. All strict interpretations of the Haldane Principle, including the currently accepted interpretation from the 1993 OST White Paper "Realising Our Potential"[2], task research councils with day to day

[1] http://www.publications.parliament.uk/pa/cm200809/cmselect/cmdius/168/168i.pdf

[2] Department of Trade and Industry, *Realising Our Potential: A Strategy for Science, Engineering and Technology*,

decisions on the scientific merit of different strategies and projects, but give a higher, overarching strategic role for government. Therefore, it can be argued that it is in fact observed.

3.3. In practice, the line between where government overarching strategy and research council decisions meet is ill defined and can lead to valid criticisms that the Haldane Principle is not always observed in spirit. Government priorities reflected in an overarching strategy will, inevitably, favour areas of research or inquiry that chime more strongly with those priorities and there is nothing wrong with this, provided Government is open and takes responsibility for its directions. While there is stability, this may not present a problem either for government or researchers, however, political priorities are likely to change on a faster timescale than academic research priorities.

4. Are existing objectives and mechanisms for the allocation of public funds for research appropriate? If not, what changes are necessary?

4.1. The current system of funding research with some imposition of research themes appears to be fit for purpose, but there is no structured mechanism for feedback. The Research Councils are required to fund research which contributes to UK competitiveness and quality of life and while impact is assessed and reported on, particularly in the periodical international reviews of research sectors commissioned by Research Councils, there seems to be little assessment as to whether these are more likely to be achieved sponsoring research in, say chemistry than computer science. The establishment of priority research areas for the Research Councils in areas such as energy and living with environmental change are useful in supporting the general challenges of wider Government policy.

4.2. The mechanisms by which research funding is directed through the Research Councils to individual researchers or groups and the top-down imposition of research priorities work well and have the confidence of most researchers. However, some feel that the Research Assessment Exercise, administered by HEFCE to allocate block grant to universities in support of research infrastructure, has a strong distorting effect on the range and types of research carried out in the UK. It is asserted that this is because it is a competitive system between universities and could discourage collaboration between institutions even though collaboration is often sought and rewarded by the Research Councils and Regional Development Agencies. The replacement Research Excellence Framework will seek to address some of these perverse incentives, however, whatever system is ultimately put in place, universities will naturally attempt to maximise their funding by tailoring what they are assessed on to match assessment criteria.

4.3. The competitive ‘call for proposals’ method is often useful but there are some instances where another method would be more suitable for use by research councils or TSB. For example, it should be possible to agree to co-fund company or university work where the company has already selected its preferred partner; or to scope out centrally what’s required and then go and commission/implement it, systematically, on the basis of an objective analysis of who is best placed to conduct the work.

May 1993, Cm 2250

5. **What governs the allocation of funding for Government policy-directed research through Government departmental and agency initiatives? Are existing mechanisms appropriate? What is the role of Departmental Chief Scientific Advisors?**

5.1. It seems appropriate that government departments should have budgets allocated to funding research addressed at specific policy issues within their portfolios. As the requirement in these cases is often assessments of existing knowledge, evidence and best practice designed to fill knowledge gaps in the understanding of individual departments and the maintenance of longitudinal surveys, government departments have been known to rely on consultants rather than engaging with the academic community.

5.2. The needs of individual departments for research differ greatly from department to department with some, such as the MoD, spending significantly more on research than others. The objectives also differ from research funded through the research councils and where research is commissioned to answer specific questions, the commissioning mechanisms are adequate. However, there is evidence that the level of technical understanding among the civil servants responsible for framing and commissioning departmentally sponsored research is generally low, leading to over-reliance on consultancies and a lack of critical judgement of the work delivered.

5.3. Coordination of science and technology research across HMG is one of the roles of the Government Chief Scientific Advisor (GCSA) and the Departmental Chief Scientific Advisors (CSAs), and is one of their priorities. The role and influence of Chief Scientific Advisors within departments is still evolving, faster in some departments than others. As yet, CSAs do not generally have effective control of departmental research budgets but do have the role of advising on the effectiveness and use of the research advice sought.

6. **Is the balance of Government funding for targeted versus response-mode research appropriate? What mechanisms are required to ensure that an appropriate and flexible balance is achieved? Should the funding of science and technology research be protected within the Research Councils or Government departments? How will the current economic climate change the way that funds are allocated in the future?**

6.1. The arguments about the balance of targeted versus response-mode research are often polarised, particularly when funds are tight. Arguably, the focus should be on research that addresses priority areas provided that those areas have been correctly identified. Priority areas can be funded through response-mode and managed programmes and in an ideal world, the two funding mechanisms should attract equal attention from researchers. The opportunity to support curiosity driven research that addresses the general themes of targeted programmes should not be ignored. It should be noted, however, that response-mode panel success rates are often less than 10% while some managed mode programmes have success rates in excess of 70%, indicating a general imbalance between the two modes. Whether this is a supply and demand side issue or an administrative issue is not clear.

7. How is publicly-funded science and technology research aligned and co-ordinated with non-publicly funded research (for example, industrial and charitable research collaborations)? How can industry be encouraged to participate in research efforts seeking to answer societal needs?

7.1. In the area of pre-commercial technologies, there are two forces at work. Researchers in universities are keen to push their technologies out of the lab and into the commercial world where they can become or contribute to commercial products. At the same time, commercial companies are looking for emergent technologies to fulfil particular needs. It is an area where solutions looking for problems and problems looking for solutions could be better managed to converge productively. Companies will not invest in ideas for which there is no market or the timing is not right.

7.2. If research with application to perceived societal needs is to be taken up by industry, research priorities need be made with a much broader understanding of how industry makes its investment decisions. There would be significant value in the establishment of an office of technology assessment, drawing on the expertise in Government departments, the TSB and other bodies and industry to promote understanding of and provide advice and support for the productivity of UK based research and development activity. It would be important that this function were at the core of the responsible department so that its expertise is fully embedded in the policy-making process.

7.3. Official statistics show a real terms increase in industrial R&D expenditure in manufacturing 1999-2007[3]. However, within that there were significant decreases in 'electricity, gas and water supply' and associated 'electrical machinery', as well as 'transport equipment'. There are concerns where issues associated with climate change might be expected to have some impact, indeed urgency. There are areas where regulations would have some influence, and indeed Ofgem have taken some action to encourage R&D expenditure, although it is unclear whether it has been effective. On the other hand, Ofwat seems to have ignored calls for action in their latest regulatory review despite responses to their consultation "setting Price Limits for 2010-15" from ICE and others arguing strongly for the regulator to allow increased R&D spending in the sector.

7.4. Industry, by and large, is well focused on the technologies it needs and wants to pull through. Academics, however, are less focused on the potential commercial uses of their discoveries. Efforts to improve the alignment of research priorities and industry needs therefore need to be fully informed by the industries and business sectors which seek to make use of and commercialise the fruits of academic research. Closer communication between stakeholders will help the alignment and coordination of the different research programmes. Better tax incentives could encourage greater industrial participation in research.

7.5. The Research Councils are engaging with industry and the professions to inform their strategy. However, it is too soon to assess the fruits of this and in the case of civil engineering it has revealed how difficult it is to produce a simple match between disciplines and expenditure; EPSRC's definition of

[3] Expenditure on R&D Performed in UK Businesses: Broad Product Groups, 1999 to 2007. Published by the Office of National Statistics

civil engineering is effectively structural and geotechnical engineering, although it is often funding research in a cross-disciplinary way, for example, by its Sustainable Urban Environments (SUE) programme. This multidisciplinary research has a significant relevance for civil engineering practitioners, and has led to successful industry-academic collaboration, but is not captured well by the sectorally driven definitions.

7.6. The 2008 EPSRC Review of the UK materials research base witnessed some excellent examples of collaboration between academics and industry[4]. The report raised concerns that closeness of university research to industrial interests led to short term economic advantage but at the expense of universities being able to sustain longer term innovation at a time when globalisation is restricting the ability of businesses to do that. This created a paradox, which was best addressed by a university research portfolio that was balanced.

8. To what extent should publicly-funded science and technology research be focused on areas of potential economic importance? How should these areas be identified?

8.1. Economic impact is not the only kind of impact that publicly-funded science and technology research should generate. Beneficial social and environmental impacts are also of value and, indeed, are already acknowledged in the assessments which are now being made by the Research Councils, in agreement with the Treasury.

8.2. It is notoriously difficult to identify the potential impact of speculative, blue-sky scientific research carried out with the primary aim of the pursuit of knowledge. As research in particular areas or sectors becomes more applied, the potential uses of those discoveries become more apparent.

8.3. Areas of true economic potential become apparent from addressing a perceived need for a better or more efficient process or product and scientific ideas are then brought together once the problem has been defined. Business and industry are usually well equipped to identify and exploit such areas of potential economic impact for their own purposes. It therefore seems appropriate that areas of research with potential economic benefit should be identified by government in partnership with industry. However, some of the biggest economic impact areas are in the public sector or societal such as transport, defence, climate change and Government must have a role in identifying these.

8.4. In evidence gathered by the Stern Review the stark collapse in R&D funding (10 fold in the UK over 25 years) in the energy sector led to calls for a major ramping up of expenditure to address issues of climate change. Issues to do with differential in incentivisation to address differences in maturity of technologies, e.g., onshore / offshore wind were raised, but have yet to be addressed. The scale of output of necessary low carbon technologies (20 fold) requires an advanced skills base currently lacking.

8.5. However, in cases where the financial risk of investing in research outweighs the potential returns, mechanisms must be available for government to reduce risks through public funding. Mechanisms by which to

[4] International Perceptions of the UK Materials Research Base. Engineering and Physical Sciences Research Council 2008

achieve this de-risking are numerous and include the work of the TSB and various methods of supporting company R&D though UKTI programmes.