

RESEARCH COUNCILS UK INPUT TO THE CONSERVATIVE PARTY TASK FORCE ON STEM – JULY 2006

The UK Research Councils

1. Research Councils are the public bodies charged with investing tax payer's money in science and research in the UK in order to advance knowledge and generate new ideas which can be used to create wealth and drive improvements in quality of life. There are eight UK Research Councils with a combined budget of £2.2billion (2005-06). The Research Councils are the:

Arts and Humanities Research Council (AHRC)
Biotechnology and Biological Sciences Research Council (BBSRC)
Council for the Central Laboratory of the Research Councils (CCLRC)
Engineering and Physical Sciences Research Council (EPSRC)
Economic and Social Research Council (ESRC)
Medical Research Council (MRC)
Natural Environment Research Council (NERC)
Particle Physics and Astronomy Research Council (PPARC)

2. Seven of the Research Councils:
 - fund excellent basic, strategic and applied research
 - support research training and career development (PhDs and masters students and post-doctoral fellows)
 - fund activities to promote knowledge transfer and provide services and trained scientists and researchers, which contributes to economic competitiveness, the effectiveness of public services and policy, and quality of life in the UK
 - support public engagement and dialogue activities
3. The CCLRC has a different role, managing a number of large, international research facilities based in the UK as well as providing strategic advice to Government on the development of large-scale research facilities. The Government is currently consulting on plans to merge CCLRC and PPARC to create a Large Facilities Research Council.
4. Collectively the Research Councils support approximately 10,000 researchers and 14,000 postgraduate students in UK universities and in their own Research Institutes.
5. Research Councils UK (RCUK) is a strategic partnership between the eight Research Councils. RCUK was established in 2002 to enable the Councils to work together more effectively to enhance the overall impact and effectiveness of their research, training and innovation activities, contributing to the delivery of the Government's objectives for science and innovation.
6. Further information about the work of the Research Councils is appended:

Annex A: The Research Councils' role in funding research
Annex B: The Research Councils' contribution to the UK
7. The sections below outline the collective views of the Research Councils on the themes raised by the Task Force on STEM.

The scope of a national strategy for STEM

8. The UK has an international reputation for outstanding scientific and technical discovery. This reputation is built on the UK's R&D capacity - excellent skilled people, state of the art facilities and laboratories and a supportive regulatory and research funding environment. A national strategy for STEM would need to encompass each of these elements.
9. Although the Task Force is looking specifically at STEM, the Research Councils would like to emphasise the importance of considering the UK research base in its entirety. This is important because:
 - end users of research increasingly want real world, interdisciplinary solutions to complex research challenges e.g. in tackling issues around ageing or energy policy;
 - there is real potential for groundbreaking advances at the boundaries of traditional disciplines, including between STEM subjects and the social and economic sciences, arts and humanities e.g. developing our understanding of brain function;
 - growth sectors of the UK economy such as the service sector and particularly the creative industries (one of the fastest growing sectors contributing over £56 billion to the UK in 2003, accounting for 8% of GDP) are increasingly drawing on research in non-STEM subjects.

The relative importance of applied science and blue skies research

10. The research community increasingly finds the distinction between "applied" and "basic" (or blue skies) research to be an artificial one, since new and emerging areas of science and research contain elements of both what might traditionally have been labelled basic or applied. The term "frontier" research is preferred as a way of better capturing the research endeavour. One activity at this frontier, which the Research Councils are actively encouraging, is "translational" research where the aim is to stimulate the transfer of new research discoveries into application and where the reciprocal sparking of new research ideas feeds back from practical experience.
11. Successive studies have shown that the UK's economic competitiveness is underpinned by a spectrum of research which ranges from what can be termed basic, or curiosity driven research to strategic and user driven research that is directly targeted at specific business need or social and economic issues. Maintaining this spread of investment is essential - speculative and novel research provides the ideas and knowledge on which more applied investments can be made to generate new goods, services or policy or cultural benefits. The view from the majority of the business community representatives who advise and work with the Research Councils is that what they value about the UK research base are its broad range of expert knowledge and its highly skilled people - elements that underpin rather than replicate their own R&D activities. Similar views are expressed by many of the major companies cited in the Council for Industry and Higher Education's recent report on "International Competitiveness" (May 2006).
12. In a healthy research base the relative importance of different goals and priorities, and the levels of support provided, will ebb and flow over time in response to new knowledge, technological challenges and new strategic economic and social needs. The key to success is to ensure that the UK research base has sufficient agility and incentives to capitalise on new knowledge, technologies and socio-economic

priorities, whilst retaining strength and expertise in core areas and those of strategic importance.

13. It is the role of the Research Councils to fund and support a balanced portfolio of research activities in this dynamic environment, working in partnership with other funders including the HEI Funding Councils of England, Wales, Scotland and Northern Ireland, the Technology Strategy Board and the research charities. In so doing, the Research Councils tension a number of research, training and knowledge transfer objectives, including: enabling the very best researchers to pursue innovative research ideas; nurturing new areas of research (particularly in the areas between traditional disciplines); sustaining the incremental progression of knowledge within established areas; stimulating collaborations and partnerships with end users, and maintaining a healthy UK research base with sufficient capacity, expertise and capability across the subject base and in critical areas of national importance. The balance between these goals is informed by expert opinion from the research community, business and Government.

The key research areas that need to be developed or retained

14. It is impossible to predict with any confidence which scientific areas will, in the long term, lead to the breakthrough discoveries of tomorrow. To remain internationally competitive the UK should therefore continue to invest in a broad portfolio of research. Research funders and the academic community need to retain their capability to rapidly identify new opportunities and the agility to respond to these, and overall the UK should maintain sufficient capability and expertise in underpinning disciplines such as mathematics, chemistry, physics, biology and statistics and strategically important areas such as languages, .
15. There have been suggestions in the past that countries can have a “free ride” taking up the research ideas discovered by others. However, it is now widely accepted that in order to have the capability to take such ideas up, a country must itself have an active and informed research community, in sufficient numbers, in the field in question.
16. Each Research Council produces a science vision or research strategy that sets out the key areas of research within their remits, which need to be developed or expanded in the shorter term. These strategies are developed through a process of extensive consultation with the international research community, business, Government, end users and the public. These strategies can be accessed at:
<http://livercuk.epsrc.ac.uk/research/priority.htm>
17. In January this year the Research Councils published a report on the strength of research disciplines in the UK. This showed that the UK research base is vibrant and successful with increasing staff and student numbers in many disciplines. However, it also highlighted problems faced in a number of areas where there are falling student numbers, ageing staff profiles and recruitment and retention issues. These include critical underpinning subjects such as economics, engineering, physical sciences and mathematics. The report outlines how the Research Councils and Funding Councils are working together to address these concerns. The RCUK Health of Disciplines Report is at: <http://www.rcuk.ac.uk/press/20060315hod.asp>
18. As outlined at paragraph 9 above, a specific challenge is the provision of effective support for interdisciplinary and multidisciplinary research. For interdisciplinary research to flourish there is a need for all of those engaged in its funding and delivery to think beyond traditional discipline based structures, and continue to address the

cultural, organisational and communication barriers which remain. Given the influence of the Research Assessment Exercise (RAE) on university culture, a major challenge will be to ensure that the 2008 RAE and subsequent assessments act to encourage interdisciplinary research and collaboration and to promote and develop research staff.

The achievement and exploitation of STEM in a global market

19. Increasingly globalisation presents not only a challenge for UK business, but for the UK research sector. This challenge manifests itself in a number of areas: the need to train and develop the next cadre of UK researchers; the need to attract the brightest students and academics to study and work in the UK, and collaborate with our best research teams; the need to ensure that UK researchers continue to have access to cutting edge laboratories and facilities wherever they are located; and the need to develop the UK as a key knowledge hub in the global economy, with a reputation not only for world-class research but also a world leader at turning that knowledge into new products and services.
20. Views on attracting and retaining students and experts and international research collaboration are covered at paragraphs 36-41 and 53-55 below. In terms of access to state of the art laboratory facilities and equipment, it is important to recognise that national capabilities are increasingly being replaced by international facilities. This reflects rapid advances in technology development which often drives more complex and expensive facilities which tend to be beyond the scope of any one country to develop. Research too, is being pursued to a greater degree on an international basis, reflecting the nature of global challenges such as climate change and the scale of major endeavours in areas such as particle physics. To maximise the achievement and exploitation of STEM in this global market it is essential that the UK continues to take a long-term and strategic view of the facilities that UK researchers are likely to need access to and manage the investment of public funds accordingly. Details of current needs are contained in the RCUK Large Facilities Roadmap, which is developed in partnership with the Office of Science and Innovation.
21. The Research Councils are committed to ensuring that their activities and investments are effectively exploited to drive UK economic competitiveness. The Research Councils contribute to this agenda in a multitude of ways including through their investments in collaborative research and training, from strong partnerships and engagement with users, and from flexible and diverse approaches to knowledge transfer. The economic benefits delivered by Research Council activities are diverse, extending beyond productivity gains, to value created through better healthcare, better public services at national and local level, law and policy making, and cultural benefits. Further information about the contribution of the Research Councils to the UK economy is at Annex B.
22. There is a real need in the UK to stimulate UK business and industry's capacity to absorb and exploit new research ideas, particularly in relation to SMEs. On the whole businesses in the UK have generally low levels of investment in R&D compared to other economically competitive nations. Business expenditure on R&D has fallen steadily as a percentage of GDP and is now below the OECD average. While differences in industrial structure may explain some of the differences in R&D intensity between the UK and the US or France, the most significant cause is lower R&D intensities in several leading sectors. Business expenditure on R&D in the UK is heavily dependent on the efforts of a few leading firms, particularly in pharmaceuticals and aerospace, which, by international standards, spend substantial

amounts on R&D. Business expenditure on R&D is also heavily dependent on the activities of foreign firms. The outcome is that all too often the UK science base develops world class research only for it to be exploited elsewhere. This is damaging to the nation's long term economic prospects, narrowing the manufacturing and other economic bases on which the UK's export capacity is built.

23. Research can also help to advance understanding of the key factors that underpin the economic competitiveness of the economy. Such research informs Government policy on how best to assist UK businesses increase their competitiveness to take advantage of the opportunities that emerging economies and markets are creating, and thereby succeed in the rapidly changing global economy. For example, ESRC and EPSRC is investing £20M in the Advanced Institute of Management Research, which is undertaking research into UK productivity and performance for the 21st century and sustaining innovation to achieve competitive advantage and high quality public services. ESRC also funds a number of university research centres in these areas including the Centre for Economic Performance (at the LSE) and the Centre for Market and Public Organisation (at Bristol). EPSRC funds a substantial portfolio of research into manufacturing technologies, operations management and strategy (approximately £40M). Responses to the shifting balance of international economic activity are a significant driver for much of this research, since the overwhelming majority of it is collaborative with UK manufacturing organisations and hence reflects their concerns. In particular, many research projects are explicitly concerned with providing knowledge that will enable UK firms to make better outsourcing decisions, often identifying significant hidden costs relating to less integrated manufacturing systems or human resources. The Cambridge University Centre for International Manufacturing is a notable centre of activity.

The most effective mechanisms for the successful exploitation of STEM

24. The successful exploitation of STEM (and research in general) is a non-linear and complex activity. Research undertaken in a particular area or with a specific aim in mind can often have unexpected and unforeseen applications in an entirely different area. For example, basic research in high-energy physics was the starting point for imaging techniques now commonly used in medical diagnosis and treatment.
25. It can also take many years and multiple investments in research and associated technologies for basic research to deliver economic benefit, and it may be decades before the true value of early investments are realised. For example, MRC-funded research from the 1970s led to the development of monoclonal antibodies, which has revolutionised biomedical research and sparked an international billion-pound biotechnology industry. It was not until 1990 that researchers were able to develop and patent the production of such antibodies, which has subsequently led to the rapid development of a range of research and commercial applications. The work has given rise to a new class of drugs for treating numerous diseases such as cancer, arthritis and asthma.
26. Exploitation of research is a two-way process and to achieve this successfully, understanding and commitment to the partnership is needed from the research provider and the research user. The diversity of users who exploit STEM (and other research) is vast, ranging from large multinational companies to SMEs and from policy makers in Whitehall, the regions and in Europe to the NHS, Government Agencies and NDPBs, and museums and galleries. Users may wish to work with research providers for a wide variety of reasons (collaborative R&D; contract R&D; access to skilled people, world-class facilities and new knowledge; consultancy,

provision of training; curriculum development; continuing professional development etc). No two users are identical in their needs, understanding or resources, and no research organisations are identical in the skills and expertise they are able to offer. Such diversity poses a substantial challenge in achieving successful exploitation.

27. Specific challenges also exist in some sectors. For example, the creative industries sector is characterised by a prevalence of micro-enterprises and freelance workers and is predominantly reliant on business models that are underpinned by networks, exchange of IP, and collaborative working across supply chains. Different knowledge transfer models are therefore required to those employed in traditional manufacturing.
28. A greater level of granularity and analysis is therefore needed to better understand current business-HEI relationships and what different businesses want from collaborations with HEIs. This is particularly true in relation to the SME sector, service sector industries and other sectors with a low R&D intensity. The 2003 Lambert Report also identified the importance of raising the level of demand for research from business. Universities, research funders and Government all have a role to play in reaching out to business to raise companies' awareness of what HEIs have to offer in terms of research, expertise, facilities and training. Given the widely differing needs of different sectors and companies, it is essential that the Research Councils and other players are able to offer flexible support.
29. The Research Councils believe that the movement of individuals, networking and brokering, collaborative R&D with end users, development of clusters of expertise, and skills training are necessary and effective in encouraging the exploitation of research.
30. Ideas move with people, and as this is a critical factor in stimulating exploitation in the development of working relationships between academics and business people and, ideally, the exchange of people between a business and research environment. To stimulate this, the Research Councils fund a range of industry or enterprise fellowship schemes, which enable the exchange of personnel between academia and user organisations. Several Councils have, or plan to introduce, mechanisms to enable researchers to be 'bought out' of their project by businesses that wish to pursue exploitation.
31. A second key aspect of successful innovation is the development of strong and visible networking mechanisms and brokering arrangements, encompassing the full range of businesses and users in the public sector. Effective brokering relies on appropriately skilled intermediaries who are empowered to interpret business and user needs and identify the relevant research, knowledge, skills or facilities to meet those needs. The value of these intermediaries should not be undervalued, since these individuals play an important role in facilitating partnerships between organisations that speak different "languages", and have different priorities, cultures and resources. Such networks also provide an effective platform for plugging into broader European and international networks. Existing Research Council brokering activities provide a good starting point for identifying good practice in networking and are highlighted at Annex B.
32. Brokering and networking rely on having sufficient skilled people to take advantage of innovation opportunities. This is the responsibility of both the university sector and research funders. All of the Research Councils work with UK universities to provide collaborative PhD studentship schemes, many of which offer training in partnership with business, and all encourage the university sector to provide business planning,

enterprise, IP management and entrepreneurship skills training for postgraduates and postdoctoral researchers.

33. In terms of collaborative R&D, it is essential that research funders offer companies, and other partners, flexibility and choice in terms of the level of engagement and funding. The Research Councils seek to maximise this flexibility in their funding arrangements and have found this can be particularly attractive to SMEs who are able to get involved with research projects in a meaningful way, often with a local university, without being required to make a significant financial contribution. Other opportunities enable SMEs to become part of consortia through supply chains or through clubs organised by intermediaries such as Trade Associations.
34. The development of clusters of excellence, bringing together researchers and business, has also been proven to drive successful exploitation. For example, most Research Council Institutes have established strong links with their local RDAs to promote collaboration with business and knowledge transfer from the research base. BBSRC has been working with the East of England Development Agency (EEDA) to provide a Technology Development Fund for the biocubator facility at the Babraham Institute. The facility is now full, with 28 companies on site (over 15% of all biotechnology companies in the Cambridge area) increasing employment and regional economic prosperity and has just received a further investment from EEDA of £2M to expand these facilities. CCLRC has worked closely with the Universities of Manchester, Liverpool and Lancaster, the North West Development Agency (NWDA) and Halton Borough Council to develop the Daresbury Laboratory site, with the NWDA investing over £50M and designating it a 'strategic regional employment site'. PPARC has established a university accelerator R&D centre in an NWDA funded, custom built building in collaboration with CCLRC, the NWDA and the above universities. Either of the examples listed above, or other Research Council Institute examples, could provide a case study (or model) for regional innovation.
35. Research Councils do not normally own the IP discovered during research supported by grants to universities. However, the Research Councils are assiduous in exploiting their own IP discovered in RCIs. For instance, the licensing income earned by MRC on its IPR has exceeded that earned by all English universities put together, twice in recent years.

The relative effectiveness of input funding versus government procurement

36. Procurement can be an important means of stimulating innovation.

The methods and mechanisms of attracting and retaining students/leading experts

37. The Research Councils are committed to enhancing the quality and output of the UK research base through training the next generation of world-class researchers - including attracting the brightest talent from overseas.
38. RCUK does this by supporting improved training and continuous professional development for researchers, being responsive to employers and the skills needs of the economy, and increasing the participation of women and ethnic minority groups in research. RCUK provides a focus for engagement with partner organisations such as the OSI, Funding Councils, and the Higher Education Statistics Agency (HESA)
39. RCUK has significant responsibility for implementing many of the recommendations of the SET for Success (Roberts) Review 2002: Chapter 4 (Postgraduate Education); and 5 (Employment in Higher Education). At PhD level this includes raising the

minimum stipend, enhancing the stipend in areas where there are recruit and retention difficulties and supporting longer duration PhDs. There is also coordination of transferable and careers skills training for researchers both at postgraduate and postdoctoral level. For postdoctoral researchers provision has been made to enhance salaries in areas where there are recruit and retention difficulties and improving the information about research careers.

40. The Research Councils support a range of Research Fellowships which have been developed to recognise a range of discipline specific strategies and are tailored to the career of the individual. RCUK Academic Fellowship scheme is also supported by the Councils and is intended to provide contract research staff with more attractive and stable paths into academia.
41. The Research Councils award large grants, where there are serious concerns that the areas of research in the UK no longer have the capacity needed for research and postgraduate training, and where the UK may not be able to sustain the research capacity needed in the future, including the production of enough well-trained people and the development of leaders of research teams.
42. RCUK will shortly be publishing its strategy for Research Careers and Diversity. This will reflect Councils' implementation of recommendations made in the Roberts review of science, engineering and technology, the Leitch Report on Skills (due in mid-2006), and work undertaken by the Research Base Funders' Forum on skills, careers and training.

The role of Public Sector Research Establishments (PSREs)

43. BBSRC, CCLRC, MRC, NERC and PPARC all make major investments in their own Research Council Institutes (RCIs), which are classed as PSREs. RCIs provide unique long-term, strategic research and training capabilities for the UK, which complement the capabilities and research infrastructure of the HEI sector.
44. Each RCI has a unique purpose and fulfils a variety of roles which may include: the delivery of world-class research in areas of national strategic importance; the provision of cutting-edge national and international facilities; an ability to respond rapidly to national emergencies providing expertise or advice to aid policy making; training (including for Masters and PhD students) and staff development; and knowledge transfer and public engagement activities.
45. RCIs provide a means for concentrating resources on a specific research endeavour or area of activity. This may be where a strong drive is needed to rapidly develop a new area of research or to better co-ordinate distributed research activities. Some RCIs are focused on pursuing scientific work in areas where it is necessary to maintain strategic national capability and expertise (for example in the area of infectious diseases), or the provision of national facilities and long-term survey, monitoring and data management. In these areas the RCI model provides a means for establishing clear leadership and scientific management and concentrating efforts to enable the rapid development of critical research mass on a scale that may not fit easily within a university environment. All RCIs are funded long term, although each period of funding is time limited and renewed funding is the subject of regular review and evaluation.
46. Although each of the RCIs funded by the Research Councils has different strengths and capabilities, one feature that all share is their potential to foster multi- and interdisciplinary research. The provision of stable, longer-term funding signals a

strategic commitment to a particular set of research challenges, and gives research teams the time and access to skills and resources to build collaborations, and the flexibility and freedom to pursue novel ideas. The RCI long-term support model enables scientists to have a higher risk appetite so taking on and investigating ideas that university researchers might be less inclined to do.

47. Many RCIs receive a substantial proportion of their income from commissioned research. Commissioned research strongly powers knowledge transfer (KT), both in policy and business areas, and therefore strengthens the ability of the RCIs to act as KT agents, generating and applying basic knowledge for the benefit of their customers. RCIs also undertake collaborative research with universities and the private sector, sometimes acting as regional hubs for collaboration with business. Research Councils with RCIs all have well-established and successful means for commercialising and exploiting the research they fund, e.g. by launching spin-out companies. The KT examples in Annex B include several resulting from the work of RCIs.

The remit, organisation and management of the Research Councils

48. The UK science base is widely regarded as being highly productive and by many measures is second only to the US in terms of the quality of its output. The Research Council peer review system is a hugely important factor in enabling the Councils to fund world class science and is regarded by many as a benchmark of excellence. Annex A provides more information about how the Councils' peer review mechanisms operate.
49. Each of the Research Councils supports research and training across a wide range of academic disciplines. Successive reviews have recognised the strength in the diversity of this system, with each Council providing a strong and effective focus for their research and business and user communities. Coupled with this, each Research Council is a member of the RCUK partnership. This non-executive coalition provides the platform through which the Councils work together collectively to:
- discuss shared research priorities, facilitating an open and collective approach to investing in multidisciplinary research and training;
 - engage with external stakeholders promoting dialogue, collaboration and partnership;
 - articulate coherently the activities, views and opinions of the Research Councils to increase their collective visibility and policy influence;
 - work with the academic community and other funders to provide more effective and efficient services
 - improve Councils' operational performance by sharing best practice and making efficiency gains to maximise Science Budget resources for research
50. The House of Commons Science and Technology Select Committee scrutinised the effectiveness of this relationship early in 2005. This concluded that the current arrangements are largely effective and noted in particular successes in Councils working together to address concerns about academic disciplines, promoting interdisciplinary research and in working with the university sector to improve and simplify the research funding process.
51. The Research Councils have a good track record of working in partnership with the academic community and other funders to improve services, reducing the level of bureaucracy on universities. For example, seven Councils have implemented a single

electronic system for handling the submission of research funding proposals and all have instigated common grant terms and conditions. This significantly eases the complexity of the Research Council funding system for researchers in HEIs. Surveys of the university community show that the level of satisfaction with the system is high, and that it has made the grant application process more efficient, particularly in reducing time and paperwork and enabling the development of collaborative proposals.

52. The Councils have also benchmarked their operational performance against other national and international research funders. This shows that the UK compares favourably with other major competitor countries on the overall efficiency of research funding. In particular, the UK Research Councils' administration cost as a proportion of total budget is at the lower end when compared to the other grant giving organisations surveyed.
53. In line with the Gershon Review of Public Sector Efficiency (2004) the Research Councils are individually and collectively committed to pursuing a culture of continuous improvement in efficiency. In 2005-06, the Councils achieved efficiency gains of £76.89M against a collective target of £61.50M, and are well on track to delivering their aim of achieving efficiency savings of £170M per annum by 2007-08. Other activities in train to improve efficiency include:
- a project to replace existing multiple grants processing systems with a common IT system. This will reduce administrative costs further and enable increased convergence of Councils' policies and processes, ultimately leading to simpler and more efficient grants processing. The project started in autumn 2005 and is scheduled to deliver the system in 2008-09
 - a project to look at the efficiency and value for money of the Councils' peer review processes. Work in underway and the report will be published the autumn of 2006
 - a project to establish a shared services centre, which will provide common services to the Research Councils and their institutes. The aim is that by 2009 HR, finance and procurement transactions, some aspects of IT and telecommunications, administrative information systems and grants, fellowships and studentships processing will be provided on a shared basis.

The impact of EU and international research collaboration

54. In a world in which research is increasingly conducted across European and international boundaries it is essential that future UK research policy reflects the global environment and the research challenges it brings: the research challenges which arise from tensions between cultures; and those that result from climate change and pressures on natural resources. The UK has an excellent international reputation for research and a long history of facilitating and taking advantage of opportunities for international partnership. This reputation enables the UK to form strategic alliances and participate in international research programmes, which in turn deliver benefits in terms of sharing of data, IP and facilities, and influencing international policy. It also enables UK researchers to continue to compete effectively for European and international funding and for the UK to contribute to development of international standards and frameworks – for example in establishing a European Research Council. All this enables the UK to punch above its weight. The Research Councils have contributed to raising the profile of doctoral developments in Europe through: co-operation with the Europe Unit; membership of the EC-DG Research 'Steering Group on Human Resources and Mobility'; and participation at conferences on the EU Charter and Code, the Bologna process and the European University Association

doctoral projects; and worked closely with UK Research Office in order to maximise the value of the Marie Curie actions and understanding of Framework Programmes.

55. The internationalisation of research generates opportunities to increase inward investment in R&D and higher education in the UK as well as presenting export opportunities for UK companies and universities. The UK remains an attractive location for multinational and foreign companies looking to undertake a range of R&D related activities. This attractiveness depends in large part on the reputation of the UK research base, the regulatory and IP framework, and the skilled individuals in UK HEIs and RCIs.

56. In an increasingly competitive international market the Research Councils and other funders are keen to maximise the mobility of students and researchers, both to and from the UK. International mobility of researchers helps to share expertise and cross-fertilise ideas, and enables UK researchers to benefit from international training and development programmes. Furthermore, researcher mobility underpins cross-disciplinary activities that may be difficult to achieve within a single country, contributes to the sustainability of basic disciplines, and helps research to address international development challenges.

Annex A: The Research Councils' role in funding research and innovation

The primary role of the Research Councils is to fund research. Each year the Councils invest around £1.3 billion in research, training and innovation in UK universities and in their own Research Institutes. This money is used to fund the very best world-class research as judged by independent, expert peer review.

Working in partnership with their academic communities, as well as other research funders and stakeholders including Government and the private sector, Research Councils have developed and implemented an extensive and successful portfolio of flexible funding mechanisms and approaches supporting a huge range of excellent research.

The dual support mechanism

In UK universities public funding for research is provided under a dual support system. Under this model, the Research Councils provide grants for specific projects and programmes, whilst the UK's Funding Councils provide block grant funding to support the research infrastructure and enable institutions to undertake ground-breaking research of their choosing. Such funding also provides the capacity to undertake research commissioned by the private sector, Government Departments, charities, the European Union and other international bodies.

There are four Funding Councils in the UK, supported by the Department for Education and Skills (DfES) and the devolved Departments of Education:

- Higher Education Funding Council for England (HEFCE)
- Scottish Further and Higher Education Funding Council (SFC)
- Higher Education Funding Council for Wales (HEFCW)
- Department for Employment and Learning Northern Ireland (DELNI)

Research Council funds are awarded on the basis of applications made by individual researchers, which are subject to independent, expert peer review. Awards are made on the basis of the research potential and are irrespective of geographical location.

Funding Council support for research (Quality Related or QR funding) is distributed as a block grant to institutions using the results of the Research Assessment Exercise (RAE). Awards are made on the basis of past performance and reflect a geographical distribution i.e. HEFCE makes awards only to English higher education institutes.

Research funding and peer review

Research Councils award grants for specific research projects on the basis of scientific excellence, as determined by peer review. This is done through formal calls for proposals in specific research areas (which include national strategic priorities and areas where there is a need to grow capability or support interdisciplinary research), or in 'responsive mode', where researchers are free to submit proposals in any area they choose. In addition, many Research Councils also fund their own specialist research institutes, and subscribe to international science facilities.

In simple terms peer review is a tool for selecting the best research proposals through competition. It involves an assessment of a research proposal or research outcomes by researchers or others who have the requisite knowledge, training and experience to be able to judge the matter under consideration. Use of peer review system is the dominant allocation

mechanism employed by the world's main funding agencies. The Research Council's peer review system is recognised internationally as one of the best in the world and has the confidence and respect of the research community. This latter point should not be underestimated since the effective operation of peer review is dependent on the research community's belief in the system and their willingness to engage with it.

If a research proposal is successful, a grant is typically made for 3-5 years. Longer term awards to create or sustain centres of research excellent in specific areas may be made for 5 years, with the potential for renewal.

All of the Research Councils have strong user representation on their Councils and advisory bodies, and most have specific user advisory panels. All work with potential end users in developing research activities and all employ end-users on their peer review colleges and panels. A substantial proportion of the research funded is delivered in partnership with users as joint funders or collaborators.

Annex B: The Contribution of the Research Councils to the UK

Research outputs, training and sources of new knowledge and technology are the raw materials which power successful innovation. The Research Councils play a number of fundamental roles in driving innovation and delivering economic benefit which include:

- funding excellent research, a substantial proportion of which is delivered in partnership with business, policy makers and end users. The new knowledge, technologies and information generated from this research are used by business and industry to develop new products and services, by the NHS to improve patient care, by Government and regulators to develop better policies and deliver better public services, and by many other users for social, economic, environmental and cultural benefit
- attracting and supporting the brightest people to pursue education and training at masters and doctoral level, and ensuring that this training is relevant and reflects employer needs
- employing, training and supporting the career development of some 11,000 expert (approximately) scientists and technicians, in the Research Council's institutes, facilities and centres
- supporting and promoting the transfer of new knowledge via collaborative research and training, the movement of people between academia, business and user organisations and via brokering and networking activities
- ensuring that research outputs are commercialised through the exploitation of intellectual property, such as licensing and patenting
- using Research Council institutes and facilities to as the nuclei of clusters of excellence in research and innovation, providing facilities for businesses and start-up companies to work alongside first class researchers and use excellent facilities

Selected highlights of the impact of knowledge transferred from Research Councils' programmes

- **Crime Detection:** early Research Council support for Professor Sir Alec Jeffries at Leicester University, which led to the development of genetic fingerprinting with its subsequent impact on crime detection. Research into the psychology of face recognition has made a significant contribution to the way in which images are utilised by the police. Based on research into how language shapes visual imagery, the police are now better equipped to help witnesses describe faces more effectively and enhance the possibilities for suspect identification.
- **Satellite control:** Software developed to control space missions such as the Huygens probe to Titan has underpinned multimillion pound commercial contracts for the company.
- **Bioprocessing:** For the first time in the world a new technique (developed at a Research Council's centre), will significantly improve the speed to market of a therapeutic protein by increasing the capacity of a crucial early stage step by seven fold.

- **Terahertz Technology:** Research Council support for terahertz technology played a prominent part in the creation of TeraView Ltd, the world's first company solely devoted to the commercial exploitation of Terahertz light. TeraView has pioneered many applications of Terahertz, e.g. cancer imaging, and is constantly exploring new markets, such as drug discovery and formulation and security screening. TeraView has opened up an entirely new market segment in pharmaceuticals – the online inspection of tablets in a non-invasive manner not possible by other means. In addition Thruvision, a Research Council spin out, is aiming to become the leading commercial provider of compact security screening equipment using terahertz imaging technology and is generating substantial commercial interest with a range of security products.
- **Health impacts:** basic research funded by the Councils has demonstrated the following major health impacts:
 - Established that smokers lose a decade of life compared to non-smokers
 - Showed that surgery for stroke can halve the risk of a subsequent one
 - Demonstrated that screening for abdominal aortic aneurysms is cost-effective, saving over 3,000 lives after four years in the 65-74 age group
 - Showed that cholesterol-lowering drugs can reduce the risks of heart attacks and strokes by at least one-third
- **Antibody technology:** research in antibody engineering started in the mid 1970s and resulted in patents covering a series of inventions during the late 1980s and early 1990s for making 'humanised' or fully human monoclonal antibodies. These technologies have had a major impact on health and the economy, with eleven therapeutic antibody products now on the market including treatments for breast cancer, leukaemia, infant respiratory disease, asthma, psoriasis, kidney transplant rejection and rheumatoid arthritis
- **Economics:** The World Bank uses research funded by the Councils to advise Governments on R&D tax credit schemes
- **Better livestock transport:** animal welfare has been enhanced by determining the environmental features required to minimise stress in animals during transport. These findings have been incorporated into EU legislation
- **Thames Barrier:** providing the data required to inform decisions on when to raise or lower the Thames Barrier. The cost of getting this wrong would be £30 billion and many human lives
- **The arts:** funding researchers who co-curated the National Gallery's successful Raphael exhibition
- **Development of Lagan Weir** (one of the largest civil engineering projects ever to be undertaken in Northern Ireland): Model tests on the Lagan Weir using research techniques developed through Research Council research, demonstrated that Laganside could be developed without the risk of flooding. This has led to riverside developments up to this date of over £1000 million