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GLOBAL EDUCATION DIALOGUES RESEARCH

UK
RESEARCH REPORT

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This research was commissioned as part of the British Council's Global Education Dialogue, From Catapults to Commercialisation: How can universities use their knowledge and research more effectively?

9, 10 March 2015, The Crawford School of Public Policy, Australian National University.

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"Universities generating cutting-edge research and resulting insights may be likened to the tip of an arrow, with the arrowhead behind it representing the economic activity enabled by research-led innovation. Maximising the size of these arrowheads and their economic benefit to the UK, specifically, is fundamental..." [1]

Sir Andrew Witty

[1] Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth, October, 2013

Key Features

Research Spending

- While research and development (R&D) is as a proportion of the UK's GDP (Gross Domestic Product) is lower than the Organisation for Economic Development (OECD) median, the UK R&D sector continues to perform to a very high standard, despite overall decreases in the country's R&D expenditure in recent years.
- Two thirds of R&D expenditure in the UK is business expenditure.
- Universities carry out three-quarters of publicly funded R&D and one-quarter of all R&D.

Commercialisation of Research Ecosystem

- Knowledge and innovation is key to the government's Industrial Strategy.[2]
- In the UK there is a long history of commercialisation.
- Particular universities have significant expertise in facilitating getting the maximum benefit from their researchers' ideas.
- The ecosystem is constantly evolving, but overall seems to be improving.

Supply Side

- UK universities are significant performers in terms of research, undertaking the majority (74.3 per cent) of publicly funded R&D and 27 per cent of all R&D performed in the UK. They are largely responsible for the UK's world-leading research performance.[3]
- The debate in universities regarding R&D appears to have evolved beyond supply-side barriers.
- Recent changes to funding provide incentives to consider and act upon the potential for commercialisation.

Demand Side

- Much of the discussion is focused on blockages on the demand side.
- There is concern about the ability of businesses to absorb the ideas.
- There appears to be insufficient investment at various points in the process.
- A lack of information and/or the ability to communicate with institutions might also act as barriers.

Policy

- The UK Government's Strategy for Growth has technology and innovation as key components.
- Key funding sources and policies of interest and relevance on the supply side:
    - Higher Education Innovation Funding (HEIF)
    - Research Partnership Investment Fund (RPIF).
- The Catapults' initiative effectiveness is yet to be proven.
- It is difficult to attribute changes to individual policies.

[2] UK Science & Innovation: Amanda Brooks, Director Innovation: BIS
[3] Universities UK: 2014

Key Talking Points

- The need to take a multi-level approach – no single solution. There are a myriad of potential blockages and barriers that require a diversified approach.
- How does the UK better align funding streams to opportunities?
- How can cross-institutional collaboration be better facilitated to avoid delays in ideas reaching maturity?
- To what extent should the UK Government determine what kind of research (sectors/areas) universities should be focusing upon?
- How can the UK avoid geographic and institutional barriers and ensure funding flows to support technology/industry needs and opportunities within the UK?
- Benefit of having a sectoral approach – there is not a one-size-fits-all solution.
- Having entrepreneurial academics can lead to many benefits: as well as providing models of collaboration for their students, their linkages might lead to better employment outcomes too.
- There seems to be a real opportunity for higher education institutions (HEIs) to be better positioned, or at least considered, by businesses/industry as more important sources of information for industry.
- Is the Scottish sector's more collective policy-goal-driven approach more effective, than the English more institutionally driven approach?[4].

[4] Incentivising Knowledge Exchange: A comparison of vision, action September 2102: Fumi Kitagawa (University of Manchester) and Claire Lightowler (IRISS)

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1. Introduction

Background of this research project

In December 2014, the British Council (BC) engaged EduWorld to conduct a research project with the following objective:

- **To examine how national policies, as a sub-set of national pre-conditions, affect commercialisation outputs of research.**

This was to support the British Council's Global Education Dialogue (GED), a high-level discussion between higher education professionals and policymakers from Australia, the UK and the East Asia Region, held in Canberra, Australia in March 2015.

The Council identified four regions[5] on which to focus: the **United Kingdom** (primarily England and, to a lesser extent, Scotland), **South Korea**, **Brazil** and **Hong Kong**, each of which is actively looking at the commercialisation outputs of research, albeit at very different stages of development and, of course, within a different set of national conditions.

Following an initial consultation involving interviews with senior stakeholders in universities in the UK and Australia to direct and refine the focus of the research in line with the objectives of the GED, the research comprised two components conducted concurrently over the 10 weeks of the project.

1. Primary research in the form of in-depth interviews with between five and eight stakeholders in each of the four countries.[6]
2. Secondary research, namely a review of a wide range of publications from many sources including government departments, parliamentary reviews, universities, funding agencies, non-government organisations, businesses, consultancies and media relating to the commercialisation of research.

This report focuses on the findings in relation to the United Kingdom.

There appears to be a seemingly endless wealth of literature about the commercialisation of research within the United Kingdom (UK). For the objectives of this paper, we have tried to synthesise the most appropriate documents and data to inform the audience and stimulate discussion. To achieve this, we conducted extensive secondary research involving reviewing a wide range of publications from various sources, including government departments, parliamentary reviews, universities, funding bodies, non-government organisations, businesses, consultancies and media. A full bibliography is provided at Appendix 3 to this report.

Given the breadth of this subject matter and the project scope, this report focuses primarily on activities in England, although some commentary is included on initiatives in Scotland in Section 5.

To supplement the secondary research, we undertook primary research comprising interviews with key senior stakeholders involved in the commercialisation of research in

[5] While Hong Kong is a Special Administrative Region of the People's Republic of China, it is referred to as a 'country' in this report for the purposes of comparison with the relevant countries.
[6] A list of the job titles and organisations of participants is provided within this report. Participants were assured that their names would not be used and that any comments would not be attributed to individuals.

the UK. We would like to thank the interviewees for their time, insightful input and their recommendations of relevant individuals for us to interview and suggestions regarding sources of further information.

This report is in four sections.

- The first section provides information about the UK's performance in the latest Global Innovation Index.

- In the following section, we provide our overview of the UK Government's policies relating to the commercialisation of research, including an overview of the government's strategy in this area. We then outline some of the key funding schemes that relate to the commercialisation of research.

- The next section is built around the more subjective findings of our primary research. We have included their opinions and insights together with additional relevant content from our literature review.

- The final section includes a short review of activities around the commercialisation of research in Scotland.

Report Limitations

EduWorld has taken all reasonable care in researching and preparing this report. EduWorld has necessarily had to rely and base opinions upon various external third party data and information sources when preparing this report and in reaching the opinions, views and assumptions expressed in this report.

To the extent that such reliance on third party source data and information has occurred, EduWorld has assumed the accuracy, reasonableness and reliability of the source data and information without independent verification.

While at the date of this report EduWorld is not aware of any reason why any of the third party source data and information referred to or used in this report is not accurate, reasonable or reliable for the purposes for which this report has been prepared, EduWorld does not and is unable to represent that such third party information and data is accurate, reasonable or reliable and the report is released upon this basis.

2. The UK and the Global Innovation Index

The Global Innovation Index (GII)[7] recognises the key role of innovation as a driver of economic growth and well-being. It aims to capture the multi-dimensional facets of innovation to be applicable to developed and emerging economies alike. In doing so, it helps policymakers and business leaders move beyond one-dimensional innovation metrics towards a more holistic analysis of innovation drivers and outcomes.

Figure 1: UK GII Key Indicators 2013 and 2014

UK Statistics				
Key Indicators				
Population (millions)	**63.2**			
GDP (US$ billions)	**2,537.8**			
GDP per capita, PPP$	**37,306.6**			
	2014		**2013**	
GII Indicator	**Value or score (0 - 100)**	**GII Rank**	**Value or score (0 - 100)**	**GII Rank**
Global Innovation Index (out of 143)	62.4	2	61.2	3
Researchers, headcounts/mn pop	6,872.2	11	6,363.4	10
Gross expenditure on R&D, % GDP	1.7	21	1.8	20
GERD performed by business, % GDP	1.1	21	1.1	21
GERD financed by business, %	63.4	19	44.6	34
University/industry collaboration^	76.3	5	79.2	2
GERD financed by abroad, %	19.7	20	17.0	20

The UK, with a population of 63.2 million and a GDP per capita of US$37,306 was ranked in second place in the 2014 GII tables; one position higher than in 2013.

A number of factors contributed to the UK's ranking:

- 5th place overall for university/industry collaboration;
- 11th place for its number of researchers per million of the population;
- 19th place for its Gross Expenditure on R&D (GERD) financed by business;
- 20th place for its GERD financed by organisations abroad; and
- 21st place for both gross expenditure on R&D by percentage of GDP and for GERD performed by business.

The percentage of GERD financed by business in the UK has risen markedly, from 44.6 per cent in 2013 to 63.4 per cent in 2014. The number of researchers per million of the population has also risen slightly.

[7] The Global Innovation Index 2014: The Human Factor in Innovation is the result of collaboration between Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO) as co-publishers, and their knowledge partners.

3. UK Background

The UK is well positioned globally in terms of research and innovation. As indicated earlier, the UK ranked second in the most recent GII, second for the quality of its scientific research institutions and fourth for its university-industry collaborations in R&D.[8] However, according to the OECD, with its large service-based economy, the UK performs below the OECD median on several headline indicators, including R&D expenditure and patenting. Furthermore, despite being a very open economy with a relatively high proportion of business expenditure on R&D (much of which is accounted for by large foreign-owned firms), industry-financed, public R&D expenditures as a share of Gross Domestic Product (GDP) are also below the OECD median. That said, patents filed by universities and public labs per GDP are well above the OECD median, an indication of the commercial efforts made by UK universities.[9]

3.1. UK Research and Development Spending

Data from the UK Office of National Statistics shows that in 2012:

- The UK's gross domestic expenditure on research and development (GERD) was £27 billion;
- In current prices, this represents a decrease of 2 per cent on 2011 figures; and
- When adjusted for inflation, in constant prices, research and development (R&D) expenditure, actually, decreased by 3 per cent.[10]

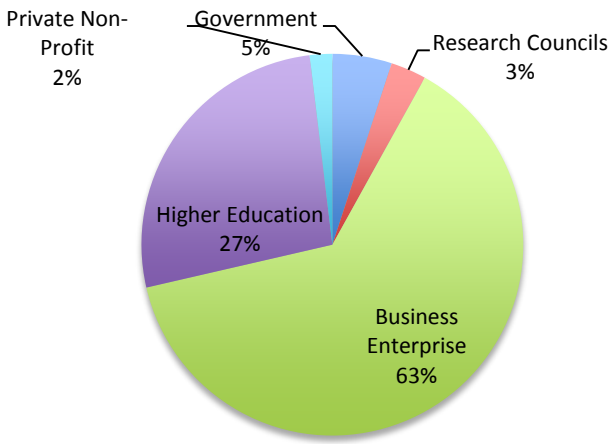
In 2013, expenditure on R&D amounted to only 1.72 per cent of the UK's GDP (down from 1.77 per cent in 2012) and far short of the target set by the previous Labour Government to increase UK R&D investment to 2.5 per cent of GDP by 2014. Furthermore, international comparisons show that UK R&D expenditure in 2012 was below the European Union's 28-member states provisional estimate of 2.06 per cent of GDP.

Although levels of public R&D expenditure are below the OECD median, the UK is still among the top performers in publication counts and boasts some of the world's leading research universities.[11]

UK universities are key players in terms of domestic research and innovation. They carry out nearly three-quarters of publicly funded R&D (74.3 per cent) and over one quarter (27 per cent) of all R&D performed in the UK (see Figure 2). They are largely responsible for the UK's world-leading research performance.[12] Although the public research system is university-oriented, most research is applied or experimental development. As the Witty Review recently reported universities have an extraordinary potential to further enhance the UK's economic growth.[13]

[8] Royal Society – www.royalsociety.org
[9] OECD Science, Technology and Industry Outlook, 2012
[10] http://www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2012/stb-gerd-2012.html
[11] OECD, *ibid*
[12] Universities UK: 2014
[13] Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth 2013

Figure 2: Sector Expenditure of R&D, UK, 2012[14]



3.1.1. Business Enterprise Research and Development (BERD)

- In 2012, total BERD expenditure in the UK was £17.1bn, accounting for 63 per cent of all UK R&D.
- In current prices, it also decreased on 2011 R&D expenditure by 2 per cent.
- BERD in 2012 represented 1.1 per cent of GDP; maintaining a level it has been since 2007.
- In 2012, expenditure on R&D in the UK by foreign-owned businesses constituted 51 per cent of total expenditure.

From a sectoral perspective:

- Pharmaceutical R&D, the largest sector, recorded the largest decrease in expenditure in 2012 decreasing by £727 million (15 per cent) to £4.2 billion.
- This was followed by computer programming, motor vehicles and parts, aerospace, machinery and equipment, and telecommunications.
- Defence R&D expenditure decreased by 10 per cent in 2012 to £1.6 billion, partly due to government contracts awarded to UK businesses for the development of aircraft, naval ships, submarines and their systems and equipment moving from the research to production stages.

[14] http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-335613

3.2. Current Government Policy

As stated in the Department for Business, Innovation and Skills' (BIS) Strategy for Growth, science and innovation are at the heart of Britain's long-term economic plan.[15] The stated aim is for the UK to be the **best place in the world for science and business**. The Department's plan to achieve this has six elements.

1. Deciding priorities
2. Nurturing scientific talent
3. Investing in scientific infrastructure
4. Supporting research
5. Catalysing innovation
6. Participating in global science and innovation

Looking ahead, BIS identifies the themes that the plan must address if it is to be successfully aligned to the changing possibilities that emerge which include:

- The importance of achieving excellence;
- The imperative to operate at a quickening pace and show agility to seize new opportunities;
- The need to accommodate and foster higher levels of collaboration between disciplines, sectors, institutions, people and countries;
- The need to recognise the importance of place, where people and organisations benefit from mutual proximity; and
- The modern demand for openness and engagement with the world.

A principle of the UK Government's approach to funding is that it is **not overly directive**: the then Minister for Universities and Science summarised this approach in a paper for Policy Review:[16]

> *"One reason science in Britain is so excellent is that Ministers do not interfere in the allocation of funds for particular science programmes – the Haldane Principle. This principle covers current expenditure on science, which is within the ring-fenced £4.6 billion annual resource budget. Governments do however have a more direct role in deciding on the allocation of major science capital spending. And there is also a role for government in deciding broad areas of technology to support through the Technology Strategy Board before they have reached full commercialisation. Even in these important areas of capital spending and technology support, however, Ministers do draw on expert advice."*

[15] Department for Business Skills and Innovation (2014), Our plan for growth: science and innovation
[16] David Willets (2013), Eight Great Technologies, Policy Review

To this end, the government has identified '**Eight Great Technologies'**[17] which it believes will propel the UK to economic growth and where significant investments have been made.

1. Big data
2. Energy storage
3. Satellites
4. Regenerative medicine
5. Synthetic biology
6. Agri-science
7. Robotics and autonomous systems
8. Advanced materials

While not completely free from critique, response to the strategy has been broadly positive. For example, Stephen Curry, Professor for Structural Biology at Imperial College, London provided the following assessment.[18]

> *"The strategy constitutes a significant statement of intent. It proudly acknowledges UK prowess on R&D but recognises there can be no room for complacency. It constitutes a serious attempt to think through an array of policy areas that aim to make Britain the best place in the world to do science (broadly defined) in a way that feeds into the health of the economy. Accordingly the document knits together plans for public investment in R&D with strategies for meeting the substantial technological challenges facing the country, and policies for how innovation and industry might work best to lever ideas out of the lab."*

3.3. Overview of Funding Schemes in the UK to Support the Commercialisation of Research

The recent Witty Review of Universities and Growth**[19]** provides a useful overview of the various funding schemes and incentives provided by the Department for Business, Innovation and Skills and its delivery partners, to support the translation of university research and the engagement of universities with business to deliver economic growth. It also delivers pointers to public support provided from other sources.[20] In summary, there are three key, complementary public funding sources for UK R&D.[21]

- **Higher Education Funding Council for England** (**HEFCE)**: provides a flexible block grant allowing universities to invest strategically in inquiry-driven research and respond to emerging priorities & infrastructure for knowledge transfer activities.
- **Research Councils**: set strategic priorities and encourage larger, multi-disciplinary projects, often collaborating with business and Innovate UK (previously TSB).
- **Innovate UK (previously Technology Strategy Board)**: provides funding directly to business and supports business innovation, often, but not always based on university research.

[17] https://www.gov.uk/government/.../eight-great-technologies-infographic,
[18] http://www.theguardian.com/science/occams-corner/2014/dec/21/home-secretary-blows-hole-government-science-innovation-strategy
[19] BIS (2013), *Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth*
[20] The focus of the Witty review is on England and on HEFCE funding streams. There are four funding bodies for higher education in the UK that collaborate on the system of research assessment and use similar but not identical methods for distributing quality-related funding. Funding schemes relating to Scotland, Wales and Northern Ireland are detailed later in this section on the UK.
[21] UK Science & Innovation: Amanda Brooks, Director Innovation: BIS

A summary of the key funding bodies and schemes is provided below.

3.3.1. Higher Education Funding Council for England (HEFCE)

In 2014, HEFCE announced its initial allocations of its grant for 2014–15 and for each university and college that it funds. Of the total HEFCE grant of £3,883 million for the academic year 2014–15, 40 per cent, £1,558 million was allocated to research as shown in Figure 3.[22]

Figure 3: HEFCE Research Funding Allocation 2014–15

Funding element	2014–15 total (in £million)
Mainstream QR grant	£1,018
London weighting on mainstream QR	£32
Research degree programme (RDP) supervision fund	£240
Charity support element	£198
Business research element	£64
Research libraries	£6

Mainstream QR Grant: Quality Related Funding and the Research Excellence Framework
Budget: £1,050 million

The HEFCE Mainstream QR funding is allocated selectively according to quality. It allocates block grant funding to Higher Education Institutions (HEIs) in England on the basis of performance in periodic national assessments of research excellence. This Quality Related (QR) funding allows institutions to invest strategically to maintain their research capacity**,** explore new fields and projects (which includes working with business), allowing them to leverage in funding and competitively price commissioned research.

The **Research Excellence Framework (REF**) has replaced the Research Assessment Exercise (RAE) as the means of periodic assessment of research quality across UK HEIs. As with earlier RAE exercises (conducted every six to eight years), the outcomes of REF 2014 will:

- Inform the selective allocation of research funding to HEIs;
- Provide benchmarking information;
- Establish reputational yardsticks; and
- Provide accountability for public investment in research and demonstrate its benefits.

[22] www.hefce.ac.uk

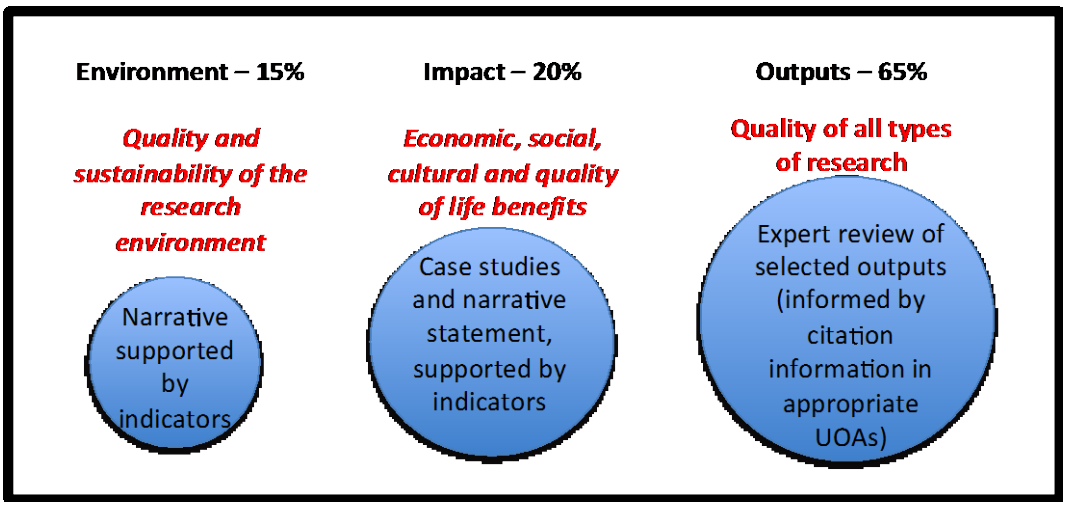
Process

HEIs submit their best research outputs from the last six years for peer review by expert panels drawn from the UK and overseas across 36 units of assessment (disciplines). HEFCE has been developing the REF for five years and it will include, for the first time, **an assessment of impact**:

- Arising from excellent research;
- Based on expert-review of case studies,;
- Enabling researchers to demonstrate their contribution to the economy, society and environment, to public policy and services; and
- To culture, health and well-being.

Impact will now account for 20 per cent of the assessment in REF 2014. REF funding is now determined according to the following inputs outlined in Figure 4.[23]

Figure 4: Research Excellence Framework, HEFCE[24]



Higher Education Innovation Funding (HEIF)
Budget: £113m

The Higher Education Innovation Funding (HEIF) supports English HEIs to maintain and build capacity and capability to work with business and other external organisations. HEIF has been reformed[25] (in 2011) to increase rewards that are **most effective in business engagement.** It is allocated on a formulaic basis alongside core institutional funding for research and teaching. It supports universities to undertake a wide range of activities working with business and others. Universities use HEIF funding to:

- Increase interactions with business (i.e. collaborative research, consultancy and training);
- Enhance technology transfer activities to help the commercialisation of intellectual property (through spin-outs and licensing); and
- Provide enterprise education for staff and students and support business startup activities.

[23] David Sweeney (2013), Presentation at AURIL: Universities and Business as the Economy Recovers
[24] HEFCE
[25] HEFCE

HEIF is an important driver of local activity. Knowledge exchange (KE)[26] strategies submitted to HEFCE for HEIF funding in 2011 describe considerable commitment to local innovation for example:

- 60 per cent of universities are investing in local innovation infrastructure;
- 71 per cent are increasing work with employers for student placements and enterprise training; and
- 52 per cent are providing expertise for local economic development.

According to the submission data, three-quarters of universities are also looking for more collaborative and shared service approaches to working with business, much of which is local.

The budget for HEIF funding for 2015–16 has recently been confirmed as £113 million, the same as it was for the previous year.[27]

Catalyst Fund
Budget: £45 million

HEFCE has funded research collaboration development through its Strategic Development Fund, now renamed the Catalyst Fund. This funds research collaborations where HEFCE considers that the nature of the challenges in a field are only likely to be tackled through the critical mass of several departments working together and where there is insufficient present large-scale supply.

Of particular current interest are cross-cutting proposals that support economic growth and unlock private sector investment that would otherwise not be available to higher education. HEFCE also aligns catalyst funding with other funders and new policies in the support of economic growth. HEFCE aims to commit up to £45 million in annual funding in the 2011–2015 period to this initiative. Working in partnership is a key feature. It is already supporting co-investments with Local Enterprise Partnerships (LEPs) and other business partners relevant both to the Industrial Strategy and also local innovation.

UK Research Partnership Investment Fund (UKRPIF)
Budget: £300 million

BIS has provided £300 million for the UK Research Partnership Investment Fund for universities to accelerate private co-investment in UK university research infrastructure and strategic research partnerships. This funding, together with private co-investment, will deliver at least £1 billion investment in R&D collaborations between universities, businesses and charities. Administered by HEFCE, it provides funding of £10–35 million to universities for large, long-term capital projects that have at least double that amount in private co-investment and build on a strong record of research excellence. In autumn 2012, £220 million was allocated to 14 projects, which levered £615 million of private co-investment.

[26] KE refers to the exchange of ideas, research results, technology and skills between higher education institutions (HEIs) and other research organisations and businesses, the public sector and the wider community. KE activities range from public lectures, the establishment of new spin-out companies and project collaboration between universities and business or other organisations.
[27] Grant Letter from BIS. http://www.hefce.ac.uk/news/newsarchive/2015/name,100591,en.html

Following a second call for bids for the remaining £80 million, six further projects have been announced. This brings the total number of projects to 20 and the final commitment from RPIF to £301.4 million, levering £855 million from business and charities and total investment of £1.156 billion.

3.3.2. Research Councils UK (RCUK)

Science Budget Allocation 2014/15:
Resource Allocation £2.6 billion; Capital Allocation £0.18 billion[28]

In addition to the HEFCE-run initiatives, another key structure supporting UK R&D is the Research Councils (RCs). Each is a Royal Charter Body, at arms length from government. There are seven in total covering the full spectrum of academic disciplines.

1. The Arts and Humanities Research Council (AHRC)
2. The Biotechnology and Biological Sciences Research Council (BBSRC)
3. The Economic and Social Research Council (ESRC)
4. The Engineering and Physical Sciences Research Council (EPSRC)
5. The Medical Research Council (MRC)
6. The Natural Environment Research Council (NERC)
7. The Science and Technology Facilities Council (STFC)

The RCs invest in research and training, currently supporting over 40,000 research projects, delivered by 30,000 researchers.[29] All research supported by the RCs is selected on the basis of research excellence and assessed through detailed peer review. The areas of research, alongside the ideas to be investigated, are defined by researchers, either by submitting a proposal directly or by informing a Research Council's strategic priorities. The RCs develop their strategies and priorities through a strong consultative process, involving leading academic researchers, representatives from industry, the public sector and third sectors (e.g. charities) recognised for their knowledge in the field.

Approximately half of all RC funding is distributed in 'responsive mode' (unsolicited ideas in any area). The balance is distributed through a wide range of mechanisms appropriate to the RC and the research challenge under investigation such as thematic programmes, knowledge exchange activities and facilities. In addition, four of the RCs (BBSRC, MRC, NERC, STFC) support research institutes that they fully or partially fund.

The RCs support substantial activity underpinning future growth in key sectors, such as those identified in the Industrial Strategy, e.g. annual spend in health-related research is over £1 billion. Many RCs have more than half of their spend aligned to the Industrial Strategy sectors, e.g. construction, aerospace, automotive, renewable energy, agri-food and pharmaceuticals, often in partnership with other agencies such as Innovate UK.

The RCs have a commitment to achieve impact from the excellent research they fund. To deliver impact, researchers need to engage and collaborate with the public, business, government and the third sector. The RCs support multiple opportunities for business involvement at a number of different levels and encourage business to move up the pipeline. At a small scale, collaborative studentships offer low-cost, low-risk engagement. Moving up the pipeline, there are opportunities to collaborate on research grants and at a

[28] http://www.rcuk.ac.uk/about/aboutrcs/governmentfunding/
[29] NCUB: State of the Relationship

high level, there are opportunities that include integrating the future research and development (R&D) of a company with the research base through strategic partnerships and major collaborative initiatives such as research centres.

The proportion of RC funding going towards research conducted in collaboration with industry varies across the Research Councils, reflecting the scale and nature of their respective activities. The RCs' estimate is that, as an overall figure, this would be somewhere around 20 per cent. A summary of the types of support provided by the RCs is contained in Appendix 2. The RCs also seek to influence culture and behaviour through initiatives such as Pathways to Impact, open access policy, awards and incentives.

UK Gateway to Research[30]

Launched in 2013, the **Gateway to Research (GtR)** website has been developed by the RCs to enable users to search and analyse information about publicly-funded research. While the website is aimed at innovative small and medium-sized enterprises (SMEs), it is also a useful tool for larger corporations (see case study below), providing organisations with easy access to information about current research projects and outcomes of past projects. It provides a search interface for users to interrogate over 40,000 research projects and their outcomes, allowing users to explore emerging areas for research and the researchers behind them.

Case Study: BAE Systems[31]

BAE Systems (BAE) is the UK's largest defence and security company with approximately 34,800 employees at 50 locations in the UK and over 84,000 globally. The introduction to GtR for companies like BAE has helped them better identify opportunities to engage with academics and exploit the outputs of RC-funded projects. In particular, the cross-Research Council nature of GtR has enabled BAE to explore a greater range of RC funding than they had previously considered.

BaE are now using GtR to inform three key aspects of their work:

- Input to their Technology Foresight Team enabling them to see what research has been funded ahead of publications;
- Identifying who they could work with at universities once they have identified topics of interest, e.g. 3D printing; and
- Using GtR to search out new capabilities.

[30] http://gtr.rcuk.ac.uk/resources/about.html
[31] NCUB State of the Relationship

3.3.3. Innovate UK (Previously the Technology Strategy Board or TSB)

Innovate UK is an executive non-departmental public body, sponsored by BIS, with the aim of **accelerating the UK's economic growth by stimulating and supporting business-led innovation**. Specifically, the organisation's goals are to:

- Provide new support for innovative SMEs with high-growth potential;
- Ensure that government initiatives such as the Small Business Research Initiative (SBRI) attract innovative UK businesses and give companies access to important customers in the public sector;
- Identify and invest in the sectors that have the greatest potential for innovation to speed up economic growth; and
- Help innovative companies work with their backers so their ideas can be developed commercially.

This includes collaboration with universities: the programmes supported often enable a business-research base engagement, with the desired outcome that the investing businesses often choose to collaborate with the research base. Approximately 30 per cent of the total grant funding goes to research base partners and 60 per cent of projects involve collaboration with the research base.

Over 150 different research base organisations from across the UK, including nearly all UK universities and a significant number of research institutes, are currently working with industry partners on Innovate UK projects. Innovate UK categorise the different forms of support it offers to businesses as follows:

- Investment for growth: Access grant funding.
- Networking and partnership: Find partners and collaborators for innovation.
- Expertise and advice: Find knowledge and advice for their innovation journey.
- Specialist facilities: Access facilities to develop and test new technologies.
- Government contracts: Develop products/services for public sector needs.

Innovate UK states that **engagement with the research base** is an important element in almost all of their programmes and particularly those listed in Appendix 1 of this report.

3.3.4. Other Sources

In addition to the key sources discussed above, there are other sources of UK-based funding for different types of knowledge exchange within universities, including funding by charities such as the Wellcome Trust and Royal Society.

3.3.5. Other Government Schemes

In addition to the large pools of funding the government allocates through the various vehicles summarised above, the government also supports corporations in their R&D activities through the provision of tax credits and other initiatives.

R&D Tax Credits

Research and development (R&D) tax credits are a company tax relief, which can either reduce a company's tax bill or, for some SMEs, provide a cash sum. R&D tax credits are the largest source of government support for business R&D.

From 1 April 2012, the rate of relief under the SME scheme increased to 225 per cent of qualifying expenditure. The rate under the large company scheme is 130 per cent of qualifying R&D expenditure. The government introduced a new Above The Line (ATL) Credit for large company R&D investment from April 2013. In the 2013 Budget, the government announced that the headline rate of the ATL credit would be increased to 10 per cent from the 9.1 per cent rate proposed in the previous year's (2012) Budget.

The SME scheme is now worth up to about 30p for every £1 spent and the large company scheme is worth about 7p for every £1 spent. Claims for 2010/11 totalled £1.1 billion, supporting R&D investment by business totalling £10.9 billion. This amount claimed was divided between 10,290 businesses in 2010/11.

Patent Box

The Patent Box was introduced from April 2013. This tax provision reduces the rate of corporation tax on the income derived from patents to 10 per cent, with the aim of incentivising firms to engage in research and development activity. However, in 2014 the UK agreed to put forward a proposal to close its Patent Box tax break in a concession to German Government concerns about the artificial shifting of profits between European countries. If the proposal is agreed by the OCED, the Patent Box will close to new entrants in June 2016 and will stop operating in June 2021.[32]

Growth Accelerator[33]

Growth Accelerator is a government-supported service that provides coaching and advice to help SMEs to grow quickly and sustainably. Of relevance to this report is that it provides access for SMEs to innovation experts who can help businesses to:

- Understand how to convert ideas into business value;
- Create new or improved products and services;
- Commercialise products, services and business models;
- Identify, protect and monetise intellectual property (IP);
- Embed an innovative and entrepreneurial culture;
- Create successful partnerships and collaborations; and
- Spark creativity in their teams.

In addition, to helping find and win the right sort of R&D grants for their business, the service provides access to a network of over 800 experts with experience of starting, managing and growing successful businesses. The government has indicated that it will invest £200 million in supporting up to 26,000 SMEs.

[32] www.outlaw.com
[33] http://www.ga.businessgrowthservice.greatbusiness.gov.uk

3.3.6. Smaller Schemes

Beyond BIS, there are many smaller schemes that support businesses to access:

- Government grants;
- Publicly-backed finance and loans;
- Business support, e.g. mentoring, consultancy; and
- Funding for SMEs and startups.

The UK Government's website provides a tool enabling companies to find the different sources of support available to businesses by sector, in their location, for their size of business.

3.4. Data on Collaborations

Data collected by HEFCE in their annual Higher Education Business and Community Interaction Survey (HE-BCI) shows the various ways in which knowledge was exchanged between UK HEIs and the public, private and third sectors (voluntary and community groups, social enterprises, charities, co-operatives and mutual funds) in 2012–13.[34]

Figure 5: Knowledge Exchange Mechanisms: Main indicators: £000s cash terms

Indicator	2012–13	% of total
Collaborative research	951,126	27%
Consultancy	399,738	11%
Contract research	1,166,038	33%
Continuing professional development and continuing education	653,305	18%
Facilities and equipment related services	141,514	4%
Intellectual property income	86,640	2%
Regeneration and development programmes	172,069	5%
TOTAL	**3,570,430**	**100%**

By far, the largest components are **contract research and collaborative research**.
A review of the income generated in both of these areas over the past decade, shows that they have both grown as an overall proportion of knowledge exchange (KE) income.

Another interesting fact from this HE-BCI survey, between 2012–13 is that:

- Large businesses increased their investment to HEIs by 11 per cent (to £729 million);
- SMEs decreased their investment by 1 per cent (£181 million); and
- Incomes to HEIs from the public and the third sector increased by 2 per cent (to £1,295 million).

[34] HEFCE (2014), Higher Education – Business and Community Interaction Survey, 2012-2013

It does seem though, that based upon data from the National Centre for Universities and Business (NCUB), supported by comments from our interviewees, that many of the collaborations that happen between universities and businesses do so independently of public policy.

Indeed, research cited by NCUB[35] from the 2011 UK Innovation Survey shows that, while 20 per cent of innovative firms cite universities and other higher education institutes as co-operation partners, only 3 per cent of responding firms ranked universities and other HEIs as of 'high importance' sources of information for innovation. Government or public research institutes were ranked 'high' by just 2 per cent of responding firms. The central role of customer and supplier relationships in the innovation process also means that 40 per cent of innovating firms rank clients and customers as of high importance.

Other research supports this, that for businesses, knowledge sources are found within the business, customers and suppliers, rather than from university research, and knowledge sources are often combined for example with the use of intermediary institutions and private–public organisations.[36]

These findings highlight the opportunity for HEIs to become, or at least to be considered, more important repositories of information for industry.

4. Perspectives on Commercialisation of Research in the UK

Numerous stakeholders interact with government to advise and influence on policy affecting business–university collaborations and the commercialisation of research. In our primary research for this project, we spoke with individuals working in the following organisations and institutions.

- Research Associate, Centre for Science, Technology and Innovation Policy (CSTI) University of Cambridge
- Vice Chancellor, Edinburgh Napier University
- Government Chief Scientific Officer and Head, Government Office for Science
- Head of Business and Community, HEFCE
- Research Director, National Centre for Universities and Business
- Managing Director, UCLB (the TTO of UCL)
- Assistant Director for Policy, International Unit, Universities UK

Their perspectives and comments are summarised in the following section, together with some of the findings from the literature review.

Again, we caution that the limitations of the project have been such that it has not been possible to provide an authoritative evaluation of UK Government policy impacting on the commercialisation of research. Rather, we have aimed, through talking to senior stakeholders involved in this area, to identify some of the key issues where the government might have, has attempted to have, or has achieved an impact in this regard.

[35] *Ibid*
[36] Open Innovation, the Haldane Principle and the New Production of Knowledge: Science Policy and University-Industry Links in the UK after the Financial Crisis, Hughes, 2011

In some of the other countries under investigation, the debate about what is required to support the commercialisation of research is still in its early stages and, hence, our discussions tended to focus on barriers to getting university research out into the broader community. In the UK, by contrast, our respondents rarely referred to these types of blockages, instead tending to focus on broader, more strategic issues that they thought relevant to government policy in this area.

4.1. Overall Perspective

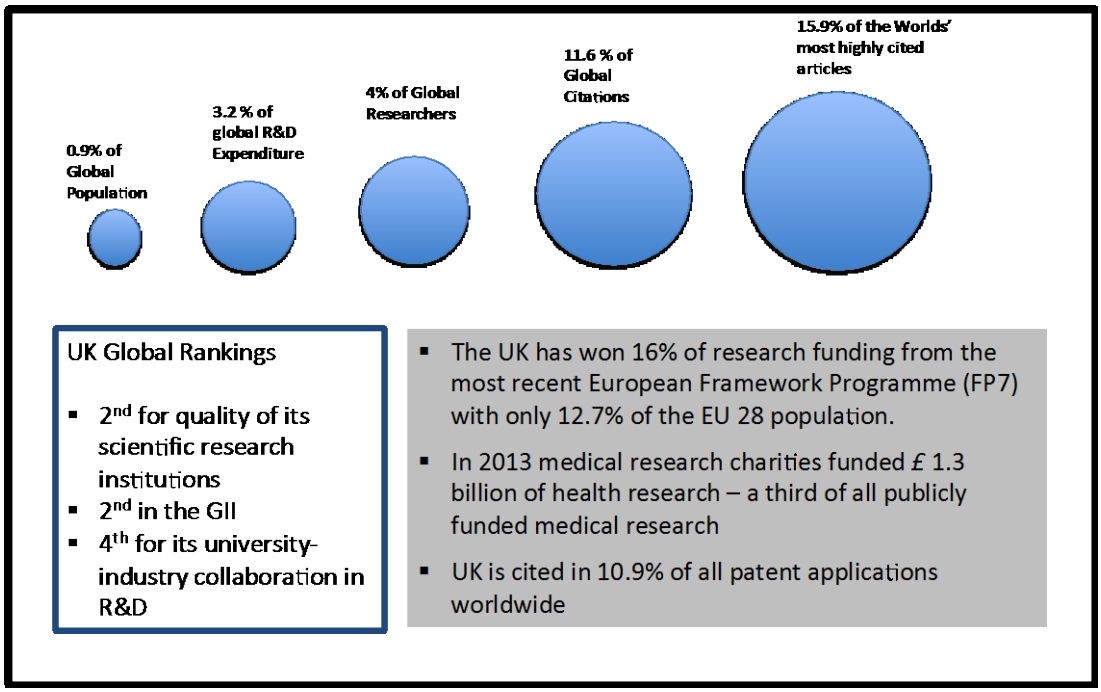
Overall, the impression that we received from talking with our respondents is that the UK Government is taking a serious and considered approach to the issue of government policy affecting the commercialisation of research, attempting to build the framework on which a highly functioning, cohesive and ideally ultimately self-perpetuating, ecosystem will flourish.

We were given a strong sense from the British respondents that there are innumerable ideas emanating from universities and many as yet untapped opportunities in the UK for businesses and universities to collaborate, a sentiment supported by the Witty Review[37] which concluded:

> *"The UK has an extraordinary wealth of ideas, technology and human energy – much of which is world-leading and capable of seeding not just new companies but whole industries with potential to build substantial export positions".*

The strength of the UK's research and innovation is summarised in the following infographic from the Royal Society.[38]

Figure 6: The Strength of UK Research and Innovation



[37] BIS (2013), Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth
[38] https://royalsociety.org/policy/publications/2015/stronger-future/

Indeed, a number of our respondents were keen to point out that, contrary to public belief, the UK universities actually performed very well in terms of commercialising their research output.

> *"There's all this talk about the US and there's this big bugbear about how wonderful they are. Politicians want to know why we're not like them…the big difference is that they're breathtakingly richer. Even compared to Oxford, they've got 10 times the revenue; mainly from their endowments."*

We asked our respondents what they would change, if they were given the opportunity, about the way that research was being commercialised in the UK. Interestingly, the interviewees found it difficult to think of any major issues that were not already being addressed. Most of the changes they suggested, they said, would be incremental to whatever was already going on in the UK (an indication that there is a belief that government policy is moving in the right direction).

However, in his review, Sir Andrew Witty highlighted that there was, indeed, room for improvement stating:[39]

> *"Significant scope exists to better align funding streams, organisational focus and increase cross-institution collaboration to avoid delays in ideas reaching maturity and the risk of British inventions building foreign industries".*

His recommendations for achieving this are based upon three key philosophies.[40]

1. *Structure funding flows by technology/industry opportunity – not by postcode. We should embrace the country's density of population and institutions and drive greater collaboration wherever the 'idea flows' – eliminating unnecessary regional barriers which create domestic competition instead of marshalling our resources to run a global race.*

2. *Universities have an extraordinary potential to enhance economic growth. The full diversity of institutions have a role to play from local SME support and supply chain creation to primary technology leadership and breakthrough invention. Incentives should be strengthened to encourage maximum engagement from universities in the third mission alongside research and education.*

3. *Government should help facilitate what I have called Arrow Projects to drive forward globally competitive technological ideas into real businesses. The Arrows should provide full support to the invention at the 'Tip' and should be uninhibited by institutional status, geography or source of funding. Government should put its weight behind creating global scale through encouragement of real collaboration in fields in which we can win. A great debate has taken place on whether Britain can or should have an ambition to grow its manufacturing sector. It seems obvious that at least two basic conditions need to be met to have any chance of a long-term sustainable manufacturing base: an invention culture that successfully translates from 'mind to factory'; and a globally competitive sense of timing and scale.*

[39] *Ibid*.
[40] *Ibid*.

4.2. Perceptions of Commercialisation

4.2.1. Changing Perceptions

In setting the stage for the current policies relating to commercialisation of research, many of our respondents started by providing an historical overview of changing perceptions of commercialisation.

While it is beyond the scope of this study to provide an authoritative overview of these historical changes, it is useful to provide an understanding of how things have changed in the last few decades.

As was indicated to us, when it comes to the measures/policies to support the commercialisation of research, there has been a shift in the primary rationale of governments in most countries, from an earlier focus on addressing barriers to technology transfer (for example, spinning out companies[41] and the licensing of technology) to today's broader objective of enabling knowledge transfer.

As detailed in a recent NCUB Report, this shift in policy objectives "*aims to optimise a broader range of innovation modes which build on a systemic view of innovation, involving less tangible interactions and feedback loops between parties. Consequently, a more sophisticated policy design is needed in order to optimise the full range of potential benefits that may arise from the collaboration*."[42]

Talking about commercialisation within the UK, our respondents were keen to stress that IP/licensing of technologies only forms a very small part of commercialisation income. (The actual proportion is detailed below.)

> *"The IP is irrelevant. The income from it just about covers the cost of managing the IP. It's part of a portfolio and certainly one of the issues if you want industry (and universities) to work together. But you have to recognise that the IP will go down, because the industry will have the money in the co-investment: the unis will give them the IP, so there will be no free IP to spin out. It's part of the portfolio."*

More recently, there has been a growing recognition that commercialisation involves a very broad set of mechanisms, and it is not just limited to business, but rather between universities and the community – including the private sector, public sector, charitable organisations and others.

In addition, it is not just about linking a university researcher to a business. Instead, there is a need for an entire '**ecosystem'** to support the output of researchers.

> *"You do need fundamental research, ability to apply it, to connect it to industrial demand. You need human capital skills – both in terms of entrepreneurism and the ability to apply this. How that's organised in institutions differs between countries."*

[41] A spin-out is a separate company, set up independently of the original institution.
[42] NCUB, *State of Things*

It was highlighted in the Witty Report that this process might be easier for large corporations, i.e. they know who to go to, but for many SMEs the research landscape is more opaque.

Today, according to many of our respondents, the debate has swung away from focusing on technology transfer and the commercialisation of research in its narrowest conceptualisation, to a broader idea of encouraging academics and businesses to come together, to build mutually advantageous relationships, where each party would better understand the other's needs.

> *"It's partly been a deliberate attempt to get policymakers to think about the breadth of mechanisms through which knowledge is exchanged…Which could be in one direction – they need something, they come to us, we give them the knowledge. But there's also been a realisation that a lot was flowing in the other direction, for example, academics working with or inside companies to find out what their challenges were, the constraints they might face."*

Under this paradigm, it is argued, that the research produced is bound to be more useful and to have other spin-off benefits.

> *"Any linkages may lead to further connection between the two sectors. The more you build it in, the more it's just that – the third mission[43] – you say, well do it as part of what you normally do."*

4.3. Barriers to Collaboration

As already indicated, our interviews with UK respondents tended to move on quickly from the more basic questions about barriers to commercialisation on to other issues, including the impact of specific policies, the role for government and others, all reported below.

However, there is plenty of literature on the subject. For example, the 2012 Wilson Review[44] cites research conducted by Imperial College which points to a number of reasons why university–business collaboration activities may not progress beyond the stage of initial discussions. They include both supply/push barriers (from the universities) and demand/push ones (from businesses and other external organisations) summarised as follows.

- The needs of business do not align with the mission and strategy of the university and expectations of outcomes may differ.
- Universities operate on longer-term commitments than the timescales required by business. Sometimes this is down to the bidding cycle for external funding.
- Universities may lack the skill set or the facilities to meet the needs of business.
- The two parties may not agree on a suitable price for the service. This is particularly the case in the context of full economic costing in research collaboration.
- Failure to agree ownership of intellectual property that may be generated: despite significant progress since the publication of the Lambert Intellectual Property agreements, this is still reported as a significant issue in some negotiations.

[43] Universities should have a 'third mission' assuming responsibility for facilitating economic growth according to Sir Andrew Witty in his report: Encouraging a British Invention Revolution: Review of Universities and Growth
[44] Professor Sir Tim Wilson (2012), A Review of Business–University Collaboration

- Contrasting views on the management of indemnities and liabilities between prospective partners; viewed as being an increasing problem.

"The practical things remain a pain in the neck, who pays for what – that's always a problem. Governments are always very opaque on what they're paying for. Universities are essentially private, but they get a lot of public funding. There's an ambiguity in knowledge exchange about who should pay for what and a lot of rhetoric from the government. Research and teaching are public goods. But then industry says growth is a public good, so pay me…"

"Particularly when we ask about barriers to the business – they will mention funding – unis will always ask for more funding even if they don't know what it's for."

4.4. Supply Side Considerations

Whereas respondents in some of the other countries included in this project spoke at some length of the supply-side obstacles to the commercialisation of research – and specifically the funding and promotion regimes which favoured academic citations – in the UK, the debate tended to focus on the steps that had been take to ameliorate these obstacles.

"There are barriers, but there is much less discourse than there used to be about cultural things. Nowadays we don't get that any more."

"That's a 20 year old view. A long time ago, that would have been a fair criticism – but these days it's not fair. The incentives for academics in the UK to push their work out is very strong. I think the universities are completely different places from what they were."

4.4.1. Inducement or Non-Directed Schemes

One of the distinctive aspects of government policy in the UK is the stream of public funding that works to induce collaboration, that is, the funding rewards collaboration when it has occurred, rather than being targeted at specific activities.

"In the UK, we'll give you a pot of money for doing your engagement with non-academics, but we will only evaluate your success and give you more money in terms of what comes out on the other side. One of the distinctive features of the UK system of induced support is that it's based on outputs – not inputs. We think it's more effective. It allows the receiving institution to manage the funds to induce collaboration in the best way they can, rather than tell them this is what you should do with it. There are many approaches and this is the one we use in the UK. Most inducements are in terms of giving money to induce particular behaviours and then evaluate them to see if they have happened or not."

Two of the key schemes that fall under this 'inducement' type approach are those provided by HEFCE – HEIF and RPIF – outlined earlier and explored further below.

4.4.2. HEIF

The funding provided under the HEIF scheme is one of the more interesting examples we found of government policy designed to support collaboration between industry and universities. It was spontaneously raised in most of our interviews in the UK and most of the comments relating to this scheme were largely positive.

Background to HEIF

Some of our respondents talked about the context within which HEIF had been developed.

> *"What's interesting if you imagine the process…how do external organisations work with unis to extract value from them and form some kind of partnership…and do something useful with it? If you think about those steps, as an academic, I may need certain skills to interact. But academics are funny beasts. Some, but not all of them, are good to talk to people outside, so they might need enhancements to their capabilities. Where HEIF comes in is it provides support to universities to build up their internal capabilities and also helps them with proof of concept funds and investing in training. But effectively it's around building the capability and capacity to engage…Knowledge exchange funding is given to universities on a formula. It's all about incentivising them to maximise knowledge exchange and for them to take it forward themselves. How do you imbed incentives and behaviour changes, whether it's in a Technology Transfer Office or as support for student entrepreneurship?"*

> *"The idea that we could put fortunes into the question of creating a blockbuster – we'd not achieve anything. So instead we increase the levels of involvement generally…not only are you maximising the chances, you're also changing the perceptions of academics that it might be more plausible that they can turn something into a spin-out."*

HEIF is part of a broader shift within HEFCE to allocate funding based on the **impact of research** (referenced earlier in this report).

The focus is upon **incentivising behaviour change among academics**, encouraging them to forge external relationships and on universities to work out the best ways to support them.

> *"The policies are quite broad – they incentivise relationships – put the onus at the local, researcher level. It recognises that working with industry is only one of the things that you might do to have an impact, but any researcher will have multiple interactions. It all then relies on the practise being shaped by the unis themselves. The researchers work out their engagement strategies and the universities work out the optimum way to support their researchers."*

Impact of HEIF

The Witty Report states that "*The majority of universities have embedded knowledge exchange"* activities and many already take a strategic approach to these. In recent research, 80 per cent reported that they have taken steps to align with the key national priorities of the Research Councils and Innovate UK. Many are working to increase the competitiveness of their local and regional economies, offering services ranging from entrepreneurship training to working directly with their LEPs.

The following points summarise the survey responses from institutions in connection with the issue of how their institution is planning to adapt and develop their knowledge exchange activities over the period 2011–2015 taken from a survey undertaken by PACE/HEFCE in 2012.[45]

- 80 per cent are taking steps to align with key national priorities of RCs and TSB[46].
- 80 per cent are seeking internal changes to help improve efficiency and effectiveness.
- 75 per cent are exploring shared services and collaborations for KE.
- 52 per cent are seeking a greater focus on private KE.
- 43 per cent believe the increased profile of KE amongst research funders is a key enabler.
- 42 per cent believe the strength of their KE infrastructure/support is a key enabler.

In addition, a more recent review of HEIF conducted by Tomas Ulrichsen,[47] does seem to indicate overall support for the funding model. Ulrichsen reports that HEIF funding is a critical part of the KE funding landscape, allowing HEIs to build the necessary capacity to experiment and learn from ways to engage with external users.

Quantitative analysis to calculate the impact of HEFCE funding shows that every £1 of HEIF received over the period 2003–2012 is associated with approximately £6.3 of gross additional KE income over the same period. This value increases for higher research-intensive HEIs and decreases for the less research-intensive institutions.

A further analysis shows that a 1 per cent increase in HEIF is associated with a 0.3 per cent to 0.37 per cent increase in KE income per academic full-time equivalent post. This would be equivalent to a £5.7 – £7.1 uplift in KE income to the sector over the period 2009–2012 from a £1 increase in HEIF funding over the same period.

Econometric analysis provides strong evidence of path dependency in the HE KE system – i.e. that the income secured in the current period depends to some extent on the amount secured in the past. Ulrichsen suggests this could be due to a number of reasons, including learning from past experiences; the long-term effects of investment in capability and capacity to engage, including in KE support infrastructure, training, organisational changes and academic culture change; and the formation of long-term relationships with, in particular, higher value external partners, leading to repeated and ongoing interactions.

[45] Strengthening the Contribution of English HEIs to the Innovation System: KE and HEIF Funding: PACEC/HEFCE 2012
[46] TSB is now known as Innovate UK
[47] Tomas Coates Ulrichsen (2014), KE Performance and the Impact of HEIF in the English Higher Education Sector, Report for HEFCE

Beyond the quantitative analysis, Ulrichsen notes the contributions to the local and national economies that a diverse range of HEIs – not just research-intensives – are delivering as a result of HEFCE KE funding, including being able to:

- Strengthen the contribution universities are making to local economic growth through a diverse set of mechanisms. Examples included:
    - Regenerating disused sites in the local economy to support local innovation;
    - Creating more coordinated innovation infrastructure and support for the local economy;
    - Providing R&D and innovation-related services to local firms;
    - Providing business support, mentoring, networking & training to local SMEs;
    - Working to attract inward investment, and supporting SMEs to realise export potential by leveraging experience of operating in, and infrastructure located in, overseas markets; and
    - Working actively with the LEPs to strengthen local innovation.
- Strengthen the focus on, and support for, student enterprise and entrepreneurship;
- Strengthen internal capabilities to improve the KE process, including a movement towards longer-term, deeper and more strategic partnerships; and
- Achieve successes through commercialisation of university intellectual property.

Overall, Ulrichsen paints a picture of HEIs having to navigate a turbulent economic landscape where the nature of demand is changing. Some institutions have to restructure their KE offer and find new clients while others have been able to respond quickly to new opportunities. However, what is also clear is that this is not sufficient. Innovation in partnership models also appears to be important for structuring the relationships and making it easier for firms and other external organisations to identify, access and exploit university-based knowledge. However, in summary, Ulrichsen does conclude that HEFCE KE funding is a critical part of the KE funding landscape that enables a diverse range of contributions to the local and national innovation systems to be realised.

Centralised or devolved

One of the key aspects of HEIF is that there is no single model for spending the funding. Some institutions choose to use it centrally, while others take a broader approach.

> *"Some institutions use [the funding] to build their professional capacity, so perhaps it pays some salaries. Some are using it for riskier things – as venture capital or proof of concept, so for that small stage, risk capital, for example if they have to build a prototype to see if it works. They need that little bit of money to take it to the next stage. Some use it for community outreach or social entrepreneurship. It's a competitive system, but they haven't picked winners."*

> *"Somewhere, like Imperial, is quite centralised and that's because they argue that their departments are quite entrepreneurial and so they tend to focus strategically across the universities. Some do it a lower level – leave it to the researchers to determine."*

Capping impact-based funds

Not everyone we spoke to was completely positive about HEIF, with some questioning the efficacy of how the funds are allocated and used. For example, some query the cap on institutions, arguing that the most effective institutions should be able to receive larger sums.

> *"There has been some questioning of whether it should be directed to concentrated unis or to all unis. Personally, in my view, many of the unis were wasting it and they didn't know what to do with it. So I think that they should concentrate it on the unis that know what they're doing. And it's capped – so even the best universities can only receive up to a certain amount, whatever the size of the organisation. When you're turning over more than £1 billion, £3 million of HEIF is not that interesting. Especially when you think that a uni that's one-quarter the size still gets £1 million. But that's the formula and so that's how it's divvied up. 'We have to be fair and share it across': that's the collegiate approach. My argument is to hand it to the ones that are delivering what you want."*

Overall though, for the most part, it seems that HEIF is seen as successful and transformative.

> *"If you go back 10 to 15 years, a lot of the unis lacked the basic capabilities and skills to put together relationships. A lot of the change has been down to the availability of the resources that have been enabled by HEIF."*

4.4.3. Research Partnership Innovation Fund

A couple of respondents spoke in positive terms about another HEFCE program – the Research Partnership Innovation Fund (RPIF), which gives awards to large-scale projects and can attract at least double the level of public investment from private and charitable sources. It has been a success, so far securing more than £1.3 billion of new investment in world-class research facilities that benefits both universities and their business partners.

Unlike HEIF, which is capped at a fairly low amount (a maximum £2.8 million per year), RFIP can help with building the larger amounts required for more 'lumpy' types of major building or investments, for example, in the co-location of companies.

The RPIF is fairly leveraged – every pound of public funding must be matched by double that amount from industry.

> *"If you go on the basis that industry wouldn't invest that scale of funding if they didn't believe there was some value, they must at least value it in some way."*

Case Study: University of Surrey 5G Centre

The University of Surrey is referred to as an example of the success of the RPIF scheme.[48] Under this scheme, the University 5G Centre, using £11.6 million from RPIF, has leveraged more than £30 million from a consortium of mobile communications global industry leaders.

The new collaborative international research centre will support the development of 5th generation cellular communications providing real-time experimental facilities to underpin the development of new mobile broadband internet products and services.

Again, Ulrichsen finds that RPIF has been positive and resulted in disproportionate income at the other end.

However, it does appear that there are some issues regarding the timing for RPIF submissions as the following comment illustrates.

> *"One of the things I'm wary of is that these funding bids take a long time to put together, sometimes it's not long enough. It's not a responsive model – calls every couple of years. One of the things is, when your partnerships are developing, they might get to a point where you need it, you are limited by capital investment. If the timing is out of whack, you've just missed it, you have to wait another year."*

4.4.4. Institutional environment

A number of the UK respondents spoke of the impact that an institutional environment could have upon the success of commercialisation activities. Those HEIs with a positive attitude towards engagement with business were, it was argued, more likely to have collaborative engagements with business. University College London (UCL) was raised by one of our interviewees as an example of an institution that was providing a good environment.

> *"The institutional context within which you operate matters – if it's hostile towards my engagement with industry, my behaviour might be quite different – versus one that's actively involved…UCL in the last 10 years has created, in a very proactive way, at a much more institutional level, sets of infrastructure and supports and sets of incentives to support engagements. The Research Excellence Framework – this time around it had an impact section and UCL came out first. It's not a coincidence – they are very good at going after these large scale, multi-disciplinary projects that involves industry."*

[48] BIS (2014): Creating the Future: A 2020 Vision for Science & Research: A Consultation on Proposals for Long-Term Capital Investment in Science and Research

4.4.5. Applied versus Basic Research

With the change by HEFCE from the RAE to REF outlined earlier, the people we consulted and the literature review were agreed on the need to be careful that a focus on the outcomes of research did not mean that basic research ended up being neglected.

> *"Academics say, well why don't we just do applied research. But it's [REF] not intended to do that: it might inspire you to have a fundamental idea. It's not meant to narrow your horizons – you have to get that message and also it's a big system. Worry that there's someone out there. It has to percolate through from senior people and heads of department and administration. This is what it's about – it's not about everyone doing applied research. It's more subtle. Which is why it's good that we're building it on the technology exchanges stuff that we started in the 1990s."*

> *"Sometimes people say we should only do what's obviously useful, then sometimes you miss what's most transformative because it came out of a very niche bit of research."*

> *"At the end of the day, you need a basket of measures. The bulk is in research paper outlets that reflect diverse incentives – the impact has only been measured for first time in this latest REF and it's only a part of how it's evaluated. Frankly it's about avoiding single incentives."*

Indeed, we were told by numerous respondents that it was the types of breakthroughs that occurred through basic research that were most likely to result in the useful outcomes for applied research. Again, this required time and a willingness to try out many things that might not actually end up having useful end results.

4.4.6. University Technology Transfer Offices

One of our respondents discussed the danger of relying upon Technology Transfer Offices (TTOs) to assume responsibility for licensing arrangements without understanding the broader relationship that might be at stake.

> *"A lot of uni contract offices are very good at looking at the research funding contracts, but industrial research contracts are quite different and might need a different set of skills. For example, if you take industrial research contracts – you can get tensions arising in the incentives. So, if I'm a TTO and I'm focusing on my research output, the way I do that, the decisions I make in terms of who I sell the technologies to might be different. For example, take a hypothetical big relationship involving millions – if I'm in the PVC's office and I'm thinking how to develop the relationship – I want the multi-million pound investment. If I'm a TTO and I don't have any understanding of that bigger relationship, say I have some technology and I'm trying to push this to get an aggressive rate, insisting on doing so in terms of IP protection, it might sour the relationship. So you have the research relationship and the more holistic relationship. The guys leading Berkeley in 2003, they merged their TTO with their business office, so they were talking to industry with one voice."*

4.5. Demand Side Considerations

Many of our respondents were of the opinion that there are significant barriers from the demand side, such as poor communication, not knowing where to go, a lack of an entrepreneurial spirit and a lack of willingness to put up long-term investment.

> *"Often there can be an obsession on the supply side – based on the assumption that universities are [useless] at doing this [commercialising]. But the question also arises, what kinds of changes are companies realising and has it led to any changes in performance? So, if I develop a new way of producing something – if I find this great new process for doing something and try to go and sell it or patent it or flog it to a company or form a relationship with a company – if that company has no ability to do anything with it, to understand it, to incorporate it into its existing activities, to develop a product around it – it's not going to generate any value."*

> *"I hear lots of stories that legal teams are so risk averse, they don't want to form these partnerships. Now that's through no fault of the academic sector. In this interesting transformative time, where companies are increasingly working with other companies and research organisations, managers may well have been trained 30 to 40 years ago, they've grown up with corporate labs – their capabilities are all how do they manage internal teams. So the question is, do they have the capabilities to manage external teams?"*

For some, this raised the more general question of what the government is doing on the demand side at a macro level (trying to retain companies in the UK) and/or micro level (training the right kind of people to work on the demand side, who are able to work collaboratively across organisational boundaries).

> *"One of the big areas that the government needs to concentrate on is the demand side. So if we create a spin-out and we look to financing, if there's no one to support us here, then it goes somewhere else…on the demand side, we need to keep these companies here so they don't move out of the UK. There are some initiatives there: the Patent Box, R&D tax credit, entrepreneurial relief. If we, as a university, are creating these opportunities, we can't be responsible for spin-out once it's out of the uni. That's now the responsibility of the board of management and shareholders."*

4.5.1. Lack of Information

According to some respondents, a significant barrier for university–business collaboration is the lack of information. This appears to manifest itself in a number of ways including:

- Businesses lack information about where to find solutions to their problems; and
- For academics, how to match up their solutions to businesses that might need them.

This barrier is, as already mentioned, reportedly less likely to be faced in large businesses. With specialist staff working in the areas of research and pre-existing relationships with academic institutions, this typically helps larger organisations to identify places or people who can help them solve their problems.

In contrast, for SMEs and LEPs, the research landscape is more opaque. It is this group, in particular, that would seem to benefit from greater transparency, as would universities able to make their activity and competence known to a wider audience of prospective research partners.

Furthermore, it was reported to us that those unfamiliar with dealing with universities can find it daunting to know where to start looking.

> *"So brokering new relationships, finding solutions about potential problems and potential new problems to solve, if you take yourself away from typical examples – of Airbus or Glaxo Kline or Pfizer – and take away big players and go down to others that look for other issues, they will tell you this is a barrier."*

Those businesses seeking new relationships tend to limit themselves to considering the same small number of institutions.

> *"The most reported barrier is 'we don't know where to go', when we asked 30 businesses to mention which unis they were talking to – all in total were repeating the same names, 10 – even though there is bigger capability for solving problems across the food economy value chain, there were only the 10 typical ones that everyone would go to – so somehow it limited other universities to come into the circle. So you end up in a kind of vicious circle – I know they can solve my problem and I will go to them, but won't talk to another uni if they come to talk to you because you only know XYZ."*

4.5.2. Communication

Another reported barrier is the difficulty businesses face in communicating with academics.

> *"Difficulties for communication, particularly among the smaller businesses that don't have a resident researcher. They find it hard to talk to them and intimidating. So we suggest, why don't you get a resident researcher that will sort this problem for them. This is where the exchange of people between academia and business becomes more important – using the presence of an academic in the business sector, to improve communication structures, so that smaller businesses can feel more confident to work together."*

> *"I think in building the relationships, universities find it easier because they already have an eclectic culture. Industries tend to be more focused and specialist – they find it an odd environment, whereas unis are used to everyone being odd!"*

4.5.3. Investment

A number of our respondents – though interesting to report, not all – said that the main barrier to commercialisation was a lack of investment.

> *"Everyone will tell you that the main blockage for all this stuff is that we haven't got enough investment to drive it forward or the right talent to drive it forward. There is no problem with the flow of intellectual property or ideas coming through. But we are in competition with plenty of other international organisations and countries, and some of the developing ones will be a concern in the future – China, India, Turkey. I just had a visit from some colleagues in Japan. They've just received $250 million to create a business office in their university with translational capacity."*

However, there is certainly also the opinion that there is a need for greater government support to commercialise research. In a joint statement released by the National Academies (a group comprising the Academy of Medical Sciences, the British Academy, the Royal Academy of Engineering and the Royal Society) urges the government to double their research spending from 0.5 per cent to 1 per cent of GDP and for business to increase their spending from 1.23 per cent to 2 per cent.[49] Without increased research spending, there was a danger that researchers would be driven abroad – for example to China – as had happened when research spending had been cut in the 1980s, with many star researchers leaving for the US.[50]

4.5.4. Entrepreneurship within Businesses (and the Wider Community)

Another perceived barrier in the UK (also found when talking to respondents elsewhere about their own countries) is an inability of businesses to put the ideas generated by universities to good use.

> *"If you're going to turn an idea into a reality – you need people who are entrepreneurs, finance, branding, manufacturing."*

> *"There's a lot of problems and a lot of solutions and they're surrounded by a lot of risk…that's something government can do – reduce the risk for venture capital coming in."*

The government itself, of course, may also be very cautious.

> *"In the UK the Biomedical Catalyst…the Medical Research Council had a pretty good idea of which prototypes would have the highest return because they developed them. What was difficult was that they were not yet at the stage where they could do medical trials…they knew it was going to fly but nobody would take it…the success rate of this was 20 per cent – which is huge for a medical research thing. But going to Treasury with a 20 per cent success rate: they said it's so low…it was funny that the perception of funders in this particular case that success rate had to be unrealistically high."*

[49] Royal Society, *Ibid.*
[50] Professor Alex Halliday of the Royal Society, quoted on http://www.bbc.co.uk/news/science-environment-31307449

4.6. Government Policy

It was acknowledged that there is far more to the issue of commercialisation than just the provision of more funding. While there was the recognition that more funding would always be useful, the discussion was more likely to actually focus on how to best allocate funding, rather than increase it *per se*.

> *"Funding is always needed. But other than funding, there are ways of improving collaboration that's not just throwing money at them…if you don't know how to organise the money that you throw at them or if it's not effective then you're wasting money. We need both – certainly resources for them to use and then the information about how best to use it."*

4.6.1. Support to Overcome Specific Barriers

While much of the discussion about the UK focused on the less directed funding schemes of HEIF and RPIF, there was also discussion of the need for more directed government intervention, at various stages of the research and development process and/or for particular sectors.

> *"The problem is the valley of death – before you even get to the venture capital stage – where you need £250k or £2m to get to the stage where you can attract an investor. So it's, well why can't you just use some of our research funding to do that? The answer is that of course you've then cut off the pipeline, by cutting off the fundamental research. There is that in-between stage that in differently structured markets, they are more likely to invest in."*

> *"Scaling-up presents long-term financial deliverables. We are a self-financing model – if I'm investing say $30 million in area of gene therapy, we, as an organisation, will probably get no cash from that for 5 to 10 years. Most investors can sit back and wait for it – but if you're self-financing, you can't do that. The bank won't lend us money – so there's this constant pressure I'm having – do more, do more, do more – where most of the investment will be delivering returns many years down the line. So you have to do things for the short-term and the long-term."*

> *"The thing about Knowledge Transfer Networks, Catalysts and Catapults – they are effective to a specific area of activity. Catapults are manufacturing or digital remit. Knowledge Transfer Networks also have a particular remit – they are for specific activities that have to be undertaken – using the funds provided through this policy instrument is quite clear and you cannot go and use them for your own purposes. Knowledge Transfer Partnerships are interesting in that they are directed because they tell you what kinds of shape these partnerships have – it has to be a three-part partnership – a champion, business and university working together to get the champion out and into business. Other than that, no remit, not a sector – but it has to be a business of any description, a university and a person – this is the one that exists here."*

4.6.2. Catapult Centres

As the latest in the measures adopted by the UK Government to improve collaboration between universities and business, there is particular interest in the progress of the aforementioned Catapult Centres (Catapults). Catapults have been designed to provide:

- Access to world leading technology and expertise;
- Research into the UK's world class research base;
- Capability to undertake collaborative R&D;
- Capability to undertake contract research;
- A critical mass of activity; and
- Skills development at all levels.

> *"Catapults fit into the system where the perceived blockages are locational and situational, they provide critical mass to some extent."*

> *"The intention was to identify where there wasn't a concentrated knowledge area and so they set them up for anyone who wanted to work in that area. The vision is great."*

While we did not specifically probe them, many of our respondents raised the issue of the Catapult Centres. Interestingly, overall, there was a sense that the '*jury is still out'* on their effectiveness/impact.

> *"The Catapults are an interesting phenomenon – I'm not sure if they have the evidence that they work yet. There are some interesting questions about how they operate. They are trying to copy the German model, but there seem to be some reservations about how they are structured and operate. Do they add value to existing relationships, to the 'valley of death'? Are they doing the right kinds of things? Are they developing the necessary research base? There are various different models."*

While there is perceived to be a need for a non-university organisation to take on the 'translation space' now occupied by Catapult Centres, particularly in areas where it is difficult for universities to work, for example, on matters of national security, there were questions about whether this required setting up an entirely new form of organisation.

> *"I'm not sure why they needed to be new independent entities, when there were existing ones that could have taken the £50 million and done it a lot faster."*

Indeed, some queried whether creating another institutional layer between universities and businesses was actually the best strategy to encourage collaboration.

> *"They say we're not very good at something, so we need another institution, that's why they're interested in Catapults…whereas Stanford, NYU, UCL, they all do this at world class levels – they just happen to do it within the same institution that awards degrees."*

> *"The question is, they're kind of the idea of being interstitial places. I have never been sure that whether creating something that's between two things will improve matters: you never make relationships better by putting something in the middle."*

"Innovate UK – this organisation has been very supportive of SMEs, operating more from the industry side. The latest one is the Catapult Centres, but as to how they're functioning, there have been some teething problems, mainly around drawing demarcation lines, who does what and some tension between certain unis and the centres."

4.6.3. Diversification

One of the interesting supra-issues relating to commercialisation of activities is the extent to which governments should restrict themselves to some focused policies or have a broad range of measures.

"There is a question – there is no right or wrong answer, it's a hard nut to crack – should there be some diversification in the amount of directedness? You put it out there for funding for innovation in general and for collaboration because of uncertainty. It's a political question and it's hard to answer definitively. It makes people think about how easy or difficult it is to direct something and get something out of it."

The approach of the UK Government in its policy seems to be one that acknowledges the need for a range of measures to assist in the commercialisation of research.

"It is important to recognise that collaboration is an uncertain type of activity and, therefore, [we] won't always know at the outset where the beneficial outcomes will be…And therefore what any government should do is diversify."

"If you look at something like Stanford – they have a blockbuster like Google every 10 years. It's a bit like producing world-class opera singers. They say how can you get another Pavarotti? Whereas getting 5 per cent more graduates qualified in STEM, that is feasible. To get one more blockbuster – could you really have a policy that does that?"

There are specific measures to address perceived blockages within the system, either directing them at particular types of resources or particular sectors.

There are also more general schemes that take a more holistic approach to the issue of improving collaboration between universities and business. Rather than be overly directive, these schemes are built around the belief that decisions about how to spend the funding should be left to the universities and businesses themselves.

"Keep a part of the money and give it to institutions – either businesses or universities – for them to try things in collaboration – therefore allowing them to explore the serendipitous nature of collaboration."

"There is a good argument for having autonomy and competition is good. Having too much dirigisme, too much direction from the top, is not a good way to run innovation policy, precisely because innovation requires managing large amounts of uncertainty. The returns from getting one thing right is tremendous, so there's a bit of a risk if you don't let some academic curiosity flourish. And it tends to be more efficient to let people compete against each other."

4.6.4. Directed funding

Discussion of HEIF raises the broader issue about the extent to which funders should allow for and/or encourage organisations – both universities and businesses – to make their own decisions about where and how to spend funding.

> *"It's a debate most countries would have: if funders get overly into detail, you develop a dependency culture. Here in the UK, we give them money over the long period and tell them they can change it: so if you're not doing the right thing, then change it. Do what makes sense with your partners – if you're doing automotive stuff and the industry collapses, then look elsewhere. Don't do what government wants you to do – do what your partners want."*

> *"Government sets the rules of the game: you're not on the pitch, but you frame the rules of the game. We can't get on the pitch and say hit the ball that way."*

More generally, there was discussion amongst our participants about whether the government should be taking a more supply driven approach – directing the areas where research and commercialisation activities occur or should it just provide a conducive and creative environment.

> *"There are plenty of examples of things that came out because of serendipity. So should you provide the environment of creativity? But the issue is currently what the impact element – the QR section of REF – just increased as the cost of basic research. But if you want impact, then you need to know what you're trying to achieve. Sometimes you just don't know where you're going to end up – if you're trying to focus people down the route of what is currently important to us, then you might miss out on the next new big thing."*

> *"That's the eternal top down and bottom up debate. Picking winners is a toxic debate. But you do have to make choices where your strengths are."*

4.6.5. Taking a Sectoral Approach

One of our respondents spoke of the need to take a sectoral-type approach to considering university–business collaboration. For example, when considering collaboration within the food economy, it was useful to think of all levels of the sector from Agriculture through Processing and Retail. Sharing information, problems and solutions across the three levels would lead to a far greater likelihood of effective outcomes.

> *"What I'm getting at is that we're not just looking at funding, we're trying to understand the way that innovation works in collaboration. That's why it's not just about funding, it's about coordinating, and the information is important for the people who use it."*

4.6.6. Crowding out Private Funding

Some respondents said there was a need to be cautious that government funding did not crowd out private investment.

> *"There's a very fine line between using public money to encourage more investment and public money crowding out private investment. You have to look at R&D investment in general. Venture capital will be influenced by your industrial structure. For example, in the UK you have a huge amount of spending in 10 pharmas and some aerospace companies and the rest is virtually nothing. So the ability of any intervention to change the behaviour of the top 20 that bear the brunt of 60 per cent of R&D investment is very low – they already are maximising their R&D investment. But if you try and encourage the other smaller ones to invest, it would have [to] impose radical changes and that would affect the ones that are already there…it doesn't work if you have a skewed system – so you have to take into account how your system is distributed. Particularly if the investments and risk-taking behaviour is very skewed, the ability to change it is limited, and it's difficult to make moderate changes."*

Others disagreed strongly.

> *"There's a massive amount of literature that suggests that public funding crowds investment in, rather than crowding it out. What the government has done is to create incentives using existing funding to make universities think about this. If you look at the change in the amount of money created through the HE-BCI survey, it shows that a pretty small amount of money investment in infrastructure and incentives to perform created a huge difference."*

4.6.7. Complex System

Another concern is that with an increasing range of sources of funding and assistance, there is a danger of providing a confusing and overly complicated funding landscape for any potential applicants, whether universities, businesses or other potential users of research. Again, a point also highlighted in the Witty Review.

> *"Then there are the seven Research Councils. A number of them have started their own funds, which leads to a big question – is it now too complicated? Are there too many funding pots with different specifications and objectives…Is it now a management nightmare to put them all together, to fund the activity?… A lot individually that could be useful, but put together by different agencies with different power struggles, it creates a lot of difficulty."*

4.7. Other Suggestions

One respondent would like to see the establishment of industry-based 'sharing networks', where businesses would come together, put their competitiveness aside and share information about challenges that they had faced/are facing and the places where they have sought solutions.

> *"If I want to make a step change on the amount [of collaboration] out there, I think what I would do would be to have a series of platforms – dedicated to four or five products – food economy, health, automotive, creative digital and creative non-digital – and finance is another one. Each to have a dedicated platform, where businesses come together to find out their successes and what others are doing…whoever wants to go can go and found out what others are doing. Businesses could agree on the type of information that would be useful to their particular sector – a bit like in the Google world, it will evolve into what is needed. I think that would help businesses understand that there are a lot of other things being done that they're not aware of, between each other and universities. And it would improve the visibility of collaboration within the system."*

Another suggested the idea of having more challenge-based funding.

> *"One of the things that the UK lacks – compared to the US – is more challenge-driven funding, like the NSF [National Science Foundation] that's given out by the DoD [US Department of Defense]. It's about solving nuclear fusion, curing cancer. They're important topics and then funding is effectively convened around that. In the UK, we are more into the science-driven stuff. We have the Research Councils, the TSB. They are small in the grand scheme of things. HEFCE does the institutional stuff and capability stuff."*

Again, this related to bringing industry together.

> *"The question is, who provides that convening power? Industry might, but how does industry get together? How do you set challenge-led priorities and ensure that the resources are sufficient?"*

4.8. General Considerations

4.8.1. Timing

As was the case in all the countries that were the focus of this research project, the issue of time was raised in various different ways. Even though they might have more funds than SMEs, the larger companies within the UK economy reportedly are more likely than in some other countries to tend to focus on short-term results.

> *"In Germany – and Korea and HK – you have middle to large-sized companies prepared to invest long term, for 10 years if necessary and in transformative outcomes. In the UK, there are a smaller number of larger companies and lots of small ones. The small ones lack money and the large companies are looking at next quarter's results."*

"I think one of the biggest difficulties about collaboration – the average returns on most of these things are huge – there can be average returns of 30 to 40 per cent over 50 years. It's not the return itself, it's that fact that it can take a very long time for these things to develop. This means that you're having different investors, having staged funding, by which they each put some of it in – but for this [you] need huge funds, something like the hedge funds, where they fund different pieces. It's a nut that is difficult to crack."

A particularly interesting perspective was that it is not only that businesses require solutions faster than academics are frequently able to provide them. It is also that academics sometimes take a long time to inform the business about whether or not it is possible to provide a solution to any given problem, as highlighted by the following quote.

"The second biggest barrier other than funding is time. They [businesses] need a solution quickly and academics take a long time to get the solution. But also academics can take a long time to produce a response as to whether a solution is feasible or not. They [industry] feel it takes a lot of time to even get a perception of whether something is fixable or not. The issue of timing is interesting. It's not just they are slow in providing a solution to a problem - academics are slow in reacting to businesses' needs in ascertaining whether something can happen or not."

4.8.2. Measurement

For the UK respondents, as in the other countries where we conducted research, the issue of measuring the impact of commercialisation activities is complex.

There was no doubt though, that measurement is critical to the area.

"One reason you need evidence is, 'I'm going to invest £1 billion in collaboration – what do I do with it? Where do I put it?' For allocation purposes you need different types of evidence – some directed funding streams have been fantastically successful but others haven't been, so you'd need evidence that is robust."

The need for data that reflects external benefits is highlighted in the confirmation of HEFCE's grant amount for 2015–16.[51]

In 2015/16 you should ensure a degree of continuity by distributing Higher Education Innovation Funding on the same basis as in 2014/15 while recognising the need for dynamism and the reward of up-to-date performance. The results from the 2015/16 Catalyst projects in small and specialist institutions should inform future policy. The Council should also consider how, from 2016/17, it might be possible to reflect the benefits external organisations gain as a result of their interaction with higher education institutions and advise government on how such criteria might be used. We note also the recommendations in the Witty Report of the need for **longer-term, predictable funding**. The performance of our universities in partnerships and knowledge exchange can be further promoted through sharing of best practice and by assessment of performance. You should develop an evidence-based framework

[51] BIS Grant Letter, *Ibid.*

against a suite of key knowledge exchange activities, which will assess university performance and identify examples of good practice.

However, with increasing numbers of schemes, it becomes more and more difficult to attribute change to any one particular policy.

> *"There are now more and more funding schemes that try to do that...so it becomes harder to disentangle the parts that HEIF is enabling."*

Ways to measure effectiveness

The respondents discussed various ways in which to approach the issue. The following three were most frequently mentioned.

1. Quantitative data
2. Expert opinion
3. Case studies

Quantitative data

To date, much of the measurement of commercialisation has focused on narrow indicators, such as the number of patents recorded.

A number of our commentators expressed their concern at this, because it was likely to be misleading.

> *"There are numbers through the OECD score cards – that provide comparable numbers in terms of patents – but they are not very robust. You really can't tell the value from counting them – some IT kit has thousands of patents, whereas a new molecule might have one patent that took a billion dollars to get there."*

Many of the current methods used for measuring commercialisation – and particularly a focus on patents and spin-outs – were considered to be problematic and misleading.

> *"There is a need to move beyond mechanisms – the metrics – they're trying to count mechanisms. For example, trying to count patents, mechanisms, research contracts – that says very little about what's being transferred through that mechanism and what change that is leading to in that user. For example, patents: it's pointless. Because there are so many ways in which it varies between countries and the way it works, you're likely to have a higher number in one place or maybe more spin-outs, but if you have fewer, it doesn't necessarily mean that we're worse. The same thing with co-publications – all it tells you is that they're working together, not the impact."*

Expert opinion

Expert opinion could go some way to addressing some of the reported shortfalls of the quantitative approaches to measuring commercialisation.

> *"Sometimes you'll look at expert opinion – numbers and outputs is the best, but there's difficulty making that kind of attribution to a funding stream. So if you can add expert opinion to patchy numbers you might have a better idea of what works."*

The Research Excellence Framework (REF) has recently introduced expert opinion as a means to assess the impact of HEFCE funding.

> *"REF – that was an attempt to judge based on expert opinion; on the evidence provided by the universities – yet the way HEFCE works is using income as proxy – so if someone's willingness to pay for some research – there's a lot of problems with it, but it's generally accepted that's the best of a bad bunch of metrics – though you do get into problems…if I've generated less contract research…The only way you can do it is going to the demand side, and it's very hard to automate that – you need to look at what kinds of changes are companies who are engaged realising? In terms of productivity or whatever – you get into these very difficult areas."*

Case Studies

As is clear from the literature, case studies are a very commonly used means of showing the impact of commercialisation activities.

However, as was pointed out, case studies tend to only focus on the successful activities and so may miss out on providing relevant and useful insights into policies that have not been so successful and therefore identifying the pitfalls to avoid.

> *"Case studies are useful, they give you a justification for spending money in it – particularly public money. If you can show that a particular funding stream has generated more than you put into it – then you have a good case for it."*

The REF is undertaken on a case study basis.

Measurement going Forward

There was a sense that, as the understanding of the nature of collaboration improved, so did the ability to measure specific strategies to advance commercialisation. However, it was stressed that some elements might not be well captured, for example, parts that were not observable, including any long-term impact of the activities, after the measurement had taken place.

> *"The issue of measurement is improving all the time – and the most important thing to remember about measuring performance is that you can measure the part that is observable – but you cannot disregard the part that is not observable, so policies will always be a part of the judgement of the policies of collaboration for sure."*

It was also emphasised that any appraisal of the output of institutions should take into account the economic and structural environment within which it occurs.

5. Other Countries within the UK

The majority of our analysis has focused on England. However, we want to acknowledge that the other three countries that comprise the UK each have their own geo-politico-economic conditions and some differing policies. We have included a topical review of Scotland given its size and initiatives in this area.

5.1. Scotland

Higher education research in Scotland is internationally recognised. In the latest *Times Higher Education* (THE) World University rankings 2013/14, five of Scotland's universities feature in the top 200, more per head of population than any other country. Similar to England, the public funding for university research in Scotland is delivered by a dual support system comprising:

- A block grant given by the funding council of each country in the UK. For Scotland this is the Scottish Funding Council (SFC) – funded from devolved budgets; and
- Competitively awarded grants from the UK-wide Research Councils (funded through the UK tax base).

Together, these two sources make up the majority of university research income. In 2012/13, Scottish universities received:

- A third of their research income (£330 million) from the SFC;
- A quarter (£242 million) in competitive funding from the Research Councils and National Academies (representing 15.7 per cent of the £1.5 billion won by UK HEIs); and
- Additional public funds attracted from other sources, such as UK charities and the EU.[52]

However, despite the similarities in overall funding, the interpretation and implementation of knowledge exchange policies and strategies are conditioned by different sets of policy actors at the UK level, and in England and Scotland respectively. The institutionalisation processes have taken different forms – while the Scottish sector adopted a collective policy-goal-driven approach, the English approach has been increasingly institutionally driven.[53]

[52] The Scottish Government
[53] Incentivising Knowledge Exchange: A comparison of visio
September 2102: Fumi Kitagawa (University of Manchester) & Claire Lightowler (PRISS)

5.1.1. Performance Assessment[54]

Despite Scotland's well-ranked universities, very strong publication record (particularly in the fields of Agriculture, Biological Sciences, Biochemistry and Immunology) and overall strong science base, a 2014 report by the Innogen Institute indicated that this base has not translated well into innovation The study shows that there is an opportunity to move beyond just good science towards good innovation by undertaking an integrated approach that successfully uses Scotland's human capital, increases research and development funding and expenditure, and encourages collaboration between academics and industry. Key factors covered during the review relating to the strength and weak innovation in Scotland were cited as follows.[55]

- **Human capital:** Scotland does not exploit its human capital as much as it potentially could. One factor of this is the fact that in Scotland, fewer graduates with tertiary education, compared to other innovative countries, have found employment in high and medium-high technology sectors. Scotland has been notably weak in cultivating commercial and managerial skills, which are critical for developing innovation from basic science. As a result, spin-outs and startups tend to leave Scotland and find a base elsewhere once their businesses start to grow. The lack of these large companies means that there are not enough 'role models' for SMEs to emulate, and the loss of more experienced entrepreneurs creates a hole in Scotland's entrepreneurial skills base.

- **R&D funding and expenditure:** Scotland's percentage of total R&D expenditure to GDP (1.7 per cent) is considerably lower than other innovative countries. This disparity is mostly driven by the lower performance of the business sector, rather than higher education and government. This calls for adopting measures that can potentially encourage R&D investment in Scotland, such as R&D tax credits and making connections with foreign venture capitalists in order to penetrate global markets.

- **Academic–industry collaboration:** The ability to collaborate across organisational and disciplinary boundaries is known to contribute to innovation. Historically, Scotland has not been particularly strong in forming and harnessing collaboration, and such a lack between companies and academia can decrease the capacity of companies to acquire and absorb knowledge from academia and each other. Moreover, Scotland has not been successful in establishing lucrative clusters, which are essential to creating critical mass and enabling innovation.

[54] Centre on Constitutional Change: Why Scotland's science doesn't translate into innovation: 22nd July 2014
[55] *Ibid*

5.2. Recent Government Initiatives

The Scottish Government has established a number of major initiatives in recent years designed to support collaboration between its universities and industry, outlined below.

Innovation Centre Programme (ICP)[56]

Budget: £110 million of core funding over five years (2013–2018) to support the university infrastructure

ICP's vision is to use the Scottish university infrastructure, human resources and research excellence as a platform for collaborations across the whole of Scotland. Innovation Centres will create sustainable and internationally ambitious open communities of university staff, research institutes, businesses and others to deliver economic growth and wider benefits for Scotland.

The Scottish Government, in its efforts to support business innovation and develop opportunities to gain commercial value from research for the benefit of Scotland's economy, launched the **Innovation Centre** programme in 2012. The programme, developed in partnership with Scottish Enterprise and Highlands and Islands Enterprise, is collaborations between universities, businesses and others to deliver a demand-led, outcome-focused, joined-up approach to support transformational collaboration between universities and businesses. The centres aim to enhance innovation and entrepreneurship across Scotland's key economic sectors, create jobs and grow the economy.

Innovation Centres are designed to draw on all of Scotland's research expertise in the relevant sector to work on problems and opportunities identified by industry, adding value through secondments, industrial studentships, spaces for collaborative work and shared access to equipment. Innovation Centres also support skills and training to develop the next generation of researchers and knowledge exchange practitioners through Masters and post-doctoral level provision.

With £110 million of core funding for the ICP over five years (2013–2018) to support the university infrastructure, each Innovation Centre is expected to lever further investment from industry and other sources of public funding. Additional funding for capital equipment and postgraduate places will also be made available by the Funding Council subject to demand and availability. To date, SFC has funded eight Innovation Centres.

Innovation Scotland[57]

Innovation Scotland is the umbrella term for both the process to improve and simplify the experience of Scottish businesses that work with Scotland's universities to develop and exploit innovative ideas and the improved infrastructure put in place to support that change. The initial implementation is made up of, but not restricted to, four main components:

- A new national policy forum (Innovation Scotland Forum);
- An expanded role for Interface, the business / university innovation match-making organisation established and part-funded by SFC;

[56] Scottish Funding Council
[57] Scottish Funding Council

- A more collaborative, pan-Scotland approach to knowledge exchange adopted by Scotland's universities; and
- The potential for new, dedicated resources to encourage and facilitate increased knowledge exchange activity between universities and businesses.

A key component of Innovation Scotland is the creation of a national policy forum to advise SFC, the enterprise agencies, Scottish Government, universities and others on:

- Increasing the efficiency, effectiveness, clarity and simplification of the support for innovation, including entrepreneurship, provided at the interface between universities and business in Scotland; and
- Future implementation of the new arrangements.

Research Pooling[58]

The SFC also created Scottish research pools, designed to encourage leading researchers across Scotland's universities to share access to infrastructure and maximise their contribution to academic and economic development.

The research pools help businesses and other organisations in Scotland to innovate and grow by providing access to specialist knowledge, skills and facilities. They do this through providing a single front door to academic expertise in key sectors such as energy, life science and computing.

They can also benefit from expert assistance in exploring and exploiting innovation and from specialist help in matching their products to new markets.

[58] Scottish Funding Council

Appendix 1: Innovate UK Initiatives

Summary of Innovate UK Programmes

Initiative	Budget in 2013/14 millions	Summary
Collaborative R&D Projects	**£172.9**	Links businesses from large to micro to academic partners to do R&D for the development of new products, processes and services.
Knowledge Transfer Networks (KTN)	**£15.2**	Overarching national networks designed to improve the UK's innovation performance by increasing the breadth and depth of the knowledge transfer of technology into UK-based businesses by connecting the various players, helping industry to access knowledge and information central to innovation growth.
Knowledge Transfer Partnerships (KTP)	**£16.9**	Designed to stimulate innovation through collaborative projects between business and the knowledge base by facilitating the transfer of knowledge and the spread of technical and business skills through projects undertaken by high calibre, recently qualified people under the joint supervision of personnel from business and the knowledge base.
Catapult Centres	**£121.3**	Physical centres where businesses, scientists and engineers work together on late stage R&D to turn high potential ideas into new products and services to generate economic growth. Each Catapult focuses on an area identified as being strategically important for the UK, and, importantly, has a large global market potential. The first centre opened in October 2011 and today there are seven, each with their own areas of focus, with two new ones planned for 2015/16. Catapults aim to complement existing R&D, providing business with the next stepping-stone on the journey to commercialisation by providing a critical mass of expertise in areas vital to this journey – i.e. in the core technology domain, or manufacturing processes, regulatory approval or supply chain development. Many offer access to equipment and specialist facilities to test ideas in reality. All use the power of people and organisations working closely together to unlock opportunity and speed innovative products and services towards commercial reality.
Biomedical Catalyst	**£30 million**	The Biomedical Catalyst is a joint £180 million INNOVATE UK and Medical Research Council programme offering funding to innovative SMEs and academics looking to work either individually or in collaboration, to develop solutions to healthcare challenges. Three categories of grant are available: ▪ **Feasibility award**, which enables the exploration and evaluation of the commercial potential of an early-stage scientific idea; ▪ **Early-stage award**, to evaluate the technical feasibility

		of an idea and establish proof of concept in a model system; and ▪ **Late-stage award**, which takes a well-developed concept and demonstrates its effectiveness in a relevant environment.
Innovation and Knowledge Centres (IKC)	**£1.9**	IKCs operate at an earlier stage than Catapult Centres offering a shared space and entrepreneurial environment for researchers, potential customers and professionals from academia and business to work side-by-side on commercial applications of emerging technologies. INNOVATE UK partners with the Research Councils on IKCs.
Smart	**£36.4**	Offers funding to SMEs to engage in R&D projects from which successful new products, processes and services could emerge. Three types of grant are available from £25,000 to £250,000 grant. Pre-startups, startups, and SMEs from all sectors may apply.
Launchpads	**£800,000**	For SMEs providing funding for business innovation supporting the development and strengthening of clusters of high-tech companies in specific theme areas and geographical locations. They provide base funding through dedicated INNOVATE UK competitions for approved research and development projects and act as a catalyst to help the companies behind the projects to attract more investment.
Innovation Vouchers	**£2.5**	A new national Innovation Voucher programme to support SMEs in working with external knowledge providers. Launched in September 2012, it is designed to incentivise SMEs to engage with the knowledge base and other forms of innovation advice to help develop new ideas and potential new commercial products particularly targeted at SMEs new to this type of collaborative activity or who lack the internal expertise or research capabilities to take forward new ideas. Current focus areas are agrifood, built environment, open data, cyber security and energy, water and waste.
Small Business Research Initiative (SBRI)	**£10**	SBRI aims to provide business opportunities for innovative companies while solving the needs of government departments to enable public bodies to fund the development of technology, to meet their future needs or policy objectives. It provides a structured approach and support for the procurement process when acquiring research and development work, particularly the vital engagement with industry. The government announced its intention in the 2013 Budget to expand the use of the SBRI among key departments five-fold. The value of contracts made available through this route will increase from £40 million in 2012/13 to over £100 million in 2013/14, increasing to over £200 million in 2014/15.
Eurostars	**£3.3**	Eurostars aims to help UK high-tech SMEs to develop partnerships with both other SMEs and knowledge and supply chain partners elsewhere in Europe, to develop their networks and to build up the knowledge to participate in large EU programmes.

Appendix 2: Research Councils' Support

Support can broadly be categorised in the following ways:

- Brokerage – RCs have in-depth knowledge of the people and the research occurring within the academic community and can help business find potential partners, e.g. through the **Gateway to Research**.

- Information exchange – encouraging challenges to be shared and debated and providing access to cutting-edge research findings to further encourage their uptake, e.g. through evidence seminars and conferences, networks such as the Knowledge Transfer Networks (KTNs), and access to large data sets.

- Collaborative research – academic research undertaken in partnership with other universities or research organisations, with business, government and/or with the third sector (e.g. charities). Collaborative research can take multiple forms, from a basic grant between two partners through to a complex multi-partner research programme.

- Collaborative training – enables researchers to develop the relevant skills to undertake excellent research, work effectively in business (and/or the government or other important sectors) and exploit the outcomes of their research. Training opportunities include vocational courses, collaborative studentship projects between academia and industry, and training in entrepreneurship.

- People exchange – all RCs encourage increased levels of university–business interaction; all support the exchange of researchers between academia and industry and stimulate partnerships between business and researchers. This includes supporting fellowship schemes enabling researchers to work in a commercial environment, Knowledge Transfer Partnerships (KTPs) and industry placements.

- Commercialisation and development – includes a number of activities to encourage researchers to take their ideas further down the route to development, and to reward them for excellence in innovation. The RCs' Follow-on Fund (plus a range of other Council-specific schemes) supports 'proof-of-concept' type work.

- Research infrastructure – providing research and development access to science facilities for both academic and commercial users as well as the physical co-location of industry, high-tech business and academic groups on research and innovation campuses.

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