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A pilot study on the emergence of university-level innovation policy in the UK

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Summary

This report investigates whether UK universities are responding to changing incentives regarding engagement with the regional, national and global economy by developing university-level innovation strategies.

A number of UK universities have explicit innovation strategies

Universities in the United Kingdom are responding to the pressures and incentives surrounding innovation and economic impact in very different ways. Some have explicit innovation strategies that are publicly available, such as Bristol, while others appear to have a strategy of no strategy in order to allow innovation to be emergent. It is unclear which approach is appropriate given each universities individual context.

A framework is needed for the study of university-level innovation policy

To this point there has been little focus on university-level innovation policy. While there has been significant investigation of individual elements, such as the structuring of technology transfer offices and the setting of intellectual property regulations, there is little work at the level of the university as a whole. This report, based on seven case studies of how UK universities are structuring their innovation strategies and activities, investigates the emerging models for innovation strategies and their associated policies within UK universities.

This pilot considers four key elements of an innovation strategy

At the level of the university there appear to be four key elements which need to be considered – the existence of an explicit strategy which spans the university and has senior leadership (which may include metrics), an enabling environment for academics to engage in innovation activities, the infrastructure to allow innovation to occur and the funding to support these activities.

University-level innovation strategies will be more than knowledge transfer or commercialisation

Many universities have developed strategies for one or more of these elements in isolation but few have considered an innovation strategy which encompasses all of these pieces in a coherent fashion. An innovation strategy for a university will be more than a set of rules for a number of issues, such as IPR or external consultancy, developed in isolation. A full strategy will have coordination and coherence as well as senior level leadership to ensure communication and buy in across the university. It is unclear which

approach is best at improving innovation outcomes for the universities in this study (Bristol, Cambridge, Cranfield, Edinburgh, Imperial, Oxford and UCL).

The expected role of universities has changed significantly

The expectations placed on UK universities, by government and industry, have changed significantly in the past fifty years. Now it is expected that universities will have significant direct and indirect impacts on regional and national economies. However, it is unclear how universities are expected to balance their multiple and at times potentially conflicting missions of education, research and innovation or economic impact.

Many challenges remain for universities

Decisions on the balance between education, research and innovation, which is a mixture of emergence and choice, will be complicated by coordination problems in many universities and a policy environment which continues to change. Universities which wish to improve their innovation outcomes may have to adapt to assessment metrics which do not include or appropriately weight, in their context, commercialisation or knowledge transfer activities. Whether each university needs an innovation strategy remains an open question, but it is one that each university must consider.

Continuing changes in policy towards universities have yet to bed down

In the past number of years there have been a significant number of policy reviews which impact on the role of universities in the innovation system including the Lambert Review, the Roberts Review and the Sainsbury Review. Also the departmental responsibilities for education, research and innovation have all changed in the past year with a re-organisation of government departments and the formation of the Department for Innovation, Universities and Skills (DIUS). These changes will take time to bed down and as yet their impacts are unclear.

And the language of 3rd stream is confused

Policy in this area is commonly referred to as 'third stream' meaning those activities which are not education or research. However, the term has been narrowed to mean in some cases knowledge transfer. The terms used in developing policies and strategies must be clear on the stakeholders involved, the scope of the policy and the activities covered. Otherwise confusion over the breadth and depth of third stream activities and policies will remain.

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1. Introduction

Universities are increasingly seen as key institutions within national innovation systems, providing skilled graduates to industry and a constant flow of new ideas and inventions that seed new products and new industries. "Today, we are seeing a transformation in the purpose and self-image of universities. Politicians, industrialists and economists are beginning to see universities as major agents of economic growth as well as creators of knowledge, developers of young minds and transmitters of culture."[1] However, as the perception of what a university is changes and incentives for education, research and commercial work evolve how are universities responding? Are they able to develop institution wide strategies or are their responses coming at the department and individual level? And are these changes to the benefit of the universities and their impact on regional and national economies?

This report, sponsored by the Cambridge-MIT Institute (CMI), investigates whether universities in the United Kingdom, in response to changing needs and expectations, have begun to explicitly develop innovation strategies and associated policies. Much effort and debate has focused on elements of innovation strategy, such as the structure of technology transfer offices or how to reward academics for external consulting work, but there does not appear to be a comprehensive study of innovation strategy at the level of the university.

Based on interviews and desk-based research, this report

- provides an overview of the changing policy environment for universities,
- develops a framework for describing university-level innovation strategies, and
- provides an initial view of the response of UK universities to changing innovation demands through case studies of seven institutions.

By developing a framework for university-level innovation strategy and providing this first view of responses across the UK we hope to inform the ongoing discussion on the appropriate roles for universities in a modern economy.

1.1 Approach

The approach taken for this work, as a pilot project, was to investigate through case study the emergent nature of innovation strategies at a number of UK universities. The universities selected for cases were based on previous work completed by Minshall and

[1] Sainsbury (2007) The Race to the Top: A review of the Government's science and innovation policies, HM Treasury.

Wicksteed[2] which investigated the evidence gap on university spin-outs in the UK. The method used for selecting universities was based on research income, contrasting those with the largest research budgets to those with low overall budgets but significant proportion of those funds coming from industry.

1.2 Structure of the report

This document is structured as a core report (sections 2 – 6) with supporting materials in a number of annexes.

- Section 2 builds a framework for discussion university-level innovation strategies
- Section 3 highlights the evolving missions for UK universities
- Section 4 sketches the key government policies impacting on research and commercial activity
- Section 5 provides a summary of issues for the seven universities included as case studies
- Section 6 summarises the key points raised by this work and what may be needed to take the work forward

1.3 Acknowledgements and thanks

This report would not have been possible without the support and patience of Bill Lucas at MIT. The inspiration for the work came from Lesa Mitchell at the Kauffman Foundation who sparked the project into life and provided critical input and review. Many individuals gave their time generously to the project, either in interviews or as critical readers, for which the authors are very grateful. All errors are obviously the responsibility of the authors.

[2] Minshall, T.H.W. and Wicksteed, W. (2005), *University spin-out companies: Starting to fill the evidence gap*, St. John's Innovation Centre Ltd. and SQW Ltd., Cambridge.

2. Developing a framework for university-level innovation strategies

A university-level innovation strategy will span the three core activities of universities (discussed in more detail in Section 3) and is at the overarching level of the university, i.e. encompassing department or group level strategies, as shown in figure 1.

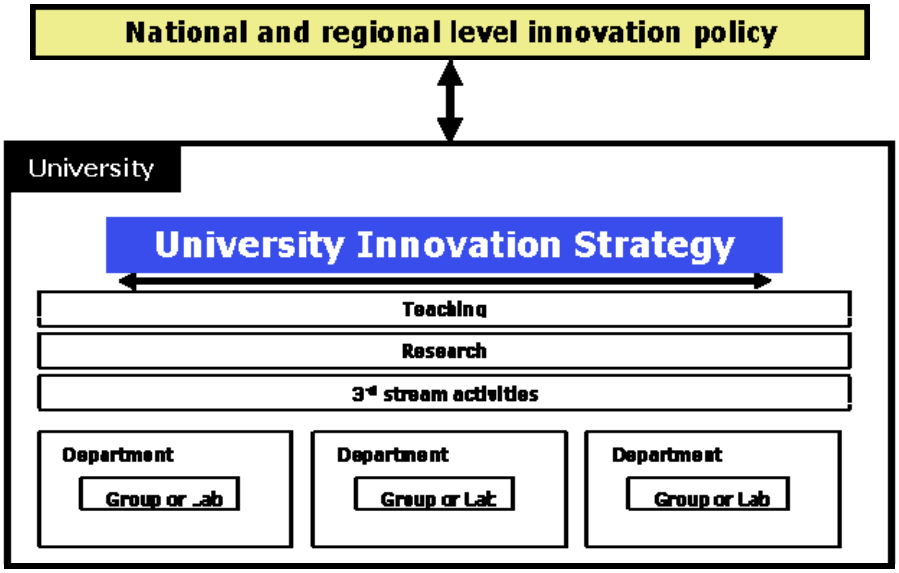

Figure 1 – Placement of university-level innovation strategy

This section develops a framework for analysis of the emergence of innovation strategies, their implementation and outcomes at the level of the university. By this we do not mean innovation by the university in terms of its organisation or teaching, rather we are addressing those activities which address the impact of the university on the national innovation system. This framework was developed to assist in the interviews and data collection and then refined following the interviews.

The framework shows key elements which indicate whether a university has an innovation strategy and where its focus lies. A key point is that innovation in this context is more than just activities related to knowledge transfer and commercialisation and so the term 'third stream' as currently used is not sufficient to describe university-level innovation.

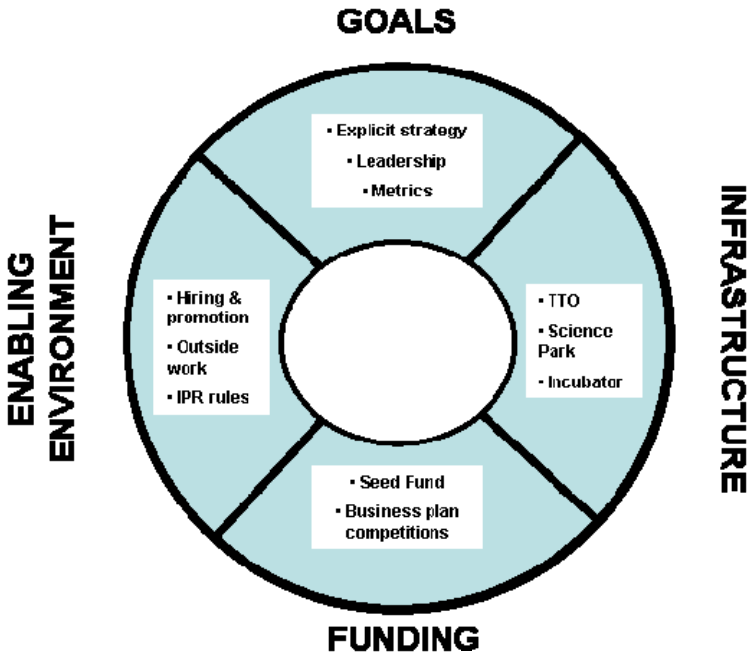

Figure 2 – Framework for university level innovation strategy

One way of examining a university's approach to innovation would be to look at which of the structural factors mentioned above the university has addressed or implemented, and subsequently attempt to categorise the approach using the combination and extent of the initiatives. There are, however, a number of problems with this method.

Placing a university in a given category of innovation strategy because it has two of the available factors, such as a technology transfer office and has a stated IP policy – as opposed to another category for universities with the three factors of a TTO, a stated IP policy *and* a science park – mistakenly conflates these factors as equivalent. It is akin scoring the university out of the maximum number of factors available, ignoring the different functions these instruments fulfil, as well as the lack of appropriateness certain factors may have to various universities. An important aspect of this approach is to acknowledge the importance of how the elements connect and interact – there is a need to understand the coherence of the various policies that may exist and whether they truly form one strategy.

This method also mistakenly equates like with like. Science parks are not all the same and do not all have the same relationship with the university with which they are affiliated. Technology transfer offices may vary in ownership, size, expertise, breadth of purpose and many other qualities. Claiming that two universities have equivalent innovation strategies merely because both have TTOs is therefore erroneous.

The most basic failing of this method is that it does not in itself address the university's actual strategy. The factors listed above can variously act as motivations for forming a strategy, instruments for carrying it out and results which may accrue, but none speaks to the intrinsic qualities of the strategy itself. It is possible for a university to employ any of the listed instruments without having an innovation strategy; it is equally possible that a university with a clear strategy will use fewer of those instruments than one without. Rather than listing which of these factors are present, it would be more profitable to examine how and whether they are co-ordinated, how clear their purpose is and how strategically they are employed. This becomes far more useful information in uncovering the qualities of the strategy itself and, treating each university's case individually, does not mistakenly equate these factors across the board.

2.1 Setting and supporting innovation goals for a university

The first elements of the framework deal with the pieces which may be most immediately obvious – published strategies, individuals with explicit responsibility for innovation and clear innovation targets.

Explicit strategies

The first element of the framework is whether there are explicit strategies and overt responsibility for innovation within the university. An explicit, published strategy on innovation is the clearest signal to demonstrate to the outside world that the university has a clear vision on innovation and the universities role in the national or regional economy. While innovation activities are clearly possible without an explicit document detailing them, an innovation strategy available to all staff will give a clear indication of what is expected and how it is expected to be achieved. Additional information, such as those responsible for delivery, when the strategy is due to be reviewed, the criteria for review and any stop/go points are also among items such a strategy is likely to contain.

Apart from confirming the existence of an innovation agenda and the university's interest in pursuing it, an explicit strategy is also perhaps the widest window on innovation culture at the university. A strategy will usually have an acknowledged start point, which will allow the reader to see where the university considers itself to be. The strategy's implementation will require the development or creation of additional instruments and may include stated goals and areas for prioritisation, all of which serve to give a thorough idea of where the university feels it should be at the end of the strategy, or which instruments it plans to have included at the end of this particular cycle. While it is not wholly conclusive – one cannot rely entirely on a published strategy for a clear and

unbiased view of university innovation – an explicit strategy document is nevertheless the single most informative element of university innovation policy.

Explicit leadership

The creation of a senior role at the university – Pro-Vice-Chancellor, Pro-Provost, Pro-Rector etc. – for entrepreneurship, business development, enterprise or innovation can be seen as an explicit step in confirming an innovation agenda at the university. An innovation strategy could equally be in the hands of an existing position, such as Pro-Vice-Chancellor for Research, but creating a senior role expressly dealing with innovation not only creates a focal point for the activities but also outwardly elevates the importance of innovation to a similar level to that of research and education.

University culture is a factor here; older universities have done things in a certain way for a very long time, and such a dramatic change may not be desirable when the innovation portfolio can be added to an existing role. However, the older universities also tend to be among the largest and most successful, for which reason an innovation portfolio may be too large merely to be added to existing responsibilities. Creating an explicit role to head the university's entrepreneurship and innovation activities demonstrates a level of prioritisation, but not doing so does not necessarily show that such prioritisation is lacking.

Targets or metrics

Targets, if they exist, potentially serve a number of purposes. A university may set targets which play to its strengths, targets which will require change and development in order to achieve the goals required, or a mixture of the two. Published targets are often a hallmark of an innovation strategy, as it is rare for any organisation to publicly set itself targets it has no planned method of attaining. University innovation targets may include the planned number of spin-out companies over a certain period, the amount of money made from consultancy, reducing the percentage of income from government or even making divisions or departments financially independent by a certain date.

Alternatively a university may provide data against a number of metrics without stating explicit targets for the university against those metrics. Showing a steady rate of growth in the number of spin-outs, patents or consultancy income over a period of years allows a university to point to the ongoing success of its innovation activities without stating explicitly that this rate of growth will or must continue. These numbers may well fluctuate somewhat, which is also useful data. For example, if a major consultancy stream for a

university is in the area of computer science, it would be interesting to see the effect on the level of income in the financial year after the dotcom crisis.

A lack of published targets does not necessarily imply a lack of a published strategy, or even the lack of a tacit one. Given the nature of innovation activities and the unpredictable nature of their outcomes, a university may decide to create as positive an enabling framework as possible without feeling the need to set targets. In the case of spin-outs and patents especially, a policy of quality over quantity may be one which would discourage the use of certain targets. Potential metrics for university innovation strategies may include -

- Graduates/people entering the workforce
- Consulting revenue
- R&D support from industry
- No. start ups/spin outs
- Capitalisation of start ups/spin outs
- Licensing income
- Fees from IPOs etc.

2.2 Enabling environment for innovation at the level of the university

The second element of the framework is the enabling environment for innovation within a university, which is dependent on many things, not least the culture of the university in question. The three things over which the university can arguably exert the most influence are its hiring policies, its position on the ownership of intellectual property and the ability of its staff to carry out external consultancy. University policy on these issues can change over time in response to competition, changes in culture or new expectations placed on the institution, but these are such key issues – most notably hiring policy, which essentially dictates the sort of staff with whom the university is populated – that dramatic, overnight change is highly unlikely.

Criteria for hiring and promotion

Fostering an innovation culture in a university depends in large part upon members of staff. While providing incentives for innovation activities may encourage staff members to consider what possibilities for innovation their work affords, there are other policies a university can put in place in order to foster innovation. The employment of academic staff is based in part on their publication record, often measured in the light of ratings such as the Journal Impact Factor. Employing staff based in part on their capacity for innovation is another possibility which may be found in universities; applicants with track records in patent registration, spin-out company formation, publications in innovative

journals or entrepreneurial students could be preferred in certain disciplines to applicants without experience in any of these areas. There may be scope in the future – if the government wished to encourage university innovation – to consider innovation activities in the Research Assessment Exercise, which would also make certain staff more attractive to potential university employers.

There are steps which could also be taken to encourage existing staff members to undertake innovation activities. Schemes by which staff seeking to establish university spin-out companies are offered sabbatical time in which to do so would be an example of this; having such a company set up on university-owned science park land with the help of the university's technology transfer office is also a clear way of easing the transition from research into industry, a path which should be made as painless as possible if innovation is to be truly encouraged.

Considering innovation activities as part of the criteria for promotion is another step which would encourage existing staff members to pursue these activities. Some would see pitfalls in such a policy – vanity patents, unbalancing teaching and research work – but a university employing such a system would either have largely overcome these or be possessed of a culture which does not perceive them as pitfalls, both of which provide valuable insight into the university's attitude towards innovation activities.

Ability of staff to work outside the university

External consultancy by academics can be variously seen as an opportunity to gain valuable insight into outside industry, an opportunity for the university to profit from its academics' expertise, an essential part of research, an activity which robs the university of teaching and research time, or a combination of these and many other things. A university could thus ban this activity, allow it subject to restriction and authorisation, allow it at the academic's discretion or make it known that this is an expected part of the job.

With such a wide variety of positions, examining the choices made by a university will inform analysis of its innovation strategy, but should also be viewed through the lens of the university's culture. One might expect a university with a heavy industrial focus to encourage external consultancy to keep its academics at the cutting edge, but such an institution could equally frown upon it, reasoning that as so much of its work is externally-focused anyway, such activities when done privately essentially take bread from the university's table. External consultancy, under such conditions, is effectively brought in-house to become a university project, whereas other universities may encourage it as an

outside pursuit which may benefit the academic's teaching and research without detracting from time spent on university projects.

Intellectual Property rights

Of the many issues surrounding university innovation, patenting, intellectual property (IP) and licensing are perhaps the most contentious. A university's ability to capitalise upon IP derived from research carried out in its labs – an aim which is frequently the driver for university innovation in the first place – is dependent upon who owns the relevant IP. An individual researcher or team, industrial collaborators, the university or the original funding body could all claim entitlement to the IP from the research and thus any ensuing commercialisation rights and profits, making deciding upon ownership or how it is to be divided is almost impossible without prior agreements being in place. There is no set solution to this issue. A university asserting rights to all IP produced by its researchers risks the most innovative among them leaving to ensure that they can capitalise on their own work. A university allowing its researchers to keep all their own IP risks making no money whatsoever from research done by its staff, on its premises and using its equipment. A middle-ground derived from the circumstances under which the research is carried out is often seen as the best option.

Industrial collaboration can also be problematic. A commercial partner will not only have existing IP from which the new research may be partially derived, but will also expect to benefit from its involvement with the research in some way. Such a company will almost certainly also have existing mechanisms for asserting its IP rights, putting it at an advantage over a university which may not have such a mechanism nor as much experience in negotiating IPR. It is likely that the company is also in a better position to commercialise the results of the research than the university. Any university strategy for innovation has to address the central issue of IPR; even without such a strategy, a university policy on IPR is still a necessity for a modern research university.

The IP model set by a university can be seen as revealing of its position and motivations; claiming all IP originated in the university indicates an awareness of commercial possibilities. This in turn suggests an available method of commercialisation, whether via the university's own TTO or some other pipeline. Allowing IP to be transferred freely does not imply a lack of awareness of the commercial aspects, but may speak more to the culture of the university, its size, or the small amount of IP it expects to generate each year which is not already claimed by industrial partnerships.

2.3 Infrastructure for innovation

The third element of the framework examines instruments within the university's infrastructure which exist to manage, encourage and develop innovation. Technology transfer offices ease many of the problems associated with commercialisation by providing a dedicated team of people to relieve academics of dealing with what is often an unfamiliar field. Similarly, science parks and incubators allow an easier transition for a company which has started from university research into accommodation which is both suitable and close to the university, and thus still in touch with the university research network.

Technology Transfer Offices

Technology transfer offices (TTOs) are generally the front line of university commercialisation. According to Colyvas *et al*, many innovations do not require the help of university's TTO to make contacts with industry, spread information or induce industry interest.[3] However, the working out of arrangements for licensing and industry funding of university research is often complicated; the patent application process is frequently complex and time consuming, and protecting the university's interests produces difficult questions throughout the transactions.

This may indicate that industry actively monitors academic developments and can learn of inventions via channels other than the technology transfer offices; however, TTOs are likely to be useful when inventions yet to generate industrial interest or there is a lack of well-established networks between academe and industry in the relevant area. The value of a TTO to the university is perhaps the result of a university decision to submit, enforce and license patents on their innovations, but this then makes it a core part of any innovation strategy the university might produce.

TTOs can come in a variety of guises and sizes. Some have been only recently created using the Government's HEIF money, whereas others have been in existence for over forty years. A TTO is often an office within its university, functioning as a division or administrative section, but a growing number have become private limited companies, wholly owned by their parent university. One is a publicly-traded company, although the university in question has bought the majority of the shares and maintains an exclusivity agreement with the new company giving it first refusal on all commercialisation from academics. Board members of TTOs frequently have links with the local venture capital

[3] Colyvas *et al* (2002), "How do university inventions get into practice?" *Management Science* vol.48, no.1, Evanston, IL.

community, or with larger industries whose future interest may be in acquiring the technologies developed.

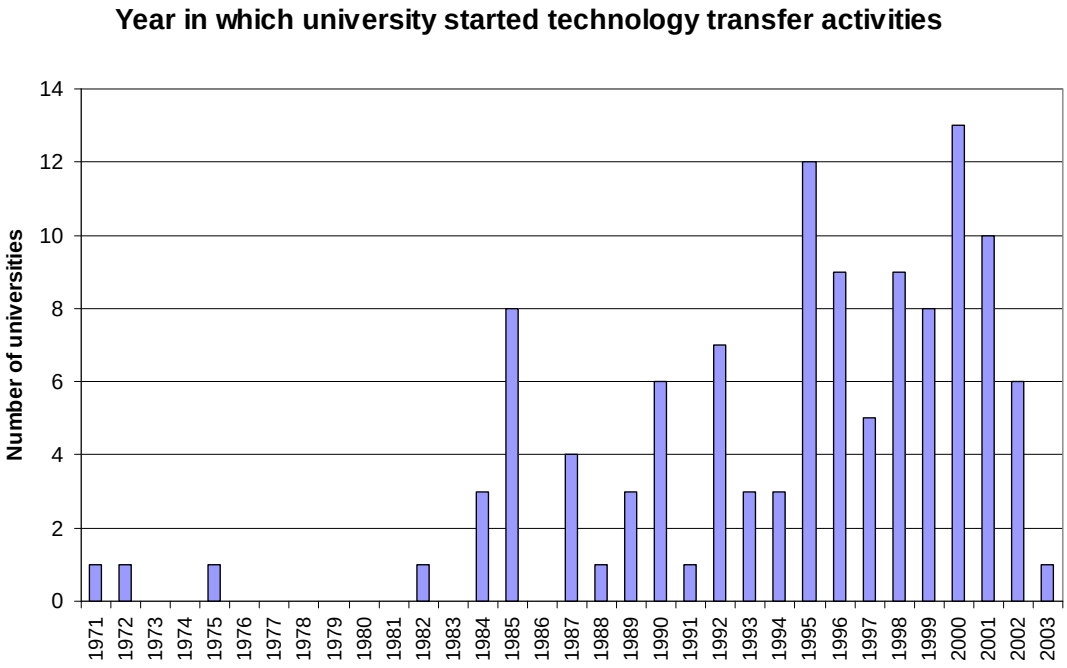

Figure 3 – Year in which university started technology transfer activities[4]

Science parks

Science Parks have been seen by many as the quintessential expression of university innovation. Following publication of Segal, Quince and Partners' 1985 report on the Cambridge Phenomenon,[5] a science park was taken by some to be the lynchpin of growth in high-technology industry, leading to an almost cargo cult approach in other parts of the world. The Australian government, among others, has been accused of believing that "if a high technology/ science park is created, with suitably high-tech buildings, then high technology firms will be attracted to move in from somewhere."[6]

The Cambridge Phenomenon report actually suggested that the Science Park was one of many factors which encouraged high-technology growth. However, the presence of available space close to the university, preferably with facilities appropriate for carrying out high-tech business and rental costs suitable for fledgling companies, is a clear enabler of innovation stemming from the university and potentially from elsewhere.

[4] Data from Lambert Review, 2003 quoting UNICO, NUBS, AURIL (2003)
[5] Segal Quince & Partners (1985), *The Cambridge Phenomenon : the growth of high technology industry in a university town*.
[6] Worthington, T. (1997), *Canberra: Cambridge or Thebes?*, Australian Computer Society

Incubators

The presence of an incubator is evidence not only that there was space available, which is not always the case, but also that the rate of new company origination at the university is either sufficient to justify creating an incubator or something the university wants to increase. Incubators are often linked to science parks, with universities encouraging companies which have demonstrated success in incubation to move on to larger premises on the science park, maintaining links with the university.

Incubators and the cost to fledgling companies for using them can differ widely. While some incubators are simple office space, others contain labs and specialised equipment. How an incubator is used and developed speaks to the university's policy on its spin-outs, although the lack of an incubator could be a greater reflection of a dearth of available space than of university apathy toward spin-outs.

2.4 Funds for innovation

While much of the activities outlined above are part of the ongoing functioning of established offices of a university, there may be a need to provide funding for new activities such as commercialisation. These funds could come from competitive bids to government (in the case of the UK through the HEIF mechanism) or it may be a strategic decision from the university to provide such funds from a core endowment or operating funds. This pilot did not focus on funding in depth due to time constraints and availability of previous reports on innovation financing (such as the Funding Technology series[7]).

2.5 Issues

The discussion of innovation policy at the university level needs to clarify whether the strategies or activities we are considering are intended to have an impact on university goals, national goals and broader international or global goals. These may or may not align and it remains to be seen how each university will identify itself – as a predominately national actor or one which operates at the global level. Beneath the goals there are the means the universities are using to achieve the goals. Finally there will be the outcomes of the actions which hopefully can be measured in some manner.

[7] The Funding Technology reports (covering America, Israel, Germany and Britain) are available to download from http://www.ifm.eng.cam.ac.uk/ctm/teg/investment.html.

3. The changing role of the university in the UK

From their founding as seats of learning, through the development of the research tradition, and on to their active engagement in the innovation system, universities continue to evolve. The purpose of universities is an issue which is highly debated at present even though "… little direct historical analysis of the topic has appeared."[8] This section outlines the triad of major missions for UK universities – teaching, research and third stream activities.

3.1 Universities as teaching institutions

The oldest university in the United Kingdom is Oxford, founded in approximately 1096 and closely followed by Cambridge in 1209. Originally educators of a tiny minority and enclaves for those seeking knowledge for its own sake, these universities and the many that followed evolved to produce people with the skills required by the society they existed in; lawyers, doctors, clergymen and administrators. This is the first recognised role of universities – to train professionals.

While the numbers who were able to attend these original universities were low, due to social and financial constraints, they have risen significantly in the past decades. This expansion in university provision started in the 19th century with the founding of six 'red brick' universities[9] and the federal University of London. More recently, the 'plate glass' or 'Robbins' universities of the 1960s and finally the post-1992 'new' universities took the total number of UK universities up to the current 106.[10]

A Committee of Enquiry had been set up in the UK in 1961 under Lord Robbins to examine the future of universities and make recommendations for change. The university system in the UK at the time was criticised for "not support[ing] technological innovation

[8] Scott, J. (2006) "The mission of the University: Medieval to Postmodern Transformations" *Journal of Higher Education*, vol. 77, no.1, January/February 2006.
[9] The term 'red brick universities' was coined by Edgar Allison Peers (writing as Bruce Truscot) in 1943, referring to the six civic universities founded in industrial cities during the Victorian period and achieving university status prior to World War II. The name derives from the distinctive red bricks used in many of the buildings.
[10] The term 'plate glass universities' was coined by Michael Beloff in his 1968 book of the same name. Beloff reasoned that the universities, until then known as 'the new universities', would not be new forever, and named them 'plate glass universities' after their tendency to feature large expanses of plate glass in steel or concrete frames in their architecture. Beloff was correct that these universities would not be new forever. Including Colleges of Higher Education in the UK makes a total number of 168 Higher Educational Institutions (HEIs). Universities UK, http://www.universitiesuk.ac.uk, accessed online December 2007.

or indeed the needs of society more generally",[11] and the Robbins Committee confirmed that Britain was falling behind in terms of science and technology graduates – 2% of the age group received degrees in this discipline, compared with 4% in Russia. The response was the creation of the so-called 'Robbins' or 'plate glass' universities; fourteen institutions including Bath, East Anglia, Warwick, York and Sussex which now regularly feature in the UK's top 20 universities.[12]

The Further and Higher Education Acts of 1992 made changes to the funding and administration of Higher Education in the UK, allowing some 58 former polytechnics to become universities shortly after the act. These institutions are commonly referred to as the 'new universities' or 'post-1992 universities'. The same Act established HEFCE, the Higher Education Funding Council for England, as well as equivalents in Scotland and Wales.

Number of UK Universities

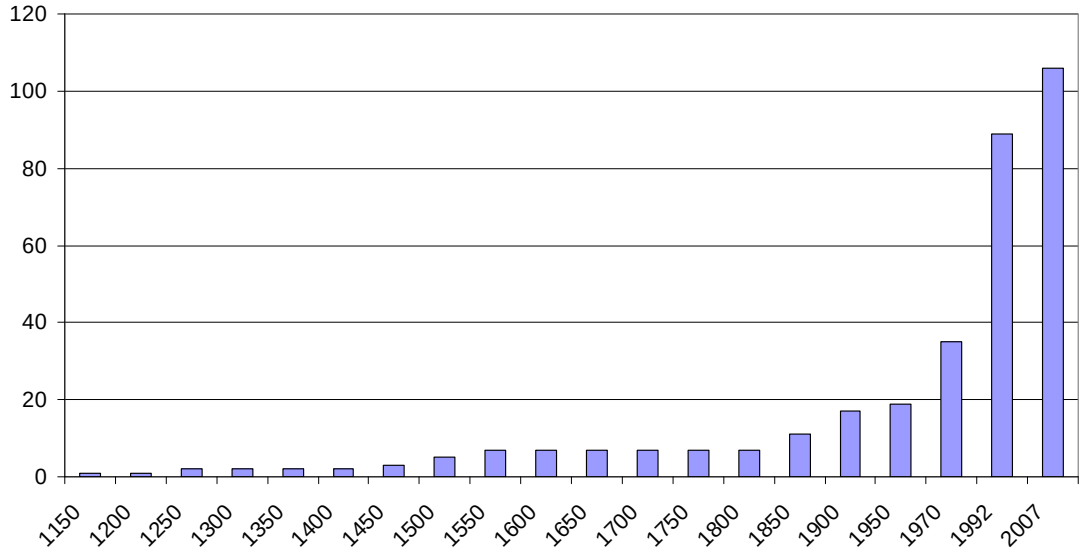

Figure 4 - Number of UK Universities 1150 – 2007[13]

Current enrolment in UK universities is approximately 2,336,000, representing 43% of 18 – 24 year olds.[14] An explicit target for young adults entering university was introduced in

[11] Gill, D. *et al*, (2007) *Funding Technology: Britain Forty Years On*, Institute for Manufacturing, Cambridge
[12] Ibid.
[13] Data taken from Universities UK, http://www.universitiesuk.ac.uk, accessed online December 2007
[14] Ibid.

the 2001 Labour Party manifesto and current policy states that "… half of all under-30 year olds should participate in higher education."[15]

3.2 The transition to research

From the 17th through to the 20th century research became more prominent within universities as printing allowed innovations to be distributed more widely, and the emphasis in education changed from transmitting knowledge to encouraging the discovery of new knowledge.

Since the Second World War, the amount of money spent from the public purse on research in UK universities has grown faster than inflation. In 2007, public investment in research in the UK was just under £3bn, or 0.0027% of GDP. In the late 1940s, however, the amount was closer to 0.0004% of GDP.[16] The founding of the Research Councils in 1965 enabled a more co-ordinated approach to research funding, which in turn produced results which could be used to justify further increases in the science budget. Universities in the UK currently employ over 110,000 full-time researchers with no formal teaching responsibilities, and a further 50,000 part-time researchers in the same role.[17] This combined figure represents more than the total number of people employed in an academic capacity in UK universities at the end of the Second World War.

3.3 Beyond teaching and research

Modern universities have many roles to play; some based on their own aims and some which are placed upon them. The term 'Third Stream' or 'Third Mission' was coined in 1999 to describe those activities a university carries out which do not come under the headings of teaching or research. A 2002 report published by the Science and Technology Policy Review Unit (SPRU) at the University of Sussex describes Third Stream as "the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments. In other words, Third Stream is about the interaction between universities and the rest of society."[18]

Third Stream has been criticised and copied in equal measure. Originally intended to refer to knowledge transfer in social, cultural, environmental and economic terms, in practice the term increasingly refers to commercialisation. However, Third Stream has also been criticised as a meaningless umbrella term covering a multitude of vague activities not elsewhere classified. Governments in Australia, New Zealand and Canada

[15] See the Labour Party website at http://www.labour.org.uk/education (accessed 11th January 2008).
[16] Data from UK Office of National Statistics, OECD and Research Councils UK
[17] Universities UK, http://www.universitiesuk.ac.uk, accessed online December 2007.
[18] *Measuring Third Stream Activities*, SPRU, University of Sussex, 2002.

have all been impressed by the results of Third Stream funding and have sought advice from HEFCE on structuring their own systems.[19] These results, however, have been criticised by academics claiming that the variety of activities and the differences in their application across universities in the UK make it very difficult to measure the success of Third Stream.

3.4 Universities in the national innovation system

There has been significant research effort placed into understanding the potential roles of universities within national innovation systems. Some scholars argue that the university plays a leading role by bringing firms and local government together to support economic development, while others assert that it functions as a bolstering institution by providing a pool of talent, knowledge, and innovation (Etzkowitz, 1999; Florida and Cohen, 1999; Kodama and Branscomb, 1999).

Etzkowitz and Leydesdorff[20] use the notion of a triple helix of university-industry-government relations to describe innovation, the development of new technology and knowledge transfer. Interaction across the boundaries of the helix is mediated by organisations such as industrial liaison, technology transfer, and contract offices, with knowledge flowing between the three spheres. Knowledge transfer is thus not considered as a linear process from an origin to an application, and each sphere is increasingly able to take the role of another; universities take on entrepreneurial tasks such as marketing knowledge and creating companies, while firms develop an academic dimension, sharing knowledge between one another and training employees at ever higher skill levels.

Mowery argues that economically-relevant university outputs include, among others:

- scientific and technological information (which can increase the efficiency of applied R&D in industry by guiding research towards more fruitful departures),
- equipment and instrumentation (used by firms in their production processes or their research),
- skills or human capital (embodied in students and faculty members),
- networks of scientific and technological capabilities (which facilitate the diffusion of new knowledge), and

[19] *The Third Mission of Universities,* Innovative Research Universities Australia, 2005.
[20] Etzkowitz, H. & Leydesdorff, L. (2000), The dynamics of innovation: from National Systems and ‘‘Mode 2’’ to a Triple Helix of university–industry–government relations, *Research Policy*, vol. 29, pp 109–123.

- prototypes for new products and processes.[21]

Empirical evidence regarding the university's impact on the regional economy is inconclusive. While some studies found a weak or non-existent relationship between university research funding and income-producing activities, others show a significant and positive effect (Markusen et al., 1986; Malecki, 1991; Florax and Folmer, 1992; Beeson and Montgomery, 1993; Anselin et al., 1997; Varga, 2000). Other studies have investigated the significant differences that exist across universities in generating spin-offs and the roles of university policy and the regional technological infrastructure on this process (Di Gregorio and Shane, 2002; Etzkowitz, 2002; Feldman et al., 2002; Kenney and Goe, 2004; Feldman, 1994).

3.5 From teaching to research to commerce

As the context in which universities operate has become global and the number of universities increased, it is apparent that all of these institutions will focus on teaching, research and other activities in varying proportions. "In reality, the macrolevel missions [of a university] are often coexisting, interlocking, or contradictory in nature."[22] Few will have a focus on one mission to the exclusion of the others and in a similar vein few will be able to carry out all three missions equally. The balance of focus will be a decision for the university, which is why the study of how universities are reacting to the innovation expectations that are placed upon them at this critical time is of great importance. Not all universities or academics will agree on where this balance should be.

However, there is a lack of clarity on the language being used to describe the activities of universities which are beyond education and teaching. The terms knowledge transfer and commercialisation have in many contexts replaced third-stream. The focus of this report is innovation and the university, which we consider to include the elements of knowledge transfer and commercialisation, as well as the broader goals for the university and the national and regional economy in which it is placed. This is discussed further in section 4 when developing the framework used for university-level innovation policy.

[21] Mowery, D. (2005), 'The role of universities in the innovation system', in Fagerberg, J., D. Mowery and R.R. Nelson (eds.), The Oxford Handbook of Innovation, Norfolk, Oxford University Press.
[22] Scott, J. (2006) "The mission of the University: Medieval to Postmodern Transformations" *Journal of Higher Education*, vol. 77, no.1, January/February 2006.

4. The changing innovation policy environment for UK universities

Through the 20th century the level of policy and interaction between the UK government and universities rose steadily, as greater levels of administration were put in place to manage research funding and teaching. Prior to this UK universities were largely unaffected by the government.[23] The following sections provide a brief overview of changes in policy towards research and 'third stream' activities, with a particular emphasis on the period from 1950 to the present day. The section focuses on key policy changes and therefore is not an exhaustive listing of policy documents or events.

4.1 UK government policy towards university research

Post-World War II, universities are seen more as sources of applied as well as basic research to society, which has set in motion changes to funding structures, research laboratories and intellectual property rights which had previously not been at issue. This trend continues to the present, but the immediate post-war period is seen very much as the threshold, as it was here that the public view of university research was altered greatly from ivory towered abstraction to highly complicated, highly relevant problem solving. In the United States, Vannevar Bush wrote his report to President Truman entitled *Science: the Endless Frontier* in 1945, hoping to cement the links between science, industry and the military formed during the previous war years. His ideas, such as the value of university research to industry and what would later be called 'technology transfer' were mirrored in the UK by academics such as Henry Tizard, Rector of Imperial College; when Tizard became the Chief Scientific Advisor to the Ministry of Defence in the immediate post-war period, he continued to ensure university participation in military research and applications.

British research policy has from a very early period been guided by the Haldane Principle; the idea that decisions on what to spend research funds on should be made by researchers rather than by politicians.[24] R.B.S. Haldane chaired committees from 1904-

[23] However, the universities had a direct impact on the political system through universities being given seats in Parliament. The Ancient Universities provided Members of Parliament (MPs) from 1603, a practice started in Scotland and subsequently adopted in England following James VI inheriting the English throne. The King considered that universities were often affected by the decisions of Parliament and ought therefore to have representation in it, following the Scottish model. This continued with the newer English universities being given a seat as Combined English Universities in 1918, until the practice of university constituencies was abolished in 1950. The MPs who sat for the Universities – among them illustrious names such as Newton, Pitt, and Peel – often helped to ensure that government legislation affected the universities as little as possible, in order that the autonomy of the institutions should be protected.

[24] The Haldane Report (1918) *Report of the Machinery of Government Committee under the chairmanship of Viscount Haldane of Cloan*. HM Stationery Office, London

1918, culminating in the Haldane Report of 1918 which led directly to the establishment of the Medical Research Council in 1920. The Haldane Principle has not lacked criticism, however. The scientist J.D. Bernal claimed in 1939 that social good outweighed the researcher's freedom in deciding on the direction of research,[25] a comment which is more understandable in the light of the Second World War beginning at the time. In 1971, Solly Zuckerman, then Chief Scientific Advisor to the Government, criticised the Haldane Principle for its artificial separation of basic and applied science, and consequent elevation of the former.[26]

The most serious rethink of the Haldane Principle came in 1971, when both the Dainton Report and the Rothschild Report were published. The Dainton Report on the future of the Research Councils upheld the Haldane Principle, but argued that government departments also required access to applied scientific research which should come from government funding.[27] Lord Rothschild, then head of the Government's Central Policy Review Staff, was more damning about the autonomy of the Research Councils in applied research:

> "This is wrong. However distinguished, intelligent and practical scientists may be, they cannot be so well qualified to decide what the needs of the nation are, and their priorities, as those responsible for ensuring that those needs are met. This is why applied R&D must have a customer."[28]

With the implementation of the ideas in the Rothschild Report, 1972 saw 25% of Research Council funds, along with the decisions on the research to be funded, returned to government departments. This was not consistently successful; the government restored the transferred funds back to the Medical Research Council in 1981, it having become apparent that the Department of Health and Social Security still relied upon the MRC to propose new research, and the appropriateness of the customer-contractor relationship in a medical environment having been repeatedly questioned. Rothschild's innovations were designed in response to the impression that the researchers in British universities were more concerned with the autonomous pursuit of knowledge than the

[25] Bernal, J.D. (1939) *The Social Function of Science*. Routledge, London
[26] Zuckerman, S., *Times Literary Supplement,* p.13, 5th November, 1971
[27] The Dainton Report (1971) *The Future of the Research Council System: report of a Council for Scientific Policy Working Group under the chairmanship of Sir Frederick Dainton.* HM Stationery Office, London
[28] The Rothschild Report (1971) *The Organisation and Management of Government R&D*. HM Stationery Office, London

application of that knowledge to the needs of society.[29] It was at this time, therefore, that applied research and the customer-contractor relationship – whilst far from the exclusive method of gathering funding for research – were pressed upon universities as a necessary method of regaining funding which would previously have come to them from the research councils.

The UK Research Councils maintain the Haldane Principle. However, the government does decide the overall budget of the respective research councils, which privileges some research above others. The EPSRC, for example, has an annual budget of more than twice the *combined* budgets of the AHRC and the ESRC, the only two non-science research councils of the eight currently in existence in the UK which together represent less than 10% of the research councils' funding. It is also interesting to note that the Research Councils are starting to measure exploitation specifically within their output data metrics.

4.2 Government support for 3rd stream activities

As noted earlier, the term 3rd stream is very broad. The current use of the term tends to refer to knowledge transfer or economic impact, rather than all other activities of the universities that are not teaching and research. In that context, there have been structures in place to assist UK universities for many years including the NRDC, NEB and BTG.[30]

Total funding of Third Stream activities between 2000 and 2008 is stated by the Higher Education Funding Council of England to be £644 million (see figure 2). The first formal Third Stream programme – Higher Education Reach-Out to Business and the Community, or HEROBaC – allocated £20m annually to fund the creation of corporate liaison offices and similar facilities. Later funds were aimed at supporting the teaching of entrepreneurship, seeding spin-out companies and increasing the universities' role in commercialisation of intellectual property. Since 2000, the Higher Education Innovation Fund (HEIF) has brought together a number of previously independent third stream funding sources to achieve focused support of the universities' position as "drivers of growth in the knowledge economy".[31]

[29] Duffy, M.P. (1986) "*The Rothschild Experience*", Science, Technology and Human Values, vol. 11, no. 1, pp. 68-78, MIT and Harvard Press, Cambridge, Mass.
[30] See Annex 1 for further details.
[31] Higher Education Funding Council website, accessed at http://www.hefce.ac.uk/reachout/heif/

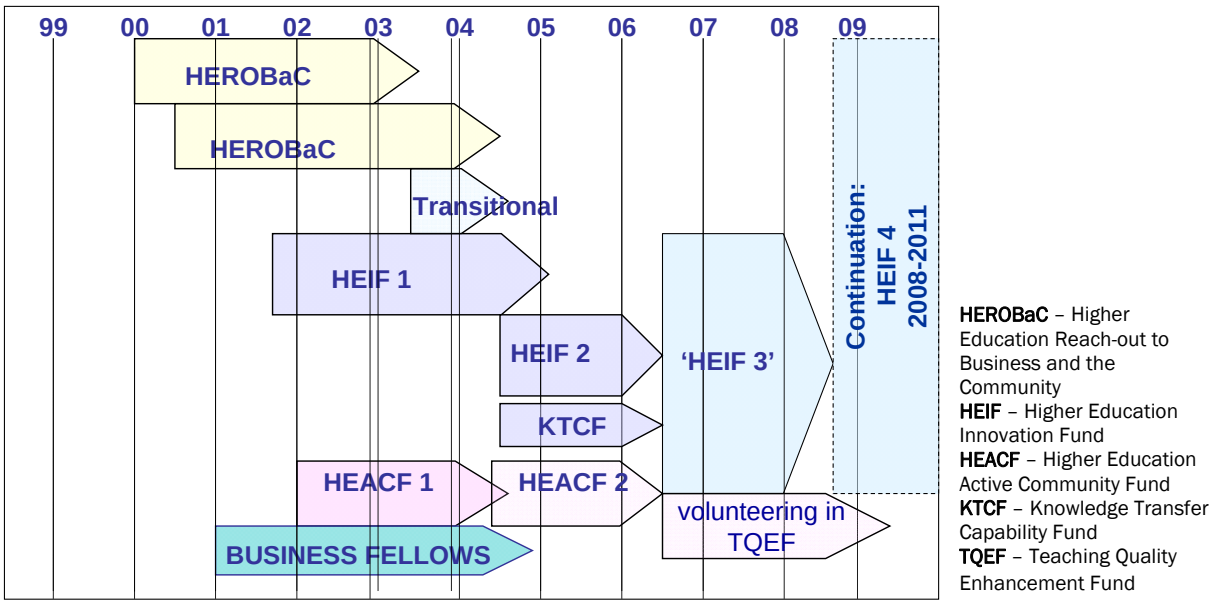

Figure 5 - Third Stream implements since 2000

HEIF was started as a partnership between HEFCE and the then-DTI to become the core mechanism of distributing funds for knowledge transfer by English universities. The first round of funding – HEIF 1 – was allocated in October 2001, following bids from universities to fund a total of £77m of knowledge transfer activities. HEIF 2 was an extension of the same process, with £186m being distributed to the 124 successful bids.

HEIF 3 saw a reinvention of the process, with three-quarters of the £238m available being distributed on a formula based on data from the Higher Education Statistics Agency. All HEIs were thus eligible for an award – the size of which was based on the HESA data and the results of the HE-Business and Community Interaction Survey – if they submitted a plan setting out how they would use the funding to support knowledge transfer activities. The remaining money was awarded after a bidding process, this time on a larger scale. All of the successful bids were collaborations involving a number of HEIs, businesses and community partners.[32]

HEIF 4 is influenced both by the Lambert Review of 2003 and by the Sainsbury Review of 2007. The award of funding is fully formulaic, after feedback from HEIF 3 suggested that this was successful. While spending awards from HEIF 1 & 2 was limited to the contents of the accepted bid, money from HEIF 3 & 4 can be spent with more discretion on the part of the universities. The knowledge transfer activities to which HEFCE refers may include setting up a technology transfer office (TTO) within the university. Money from HEIF 3 & 4 can be spent on other activities; for example as seed funding for university

[32] http://www.hefce.ac.uk/reachout/heif/heif.asp, accessed January 2008

spin-outs. The full budget for HEIF 4 will be £396m over the three years 2008-11. The amount of money available is considered sufficient to meet the recommendations from both the Lambert and Sainsbury Reviews,[33] although final allocations are not due to be announced until March 2008.

The success of these systems has been highlighted by the British Government, whose comparison of British universities' commercial activities before and after these changes shows a definite increase in the number of outputs such as papers, citations, patents, income from licences and spin-outs and value of spin-outs.[34] Whilst difficult to compare (due to differences in scale and research intensity) it is interesting to note that 2005 saw income from licensing and other spin-off sales reach £37m in the 165 HEIs surveyed in the UK, whereas the 156 universities in the AUTM survey in the USA in the same year saw £643m from the same metric. Some analysis on how HEIF funds have been invested by the universities, including the development of policies and structures, has been carried showing an initial focus on capability development for universities.[35]

4.3 Recent changes

In the past four years there have been a number of high profile reviews focused specifically on universities or including universities in their remit in the UK. These include the Lambert Review of business-university collaboration, the Leitch Review of Skills, the Gowers Review of Intellectual Property and the Sainsbury Review of Science and Innovation Policy. The impact of these reviews, along with the reorganisation of the government departments responsible for universities in 2007, will play out over a number of years. This section focuses on the content of three of the reviews (Lambert, Roberts and Sainsbury) as these are the most pertinent when discussing the role and response of universities to the innovation needs of the economy, as well as providing a brief note on the reorganisation of the government departments responsible for universities and innovation.

[33] http://www.hefce.ac.uk/reachout/heif/, accessed January 2008
[34] Gill, D. *et al*, (2007) *Funding Technology: Britain Forty Years On*, Institute for Manufacturing, Cambridge
[35] See http://www.sqw.co.uk/file_download/33 for further details.

Unintended consequences – The 2006 Charities Act

Amendments to the Charities Act 2003 were proposed in 2006 specifically designed to address perceived shortfalls in the regulatory framework in which charities operate. These changes include alterations to the position of HEIs and as yet unknown criteria for them to retain their charitable status. The largest change in the Charities Act relates to the classification of charities. The previous categories were 'registered', 'excepted' and 'exempt'. Many HEIs were formerly 'exempt' charities.

Exempt charities enjoy the fiscal benefits of being a charity and are required to conform to existing charity law. However, since 1922, they have not been required to register with the Charities Commission and are thus not monitored by it, due to the fact that they are adequately supervised by another government department. HEIs wishing to continue their status are now expected to register with the Charities Commission as 'registered' charities, but will be monitored by HEFCE to ensure that they comply with charity law.
The second largest change in the Act relates to the new 'Public Benefit test'. In order to be considered a charity and retain charitable status, HEIs will now not only have to exist 'for the advancement of education', but also demonstrate to the Charities Commission that they operate for the public benefit. Public benefit is not defined in the Act, instead explicitly being left to the Charities Commission. The Act also acknowledges the right of the Commission to redefine 'public benefit' at its discretion. The working definition is due in early 2008, according to the Commission's proposed timetable; provisions relating to formerly exempt charities are not expected to come into force before mid-2008, in order to allow the new regulators, the Commission and the charities themselves to prepare for the changes.

Any definition of 'public benefit' from the Charities Commission seems likely to be based on a quantifiable measure, whether of economic effects, activities or demonstrable service to the community. A university may be precluded from employing more than *X* percent of its staff in commercialisation and technology transfer, or its employees may not be permitted to spend more than *X* percent of their time working on third stream activities. Directives may be issued on how much private income a university can make before paying corporate tax on it, or universities may be required to prove their positive economic impact on their region.

The possibility exists, therefore, that the commercialisation activities which universities are currently encouraged to pursue by the Government will come into conflict with the Charities Commission's definition of a charity's activities. The Government insists that universities should play their role in the national innovation system, but there is no certainty that the Commission's public benefit test will include such activities in its scope. Universities are becoming worried that pressure from Government on the one hand to increase their third stream activities will be compromised by their need to remain within the new definition of a charity to retain their fiscal status.

4.3.1 Lambert Review

Richard Lambert's review of business-university collaboration was published by HM Treasury in 2003. Commissioned in response to the perceived weakness of British universities' collaborations with industry in comparison with their American counterparts, the report attempts to "identify the benefits to business of greater interaction with higher education"[36] and thus establish what might be done in order to maximise the business-university contribution to 'UK plc'. The pursuit of knowledge for general well-being is an aspect of a university's role which lies outside the remit of the review, the sole purpose is to see how much more universities could contribute to the economy. The other effects of university R&D, such as long-term business partnerships or improved teaching, while not discounted, are not examined.

[36] Lambert, R. (2003), *Lambert Review of Business-University Collaboration*, HM Treasury, London

The review itself places much of the onus for future action upon business, or in Lambert's parlance, "the demand side".[37] British business is said not to be research intensive and is the single biggest reason why the UK's R&D spend as a percentage of GDP is lower than six of its counterparts in the G7.[38] While universities need to identify the areas of research in which they are most competitive and government needs to do more to support collaborations, business needs to "raise the overall level of demand [...] for research from all sources."[39] The reduction in R&D investment on the part of business is partly attributed to a tendency to expand by acquisition rather than by organic growth; the implication is that British business purchases rather than innovates, reducing their need for research collaboration. For an improvement in the situation, Lambert recommends that business should act as a better customer to universities.

Lambert specifically recommends against introducing Bayh-Dole-like legislation in the UK, pointing out the shortcomings this law has with regard to giving universities title to IP even part-funded by government combined with industrial backing, and the likelihood that this will discourage industry further from collaboration. Instead, it is recommended that IP ownership is dependent on circumstance and should be negotiated, but that university technology transfer offices should be encouraged by third stream funding to ensure universities can also capitalise on it.

Recommendations made on how universities should be run have attracted criticism from the universities. Lambert states that universities ought to be run by governing bodies with a maximum of 25 members, a majority of whom should not be members of the university, which should adopt a Statement of Primary Responsibilities, approve the Mission and Strategic Vision of the university, long-term business plans and Key Performance Indicators; and appoint a vice-chancellor as the chief executive officer. Some universities in the UK, and notably the older ones, argue that the diffuse power base they maintain is different from the streamlined, business-oriented approach recommended by Lambert for a number of good reasons, including academic independence and security.

The question remains as to whether universities have a responsibility to play this role in the knowledge economy, and whether this commercialisation will change the institutions for the better. The Lambert Review, however, forsook this question for an examination of how universities could better play this role. This attitude is the culmination of a process of change in the universities' place in the national innovation system which has developed

[37] Lambert, R. (2003), *Lambert Review of Business-University Collaboration*, HM Treasury, London
[38] OECD (2006), *Science, Technology and Industry Scoreboard 2005,* OECD Publishing
[39] Lambert, R. (2003), *Lambert Review of Business-University Collaboration*, HM Treasury, London

over the last sixty years, addressing the activities now commonly described as falling into the 'Third Stream'.

4.3.2 Roberts Review

Sir Gareth Roberts' review of research assessment was commissioned by the funding councils in the wake of the 2001 Research Assessment Exercise, and its findings were instrumental in the design of the forthcoming 2008 RAE. The RAE is used to evaluate the quality of research undertaken by HEIs. RAE submissions from each subject area (or *unit of assessment*) are given a rank by a subject specialist peer review panel. The rankings are used to inform the allocation of quality weighted research funding (QR) each HEI receives from their national funding council. However, the metrics used do not recognise outputs in terms of commercialisation, knowledge transfer and contact with industry. The system has not been without its critics, with some unions maintaining a policy of opposition to it. The Association of University Teachers claimed:

"The RAE has had a disastrous impact on the UK higher education system, leading to the closure of departments with strong research profiles and healthy student recruitment. It has been responsible for job losses, discriminatory practices, widespread demoralisation of staff, the narrowing of research opportunities through the over-concentration of funding and the undermining of the relationship between teaching and research."[40]

It was partly in response to such criticisms that the Roberts Review was carried out. It concluded that peer review of research quality remained an important part of the process, but that the rating system could be improved to produce a quality profile which did not reduce the results to metrics or grades. This would hopefully result in less of what the Review termed 'games-playing'; the effect of moving from one grade band to another was sufficiently far-reaching that universities contrived to ensure they remained above the boundary. Nevertheless, when the new metrics were discussed, the *THES* announced that, "the metrics system will be assaulted, from the day it is promulgated, by 50,000 intelligent and motivated individuals deeply suspicious of its outcomes. There will be consequences."[41]

Changes have also been made to the nature of the assessment, which now comprises a series of sub-panels under the 15 main panels, to ensure an appropriate level of expertise in each field. Additionally, following recommendations made in the Review, each individual subject now has explicit criteria laid out for the assessment of

[40] http://www.ucu.org.uk/index.cfm?articleid=1442, accessed January 2008
[41] "New RAE based on citations," *Times Higher Educational Supplement*, 9th November 2007.

submissions. The overall result is hoped to provide a fairer view of each institution, with the final quality profile providing an accurate but less potentially negative picture of each HEI assessed.

A key issue for the future of the RAE is the impact it has on the type of academic which universities can hire and promote. If the activities associated with commercialisation, knowledge transfer and general contact with industry are not rewarded or recognised by the RAE system or metrics, it is unlikely that they will be able to flourish given the determining nature of RAE scores on research income.

4.3.3 Sainsbury Review

The most recent review that impacts on universities and innovation was the Sainsbury Review of Science and Innovation policies which was published in October of 2007.[42] Lord Sainsbury, having been Minister for Science and innovation from 1998 to 2006, was asked by the Chancellor Gordon Brown "...to carry out a review of science and innovation policies across government which will take a forward look at what needs to be done to ensure the U.K.'s continued success in wealth creation and scientific policy-making."[43] The bringing together of the science agenda and the innovation agenda is significant as it speaks to a systemic perspective on the issues. The terms of reference for the work include knowledge exchange between universities as well as R%D investment, the supply of skilled people and venture capital. The main input into the Review was the interviews that the team carried out with multiple stakeholders backed up by an evidence review on innovation in the UK.

The Review's perspective on universities is clear. "The change in the purpose and self-image of the university has been driven by the concept of the knowledge economy, an economy in which ideas and the ability to manipulate them are of more importance that the traditional factors of production. In this economy, a world-class university looks an increasingly useful asset."[44] However, when discussing universities there appears to be a polarization of types with research universities ".. focusing on curiosity driven research, teaching and knowledge transfer, and business-facing universities focusing on the equally important economic mission of professional teaching, user-driven research, and problem solving with local and regional companies." As discussed earlier, most institutions will have a multiplicity of mission and so this level of clarity is unlikely to exist.

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[42] For the full report see the Review homepage at http://www.hm-treasury.gov.uk/independent_reviews/sainsbury_review/sainsbury_index.cfm.
[43] 10 Downing Street press notice 10th November 2006 accessed online at http://www.hm-treasury.gov.uk/independent_reviews/sainsbury_review/sainsbury_index.cfm January 2008.
[44] See footnote 42.

The Review goes on to provide a number of recommendations which impact universities including establishing pilot schemes for senior industry personnel to be embedded in university research units, similar to the Principal Scientists at MIT, and increasing the value of HEIF funding. The recommendations of the Review have been accepted by the government and are in the process of being implemented.

4.3.4 New structures

In June 2007 a major re-organisation of government departments was undertaken. Two new departments came into being – the Department for Innovation, Universities and Skills (DIUS) and the Department of Business, Enterprise and Regulatory Reform (BERR) – while the Department of Trade and Industry ceased to exist and a number of other departments were renamed and reshaped.

In terms of this study, the most interesting change is to have a department which explicitly links innovation and universities, even in its name. DIUS brings together responsibilities from two previous departments.

- science and innovation responsibilities from the former Department of Trade and Industry (DTI); and,
- skills, further and higher education responsibilities from the former Department for Education and Skills (DfES).[45]

The Minister of State for Science and Innovation, Ian Pearson, responsibilities include the Research Councils the Technology Strategy Board as well as liaison with BERR. The breadth of this portfolio should not be minimized as well as the difficulties in speaking across the needs of the varied stakeholders in the national innovation system.

These changes are so recent it is difficult to comment on whether they are yet having the desired effect. As mentioned above, the explicit titling of DIUS may help to stress the position of having universities as a core component of the national innovation system. Further reviews of the new departmental structure and operation will be required over the coming months.

4.4 Focus of funding

The funding provided for education, research and third stream support is not directly comparable as each is doing very different work. The first two are investments in activity

[45] Taken from the DIUS Simplification Plan, December 2007, accessed online at http://www.dius.gov.uk accessed January 2008.

while the last are funds which are in place to support capability development and to assist in the development of further funds for commercialisation and knowledge transfer. The figure below shows funding for teaching, research and third stream from central government and the research councils in the past nine years. Further analysis is required to understand the content and comparability of each stream of funding and to understand if the focus of the ongoing debate on the role of the university is aligned with the balance of funding.

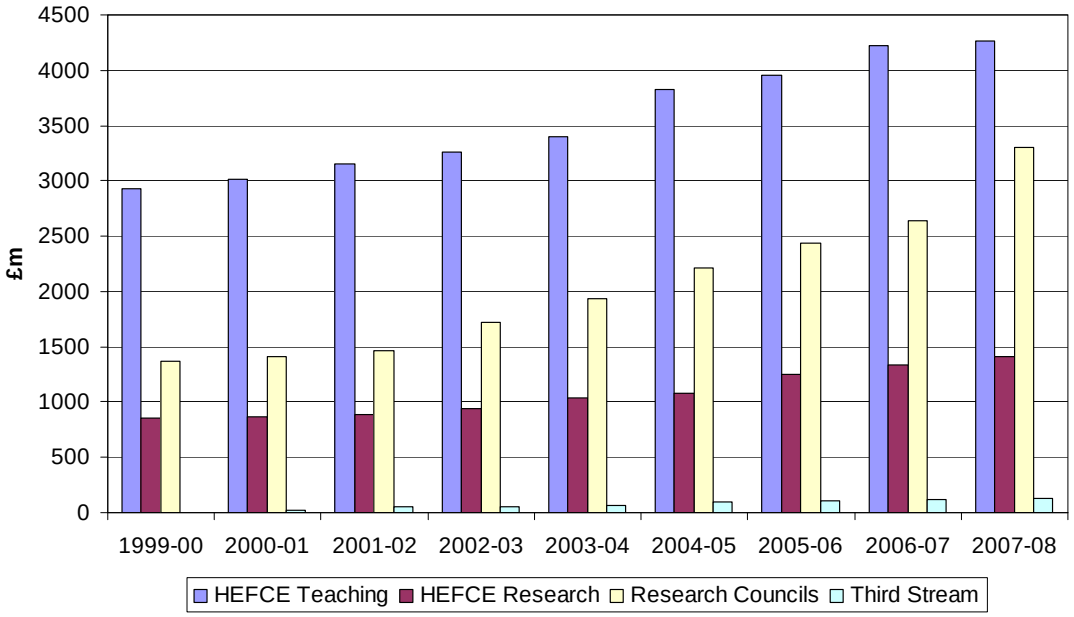

Figure 6 – Government funding for education, research and third stream in the UK

Policy Document	Summary
Our competitive future: Building the knowledge driven economy, 1998	Set a "co-ordinated and coherent programme of action" to close performance gap with competitors. Actions focused around capabilities, collaborations and competition.
Excellence and opportunity: A science and innovation policy for the 21st Century, 2000	Set framework for government's role as key investor in science base; facilitator for collaboration between HEIs and business; and the regulator for innovation
Opportunity for all in a world of change: A white paper on enterprise, skills and innovation, 2001	Emphasised importance of innovation to regional and national growth, with policy objectives fort: skills; building strong regions; investment in innovation; fostering enterprise and growth; and strengthening international links
Science and Innovation Strategy, 2001	Outlined DTI's aims, objectives and science and innovation priorities
Innovation Report, 2003	Outlined direct measures to be taken in seven key areas to ensure that the UK will be a "key knowledge hub in the global economy". Recommended the establishment of a Technology Strategy Board.
Lambert Review , 2003	Analysed the specific role of university-industry collaborations in supporting innovation
Science and innovation investment framework 2004 – 2014	Set qualitative attributes of a successful system to support improvements in UK innovative performance over medium to long term
Business Support Solutions: A new approach to business support, 2004	Defined the new approach to business support in the light of the review of DTI activities
DTI: Five Year Programme: Creating Wealth from Knowledge, 2004	Outlined the key challenges facing the UK economy and the role that the 'new' DTI would play in addressing these challenges
Technology Strategy Board – Annual Report 2005	Summarised the activities of the Board since its inception in 2005 and outlined next stages of activities "to deliver a technology strategy for wealth creation and to position the UK as a global leader in innovation"
Leitch Review of Skills, 2006	Analysed skill levels in the UK; recommended that the UK set a target of being a world leader in skills by 2020, benchmarked against OECD statistics
The Race to the Top: the Sainsbury Review of Science and Innovation, 2007	Analysed impacts of science policy with recommendations to increase competitiveness

Table 1 – Summary of policy and review documents (adapted from Gill, Minshall *et al* (2007) *Funding Technology: Britain 40 Years on)*

5. Emergence of innovation strategies

Having reviewed the general trends in the evolution of the role of universities within the UK and developed a broad framework for the discussion of university-level innovation strategy, this section provides an overview of how a number of universities currently approach their innovation strategies. The table below summarises the basic characteristics of the universities which were included in this study.

University	No. staff	No. students	Total income	Research income
Bristol	5,119	13,378	£286m	£75m
Cambridge	8,570	17,803	£890m	£203m
Cranfield	1,800	2,856	£142m	£41m
Edinburgh	7,961	25,591	£435m	£113m
Imperial	8,000	12,665	£503m	£204m
Oxford	8,419	18,431	£603m	£213m
UCL	3,800	21,620	£560m	£184m

Table 2 – Summary indicators for universities included[46]

5.1 Setting and supporting innovation goals for the university

Explicit strategy

Both Bristol and Edinburgh have published strategy documents, Edinburgh's dating from 2002 and Bristol's from 2003. Bristol's Dr. Neil Bradshaw, Director of Enterprise in the Research, Enterprise and Development division (RED), emphasises the importance of the strategy to ensure that "people know where they're going, and whether they're getting there."[47] The plan lays out three broad aims, under which are ten narrower objectives and thirty-seven individual actions, each listing a deadline and the person, team or unit responsible for delivery.

Edinburgh's Strategic Plan was created in consultation with the Schools and is centralised and explicit, with clear targets and objectives, published documentation, an organisation responsible for its delivery and clear linkages between the central administration, the technology transfer office and the individual academic units. There is also evidence of strategy revision following good results and feedback from the Schools, as well as targeted investment for future success.

While there are some strategic plans with sections on enterprise, collaboration and commercialisation, there appear to be no other complete strategy documents focused at

[46] Data taken from relevant reports on each university's website.
[47] Interview with Dr. Neil Bradshaw, Director of Enterprise, RED, 30th August 2007

this level available from the other universities. A leading Cambridge academic is quoted as saying that "the strategy at Cambridge is to have no strategy."[48]

An examination of the universities comprising the Russell Group – an additional fourteen on top of the seven examined in more detail in this report – suggests that Bristol and Edinburgh are the only two universities to have published strategies of this nature even in this wider group. Many have published strategic plans relating to research and education, some of which (notably King's College, London and Sheffield) touch on innovation and enterprise, but none have made such detailed strategy documents widely available.

Edinburgh University's Commercialisation Strategy appears narrower in scope than that of Bristol at first glance; it was originated by Edinburgh Research and Innovation (ERI), the limited company which serves as the university's TTO, and focuses purely on commercial metrics. However, the Commercialisation Strategy is only part of a wider strategy initiative which links infrastructure, services and knowledge management across the university in an attempt to improve education, research and commercialisation. The Commercialisation Strategy should not be read in isolation, therefore, as it specifically addresses only the desired results of a much wider strategy as they apply to the university's income and knowledge transfer.

Bristol's Enterprise in Research and Education Action Plan was also originated by the university's TTO, the Research, Enterprise and Development Division (RED). The Action Plan lists broad aims, beneath which are numbered objectives and subsequently individual actions with deadlines and the names of those responsible for delivery. It is explicitly far more structured than its Edinburgh counterpart as well as being wider ranging, as it addresses research and education metrics rather than just commercial ones. However, Edinburgh's strategy contains more specific targets; Bristol has instead set interim assessment dates at which targets will be discussed and revised in the light of the plan's development.

The targets set by Edinburgh's strategy include an increase in research funding of 15% per year over the lifetime of the plan, an additional £15m per year from Industrial Research support, £7m per year in royalties (up from £4m) and five new spin-outs per year. The expected effect of this research expenditure, new firms and licensing deals on the regional economy was such that Scottish Enterprise Edinburgh & Lothian (SEEL) commissioned a report from the Centre for Urban and Regional Development Studies

[48] Private interview.

(CURDS) at the University of Newcastle Upon Tyne to evaluate the number of new jobs and additional income to the area, in order best to take advantage of the circumstances when they arose. CURDS predicted around 1200 new jobs and an additional £50m to the Scottish economy as a result of these initiatives.

Bristol's targets focus more upon the promotion and development of an enabling framework for innovation rather than the production of specific outcomes. A science park, incubators, systems to promote knowledge transfer and networking, an Enterprise Network and a framework to monitor progress are – where appropriate – the stated aims of the Action Plan. The specific impact on the region is therefore not quantifiable at this stage, but it is another stated aim for the university to play a major role in the regional economy.

The two innovation plans are similar in many respects, but their differences are important. Edinburgh's strategy is part of a wider series of initiatives and is therefore more focused, leading to a number of specific and measurable goals being set. Bristol's strategy is broader and has fewer measurable outputs, but nevertheless manages to be very clear and straightforward in its description of what is expected, who is expected to do it and when it is expected to be done by.

Targets and metrics

The two universities with the clearest targets are those with the explicit strategies. Bristol's RED's 2006 Annual Report gives a number of outcomes to the University's Enterprise Strategy in the year 2005/06. The University took in £395k in licensing income and filed 44 patents, as well as creating 4 new companies and supporting 31. 11% of the University's research income came from consultancy or industry, and 14 new products went to market from the University's research labs. All of these figures represent an increase over the previous year's total.

Edinburgh – in revisiting its strategy – found that it was on course to far surpass its five-year targets. The university revised them upwards accordingly, deciding to set targets which reflected improvement rather than continuation of the rate of commercialisation. The most recent targets call for 100 potential inventions, 30 patents, 20 licence agreements, 5 spin-out and 5 start-up companies per annum. In addition, the University intends to increase income from consultancy and its 'continuing professional development' (CPD) programmes by at least twice the percentage increase of the general income of the University. Statistics from the year 2005/06 from ERI claim 103 technology disclosures, 80 patents filed, 31 licence agreements, 3 spin-out companies

and 20 start-ups in that academic year. Referring back to the targets set in the Strategic Plan 2004-2008, this exceeds – and sometimes far exceeds – the University's goals in every area except spin-out companies, in which it has a 60% record.

The other universities do not seem to have published targets of this nature, although this is not to say that such targets do not exist. It is likely that the private and quoted TTOs at least have financial targets which are inextricably linked with innovation outputs from the university. Many of the universities print measurements of their successes, although – perhaps predictably – these play to the strengths of the university. Oxford, for example, has a very high number of spin-out companies, whereas Cranfield has an unsurpassed number of graduates going into a field of industry linked with the subject they studied.

A target which was mentioned quite regularly throughout the case studies, although not with any timescale, was increasing financial independence from government funding. Cambridge, Bristol, Edinburgh, Imperial and Oxford have all declared this to be a priority for the future; Prof. Alison Richard, Vice-Chancellor of Cambridge has said in public speeches on a number of occasions that academic freedom rests in large part upon financial independence. Cambridge has also set its newly-formed limited TTO the target of being financially independent of the university in ten years.

Explicit leadership

Bristol, Imperial and UCL all have named members of staff with explicit responsibility for research, enterprise and commercial affairs. These positions are all at Pro-V-C, Pro-Rector or Vice-Provost level, making them very senior and on a par with the equivalent positions relating to education and research. The academics chosen for these positions have track records in innovation and were frequently head of the department with the most spin-outs at the university in question, or simultaneously directors of existing spin-out companies.

The innovation role is often folded into the research portfolio at other universities, although this was seen in some of the interviews as an assumption; the senior academic in charge of research would theoretically be in charge of the innovation stream, but more often an advisory board, university council and other consultants would lend oversight and advice to innovation activities with instruments such as the technology transfer office being lent a good degree of autonomy to achieve their objectives.

5.2 Enabling environment for innovation at the level of the university

Criteria for hiring and promotion

Of the case studies, only Prof. Tom Stephenson at Cranfield stated overtly that industrial experience and a proven track record in delivering innovative solutions would be a distinct advantage in both being hired and being promoted at the university. Prof. Stephenson added that the university had deliberately opted out of the national pay scales and typically paid above the normal level in order to attract such people.[49]

Policy at the other universities was not as codified – perhaps a benefit to Cranfield of being the smallest university in the case studies. However, it was made clear that the RAE was still a major consideration everywhere, with innovation activities usually prioritised behind the ability of the university to hire staff who would deliver good RAE results.

Ability of staff to work outside the university

Most of the universities surveyed have a consultancy office. However, while in some cases this is to facilitate consultancy for academics who wish to use its services, in others it is compulsory for all consultancy to be cleared through this office. Income varies between universities; Imperial is widely reputed among other universities to have made £50 million from consultancy in 2006, the majority of it from clinical trials.

Cranfield is again an exception; staff are not permitted to do external consultancy as it interferes with the university's business model. A project relevant to the work of an academic could be brought into the university and used for research work; Prof. Stephenson points out that the university is well-used to being responsive, delivering to deadlines and working in Pascal's quadrant of directed, fundamental research, so there is no reason for an academic working there to take projects outside when they can bring them in. There is an incentive for academics; if they continue to bring in industrial grants such as this, they can 'buy their academic freedom' and work on whatever interests them.[50]

Intellectual Property rights

The most common IP policy seen across the case studies is the claiming of all IP originated by university staff by the university itself, unless a prior arrangement with a sponsoring company exists. If applicable, this IP is most often commercialised centrally by the University's TTO. However, Cambridge prefers to allow the researcher to choose whether or not to commercialise the research themselves, something which influences

[49] Interview with Prof. Tom Stephenson, Head of School of Applied Sciences, 6th September 2007
[50] Interview with Prof. Tom Stephenson, Head of School of Applied Sciences, 6th September 2007

the revenue percentages in favour of the researcher but also costs them money for patenting etc. This is a recent change; until 2005, Cambridge allowed academics 100% ownership of some patents.

Cranfield has left the decision of whether or not to patent an idea at the university's expense up to the Head of School, in an attempt to reduce 'vanity patents' and to invest university income only in those things judged likely to return more than the cost of application and defence.

Oxford has an interesting situation wherein the Chemistry Department has an agreement with the company IP Group[51]. In return for an investment of £20 million, IP Group acquired 50% of the University's equity in spin-out companies and technology licenses based on intellectual property created at the Chemistry Department, until 2015. In November 2003, IP Group created a £5 million seed capital fund for investing in spin-out companies across the University, not just those originating within the Chemistry Department. However, this has not altered the University's IP policy as it applies to other Departments.

[51] IP Group was formerly IP2IPO.

Changing IPR rules at the University of Cambridge

The 1977 British Patents Act established when companies should and should not own IP, somewhat clarifying a previously contested area, but the Act was seen by Cambridge as being 'wrong in principle and unworkable in practice' at the University. The University previously allowed academics 100% ownership of IP on some patents, and it wasn't until 1987 that moves were made to change the University's policy. These changes took eight years to implement. The shift in policy was undertaken for three main reasons, according to Pro-Vice-Chancellor Anthony Minson.[A] The first was a desire to make IP policy in the University apply consistently across the board; the second was the University's need for additional income, and the third concerned fairness. With the new policy in place, the University can resolve potential conflicts among staff and students, treat staff equally regardless of funding source, and remain accountable to taxpayers who help fund the facilities and the research by returning some of the ensuing profit to the institution.

The University of Cambridge now claims to have given its staff the most generous intellectual property terms of any university in the UK.[B] While the University claims ownership of intellectual property created in the course of employment or study, it allows inventors to patent and negotiate their own deals if they wish. The University also has a sliding scale formula which returns much of the income generated from the IPR back to the inventor.

Where Cambridge Enterprise is involved in exploitation, the share of revenues from net royalties is as follows:

Net Income	*Inventors (jointly)*	*Department*	*Cambridge Enterprise*
First £100,000	90%	5%	5%
Next £100,000	60%	20%	20%
Above £200,000	34%	33%	33%

Where Cambridge Enterprise is not involved in exploitation, the share of revenues from net royalties is as follows:

Net Income	*Inventors (jointly)*	*Department*	*Central Funds*
First £50,000	100%	0%	0%
Above £50,000	85%	7.5%	7.5%

There was concern when these proposals were mooted that the new regulations would ruin the entrepreneurial spirit in Cambridge and essentially end the 'Cambridge Phenomenon'. However, the University claimed that, "This rationalisation may be superficially attractive but is unprovable, and a policy based on assertion and belief is hard to justify."[C] It was considered that the additional legal protection offered by commercialisation through the University would protect less entrepreneurial individuals from predatory third-parties. The University considers that the new IP policy makes it easier to protect academic freedom and co-ordinate technology transfer, and is also more encouraging of University entrepreneurship.

[A] Report of Discussion, *Cambridge University Reporter*, 30th October 2002

[B] *Science* (2005), Vol. 310. no. 5754, p. 1597

[C] Joint Report of the Council and the General Board on the ownership of intellectual property rights, *Cambridge University Reporter*, 24th July 2002

5.3 Infrastructure for Innovation

Technology Transfer Offices

TTOs across the case studies come in a variety of guises. Imperial College has a listed, publicly-traded company running its technology transfer; other universities have their own wholly-owned limited companies; still others have university divisions with varying degrees of autonomy and power in the university structure. A number of TTOs have 'champions' in various departments whose job it is to discuss commercialisation with researchers in order to make them both aware of the possibilities and undaunted by the prospect.

Cambridge Enterprise only recently became a limited company, a move which the *Cambridge Reporter* freely admits was taken following the successful example of Oxford's Isis Innovation. Edinburgh Research and Innovation has been a limited company for quite some time, successfully wrapping all consultancy and technology transfer into a wholly-owned entity and setting financial targets for the amount of money to be given back to the university. UCL Business is the most recent amalgamation of a series of limited companies and offices owned by the university which specialised in different areas; many still exist as companies under the corporate image of UCL Business. Those universities in which the TTO is a university division – Bristol and Cranfield – seem content to remain in that situation. Cranfield's IP arrangements with industrial collaborators preclude the level of throughput which might prompt the change to a limited company, whereas Bristol's Research and Enterprise Division has a leading role in creating and implementing Bristol's innovation strategy, which might be compromised by turning the division into an outside company. Both admit, however, that circumstances may change depending on the final outcome of HEFCE's implementation of the 2006 Charities Act.

It is important to note that the size and type of the TTO at a university is not an evolutionary measure; one cannot point to a TTO's position on a linear scale from 'divisional' to 'quoted company' and judge the sophistication of the relevant university's innovation strategy. There is currently no best practice analysis which would allow a university's size, income, targets and other metrics to be used to predict what type and size of technology transfer office will best suit the university now and into the future. However, the university's elected type of TTO is indicative of the university's attitude towards innovation, and its size suggests the level of throughput the university has or intends to have in commercialisation.

Imperial Innovations and Imperial Consultants

Imperial Innovations is the cornerstone of the College's commercialisation and technology transfer activities. As the University owns all intellectual property generated by its employees, Imperial Innovations is the only organisation to license, patent, spin out or otherwise commercialise research.

Imperial Innovations was founded in 1986 as a limited company wholly owned by Imperial College. The company was financially independent of the College, with an external board and chairman, but retained exclusive commercialisation rights on IP produced within the College. In July 2006, Imperial Innovations was floated on the stock exchange, raising £26m and making Imperial College the majority owner rather than sole owner. The company's chairman is also the COO of the College, and one of only two of the seven board members to also be an employee of Imperial College. The company no longer claims exclusive commercialisation rights on the College's IP, but rather an 'exclusive long-term Technology Pipeline Agreement'[1] with the College, while also sourcing complementary ideas from other industrial partners.

In 2006, the company claims 284 invention disclosures and 61 patent filings, both of which were substantial increases on the previous year. The company also made £1.2m from new licences, a slight reduction.

The company has a business incubator – the Imperial Incubator – at the South Kensington campus. The incubator can accommodate up to 15 companies, and has 12 wet labs and 16 office suites. Leases are flexible so as best to serve fledgling companies. The facility is jointly funded with the London Development Agency, but operated by Imperial Innovations.

Imperial Innovations also has a venture capital arm which invests in companies from seed stage and across all stages of development of the company. They also claim that further funding rounds will be considered. Rather than applying themselves, however, companies must be nominated by Imperial Innovations' New Ventures team. This follows examination of the proposee's business plan and supporting due diligence.

Consultancy work by academics is handled by Imperial Consultants Ltd., a company established in 1990 as IC Consultants Ltd. to provide independent, confidential and authoritative consultancy advice and an analytical/testing service for industry, commerce and government agencies. This encourages academics to collaborate with industry, and the organisation handles potential conflicts of IP which may occur. The 2006 College accounts show an income of £8m in that year from consultancy,[1] but the turnover of Imperial Consultants is widely reputed to be around £50m, the highest in the UK.

Science Parks

Three of the universities in the case studies did not have a science park. In the case of UCL and Imperial, this was at least in part to do with a lack of available space in London. Bristol's Neil Bradshaw admitted to having doubts about the effectiveness of a science park, especially in relation to the level of expectation attached to them, and thought that a 'science city' was a more holistic approach to take. Nevertheless, the South West Development Agency is currently building the Bristol Science Park, into which the university will have a high level of input.

While Cambridge's science park is owned and run by a college rather than by the university, Oxford has two science parks, one of which is university-owned and the other being owned by a college in collaboration with a private company. The autonomous nature of the colleges means that two of these science parks cannot be seen as fully integrated parts of the universities' innovation processes; they are resources, but the university cannot direct them as Oxford does its own science park. It could be argued that the objectives of the university and of the colleges are sufficiently linked that a dramatic divergence of opinion and policy is unlikely to arise, but the possibility exists.

A science park is not an option for every university. Some, notably in London and other concentrated urban areas, simply do not have the available land. Others cannot justify the expense, wish to avoid the additional administration or are not focused in high-technology areas. However, for those universities which do run science parks, evidence can be drawn together to throw more light on their innovation strategies. Whether the science park is open to companies which did not originate in the university, what links the science park has with existing departments and academics, how negotiable the rental costs are, which part of the university is responsible for the park, and even if the park is laid out with a central meeting complex or distributed business spaces are all elements which might be used to inform a description of the university's position on innovation.

5.4 Trends and contrasts

All of the Universities interviewed have demonstrated awareness of the emerging importance of innovation, but their responses have been varied. While Bristol and Edinburgh have clearly defined strategies which set targets, deliverables, review dates and criteria, other universities such as Oxford and Cambridge have attempted to create enabling frameworks to make innovation easier, but do not explicitly require it. Imperial seems to have set itself on a path of commercialisation which others claim will unbalance its research and teaching, whereas Cranfield, arguably the most industry-facing University examined herein, claims not to have altered its course at all, nor to need a strategy for innovation.

	Bristol	Cambridge	Cranfield	Edinburgh	Imperial	Oxford	UCL
Setting and supporting innovation goals							
Publicly available strategy	Yes	No	No	Yes	No	No	No
Senior individual responsible	Yes	No	No	No	Yes	No	Yes
Clear innovation targets	Yes	No	No	Yes	No	No	No
Enabling environment							
Criteria for hiring and promotion include innovation	No	No	Yes	No	No	No	No
External work supported/allowed	Yes	Yes	No	Yes	Yes	Yes	Yes
Existence of strong IPR rules	Yes	Yes	No	Yes	Yes	Yes	Yes
Infrastructure for innovation							
TTO exists	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Science park	No	Yes	Yes	Yes	No	Yes	No
Incubator	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Funds for innovation							
Seed fund exists	Yes	Yes	No	Yes	Yes	Yes	Yes

Table 3 – summary of university placement within innovation framework

The position on intellectual property is an example of the differences which exist between the Universities. All of the Universities now claim the IP produced by their staff – although this is a relatively recent change of position by Cambridge – but the manner in which it is commercialised differs widely. Some Universities allow the staff member to commercialise the IP they have originated, whereas others insist that all IP is commercialised through their own technology transfer office, whether this TTO is a division of the University, a wholly-owned limited company or a listed organisation with the University as a majority shareholder. Similarly, the percentages of income distributed after the commercial success of the venture differ depending on the University in question, with the originator, University, department and TTO itself receiving different amounts in different organisations.

There are also many differences in culture between the Universities. Cranfield maintains that it does not need a strategy for innovation as it has always been industry-facing. Headlines have recently been created as a result of Universities such as Oxford and UCL making efforts to change the financial and administrative footings of the Universities in order to make them more reactive and 'streamlined'. Bristol and Edinburgh have comprehensive innovation strategies with deliverables identifying those responsible for meeting them. Both Cambridge Enterprise and Isis Innovation commented on the

impossibility of forcing the academics at either of their respective Universities to deliver according to specific innovation metrics, claiming that the preferred method was to enable 'good people to do good things' and ensure that the results could be as easily and painlessly commercialised as possible. Many of these Universities have a Pro-Vice-Chancellor or Pro-Rector with explicit responsibility for enterprise or innovation, whereas others have a senior academic into whose responsibility such things fall almost by default.

Differences can still be noted between those Universities whose approaches seem to be held in common when compared with the others, although these differences can perhaps be said to be due as much to situation as to motivation. A large part of Edinburgh's comprehensive strategy rests on the seven science parks run in alliance around the city, three of which the university runs, and on the university's relationship with the Scottish Development Agency and Scottish Enterprise Edinburgh and Lothian. Bristol does not yet have a science park but the university does maintain strong links with the South West Regional Development Agency, who are in the process of building the Bristol Science Park in the area.

Oxford and Cambridge are unsurprisingly similar in many ways regarding approach, but also differ on the issue of Science Parks. Cambridge's Science Park is owned and run by the autonomous Trinity College, making the Park an asset to innovation stemming from the University without being an entity which can be influenced by University-led strategy. Oxford has two Science Parks; one, like Cambridge's, owned and run by a College, but the other owned and run by the University itself, allowing greater flexibility and integration of the Park into University policies.

The issue of appropriateness is an overriding one. For a university such as Cranfield, which has taken steps to avoid vanity patenting and prizes long-term research collaboration with industry over spin-out firms, a technology transfer office which is quoted on the stock market is not likely to be appropriate. It is therefore both mistaken and simplistic to claim that Imperial College's innovation strategy is more advanced based on the fact that their TTO has evolved from a divisional office to a quoted company. This research does not seek to rank universities against one another or to judge the sophistication of different innovation agendas, but rather to describe them in order to show the wide range of differences in evidence.

It is very hard for any framework to take full account of perhaps the most important of all influences on university strategy: culture. A remarkable number of changes observed in

the seven universities studied in this report occurred in the period after a new Vice-Chancellor, Principal or Rector took over. On occasion, such as in the case of Oxford, headlines were made when the incoming Vice-Chancellor sought to make changes which were resisted by the university's culture, resulting in a degree of friction.

5.5 Comparison with US universities

The expectation of American universities to play a role in the national innovation system is similar to that of UK universities; the production of human capital in the form of trained graduates is the universities' major contribution to the national economy, while the creation of companies and licenses arising from research is another important activity, and one in which American universities far outstrip the majority of their British counterparts. A higher proportion of Americans are enrolled in tertiary education – 83% as compared with the British 60%[52] - but a greater percentage of British students are engaged in science, engineering and technology; 22% next to the American 16.4%.[53]

However, the experience of American universities compared to the British ones examined in this report is likely to be very different. American universities are often very different from their British counterparts, not least because a large proportion of the better-known American universities are private institutions which are not reliant on the government for almost 50% of their annual income. American universities do receive research funding from federal bodies, however, so their research is based in part on the amount of money available in different fields. President Bush's administration has continued the trend of increasing funding to the National Institutes for Health, such that 67% of all federal funding for academic research in 2002 flowed from one agency.[54] This represents a greater domination of academic research funding than the Department of Defense achieved during the Cold War, and is a clear example of how the purse strings in both Britain and America can be used to influence the concentration of university research.

American universities, however, have more scope for self-funding than those in the UK. The USA was thought to have seen a dramatic drop in universities' share of national basic research performance during the 1990s, from 62% in 1995 to less than 50% in 1999.[55] This decline mirrored the increase in the share of basic research carried out by industry in the same period, during which time it grew from $6.9bn to almost $14bn in constant

[52] Gross enrolment ratio in ISCED tertiary 5 & 6, 2005, *UNESCO*
[53] Percentage of graduates by subject in tertiary education, 2005, *UNESCO*
[54] Mowery, D. (2002), *The Changing Role of Universities in the 21st Century US R&D System*, American Association for the Advancement of Science Yearbook 2002, AAAS, Washington D.C.
[55] National Science Foundation, (2001) *Federal Funds for Research and Development 1953-2000*

dollars.[56] However, these figures were so surprising that the National Science Foundation re-examined them, later declaring that much of the 'basic' research carried out by industry was in fact misreported applied research. The figures were readjusted accordingly, and universities' share of national basic research from 1998 to 2004 is now quoted as a stable 68%.[57] During this period, while the share of research output remained constant, there were changes in the sources of funding for R&D within universities; the share of funding supported by federal sources dropped quite substantially, while that accounted for by industry increased slightly. The source of funds which increased most was that coming from the universities themselves; the share of R&D in universities funded by 'self-financing' doubled between 1970 and 1999.

Three possible causes of this increased self-financing have been identified,[58] although the extent to which each is responsible is unknown. Firstly, growth in the market value of university endowments during the economic growth of the 1990s increased internal support for research. Secondly, the federal government and other sources of funding support increasingly demanded matching contributions from universities during this period. Thirdly, the Bayh-Dole Act saw an increase in universities' licensing income which, while unevenly distributed among American universities, was nevertheless significant enough to have played a role in such a funding increase.

The top ten American universities as listed by the Institute of Higher Education, Shanghai Jiao Tong University, are: Harvard, Stanford, Berkeley, MIT, Caltech, Columbia, Princeton, Chicago, Yale and Cornell.[59] An examination of these universities shows no published strategy documents relating to innovation or entrepreneurship in the manner of Bristol or Edinburgh, but the scale and co-ordination of their activities – as with Oxford and perhaps other UK universities – suggest centralised or departmental strategies which are merely not publicly available. This is perhaps due to the perception that American universities are more in competition with one another; a 2002 court ruling in the case of *Madey vs. Duke* stipulated that American universities, in that they compete with one another for researchers, students, faculty and grants, as well as make money through licensing and patenting, are no different from businesses and, as such, may find their non-competitive research exemption in question.[60]

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[56] *Ibid.*
[57] National Science Foundation, (2005) *Federal Funds for Research and Development 1953-2004*
[58] Mowery, D. (2002), *The Changing Role of Universities in the 21st Century US R&D System*, American Association for the Advancement of Science Yearbook 2002, AAAS, Washington D.C.
[59] http://www.arwu.org/rank/2007/ARWU2007_TopAmer.htm, accessed online Jan 2008
[60] *Madey vs. Duke*, US Federal Circuit Court, 3rd October, 2002

6. Key issues and further work

As UK universities have responded to the innovation incentives placed on them by government they have approached the issue of a university-level innovation strategy or policy in very different ways. This is to be expected at this stage, as the concepts are emerging with little accepted practice and a lack of knowledge and research on the forms and impacts of such strategies or approaches.

This section highlights the major issues facing UK universities as the debate on their role in the innovation system continues, as well as some broader issues that have been raised by our research.

6.1 Issues for UK universities

An overarching issue for universities is whether they have a choice on the balance between their education, research and commercialisation or knowledge transfer activities. For some it will be emergent dependent on existing capabilities and funds that they are able to generate in each category. For others it will be a strategic choice shaped by the enabling environment of funding and policy, as discussed in section three above.

The number of universities with explicit and publicly available innovation strategies is low in the institutions studied. However, it is unclear the level to which existing policies (whether codified or not) on knowledge transfer or restrictions on consulting work etc., can be considered to aggregate to an innovation strategy. The emergent or ad hoc nature of the various pieces of strategy and policy would seem to indicate an opportunity for improvements if a more systemic approach were taken.

The desired level of coordination and centralisation for university innovation strategies is also an open question. The culture of many UK universities is one that values individual scholarship and independence above all else, making such coordination difficult. In other institutions the coordination occurs at the departmental level with weak guidance from central administration. If the level of direct and indirect economic impact of universities is to be raised is it necessary to have more coordinated approaches? This study cannot answer that question and we would consider this to be an important piece of further work.

As part of the discussion on coordination we expect to see a rise in the number of universities with a senior figure with responsibility for innovation within their title. The commitment to a leadership role for innovation speaks to the balance and importance that each institution is attaching to innovation and as funding agencies and central

government continue to emphasise expectations of direct and indirect economic impact it may become standard to have such a role in the senior administration of a university.

The nature of the interface between academic departments and the third stream bodies which have been set up to assist in knowledge transfer and commercialisation has received significant attention. However, we would emphasise again the background and skills of individuals in these positions is key to their success within the universities. Also, the level of backing from the university level (either through an explicit strategy or senior leadership) can play a significant role in providing these individuals with the legitimacy they require to interact and support senior academics.

As noted above, the metrics and processes used for assessing universities (specifically in research assessment) will shape the behaviour of academics towards innovation activities. If hiring and promotion criteria do not include metrics for interaction with industry and the economy broadly it is unlikely that we will see changes in the levels of impact achieved to date. This links to concerns about balance between education, research and other activities and depending on where each university wishes to place itself this may not be an issue. However for those that wish to operate in third stream in a significant manner these questions have to be addressed at a national level.

This discussion on university-level innovation policy has implications beyond individual universities. Most importantly are the regional, national and international impacts of universities on growth. The balance for national governments is how tightly they wish to try and capture the innovation potential of universities in their country and to what extent that is even possible. As leading universities have increased their global reach and footprint, through collaborative projects and offering degrees in other countries,

Throughout this project there has been a difficulty in the terms used to describe those activities of the university beyond education and research. The current definitions for third stream feel either too broad, in that it is all activity beyond education and research, or too narrow, in that the term has come to mean commercialization and some form of knowledge transfer. There is a need for a clarification of the language used, especially in government policy, so that there is clarity on what is truly expected of universities beyond the traditional activities or education and research.

Finally, our conception of what a university is and what its purpose is will continue to change. Lord Sainsbury recognises the need for diversity across universities but appears

to support the creation of a two part system. “We should … guard against a situation where all our universities aim for the same goals. What is required is a diversity of excellence, with research universities focusing on curiosity driven research, teaching and knowledge transfer, and business-facing universities focusing on the equally important economic mission of professional teaching, user-driven research, and problem solving with local and regional companies.” Given the breadth of missions included in education, research and third stream activities we believe there is a need for recognition of each and that each institution will find its own balance of emphasis. Few will do all to a world class levels and some will have a tight focus on one or two streams. However, we should not create two classes of university.

6.2 Further work

This report represents a first attempt to put a framework in place to discuss innovation issues at the level of the university as well as a collection of case studies from a cross-section of UK universities. It is hoped that the report stimulates debate on whether and how third-level institutions should structure their innovation strategies, especially in regard to the levels of coordination and centralisation of such strategies.

There are many possibilities if this work were to be taken forward including –

- A similar number of case studies to be developed in American universities to contrast the approaches to innovation.
- The development of best practice in how university innovation strategies and policies are developed and implemented for maximum benefit to the university and the economy.
- The development of an assessment tool to rank universities on the quality of their innovation strategy and implementation.

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Annex 1 – UK historical context

Early third stream support

1948 saw the creation of the National Research Development Corporation, a UK organisation intended to commercialise inventions formed with public research funding. This was complemented in 1975 by the National Enterprise Board, a company set up by the Wilson government to implement the principle of extending public ownership of industry.[61] The NEB was set up in the era of Wilson's "white heat of technology", under the auspices of the Department of Economic Affairs, headed by Deputy Labour Party leader George Brown. The purpose of the DEA was to prepare a National Plan for the British economy, which would examine every aspect of the country's development between 1965 and 1970 with the aim of significantly increasing productivity. It intended to achieve this by co-ordinating the work of other government departments in implementing policies of economic growth, particularly in the fields of industry, the regions and prices and incomes.

The NEB and NRDC were merged in 1981 to form the British Technology Group (BTG), which maintained the NRDC's monopoly on the ownership of intellectual property originating from publicly funded research until 1985. BTG's monopoly over research was ended by the Government in an effort to stimulate industry, as it was felt that the universities would be in a better position to form companies from their own research than would a larger, centralised body.[62] From this point onwards, universities were free to exploit their own inventions, while the British Technology Group remained as a technology transfer company, licensing and commercialising public research, before being privatised and subsequently bought by Cinven in 1992.

Founding of the research councils

With scientific research increasingly seen as lending benefit to humanity, the university's role as a provider of basic research to society began to be more valued in the 17th century. The Department of Scientific and Industrial Research was formed in 1917 to enhance existing university research with government funding, initially with military applications in mind. The Minister of Science was responsible for the department, but the Treasury – often without any scientific advice[63] – decided the priorities for funding across all areas of scientific research.

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[61] *The Regeneration of British Industry*, HM Government White Paper, HMSO, 1974
[62] Sir Geoffrey Owen, (2001) *Entrepreneurship in UK Biotechnology*, Diebold Institute for Public Policy Studies
[63] Trend Committee Report, (1963), HM Stationery Office, London

The Department of Scientific and Industrial Research was frequently accused of inefficiency, and the Trend Committee's investigation into the organisation of civil science in 1963 commented that, due to a lack of co-operative thinking, it was difficult to claim that a co-ordinated effort to enhance research was actually taking place.[64] The department was closed and research councils were formed in 1965, with the Science Research Council (from 1981, the Science and Engineering Research Council) taking charge of publicly funded scientific and engineering research activities including astronomy, biotechnology and biological sciences, space research and particle physics. The Science Research Council had direct oversight for the Royal Observatories in Greenwich and Edinburgh, as well as for the Rutherford Appleton Laboratory in Oxfordshire; much of the work done in these institutions supported the work of the university research community, and the vast majority of the funding not spent on their upkeep also went to the universities to support various approved projects.

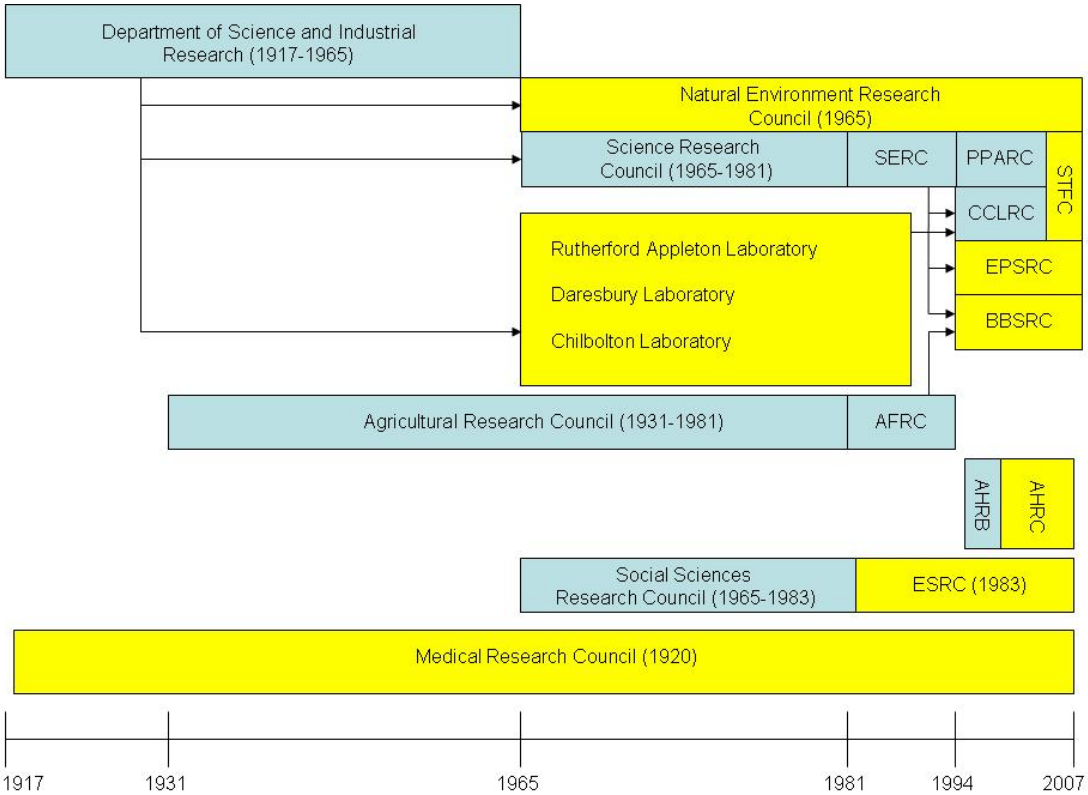

Figure 6 - The evolution of the UK Research Councils (yellow extant, blue defunct)

[64] *Ibid.*

Annex 2 – Interviewees

We would like to again thank the following who gave their time generously to assist with the research for this report.

- Dr. Neil Bradshaw, Director of Enterprise, Research, Enterprise and Development Division, Bristol University
- Dr. Phil Clare, Associate Director, Research Services Division, University of Oxford
- Prof. Clifford Friend, Deputy Vice-Chancellor, Cranfield University
- Mr. Tom Hockaday, Managing Director, Isis Innovation Ltd.
- Dr. Richard Jennings, Head of Consultancy, Cambridge Enterprise Ltd.
- Prof. Tom Stephenson, Head, School of Applied Sciences, Cranfield University
- Dr. Alan Stuttle, Assistant Director, Equity & Investments, UCL Business
- Mr. Grant Wheeler, Head of Company Formation & Incubation, Edinburgh Research and Innovation

Annex 3 – Project team

Finbarr Livesey

Finbarr joined the IfM in October of 2002. Since joining, he has assisted in the development of and is now the Director of the Centre for Economics and Policy (CEP). His work focuses on how manufacturing is described in economics, how government policy affects manufacturing (with a focus on innovation policy), and what the future holds for manufacturing in developed economies.

Prior to joining the Institute, Finbarr was a Director with GeoPartners, a consultancy based in Boston, Massachusetts , where he developed a public sector consulting practice. Between leaving the Kennedy School at Harvard and joining GeoPartners he assisted in setting up the Open Economies project at the Berkman Center for Internet & Society at Harvard Law School, acting as the policy director of the project.

Before moving to the United States in 1999, Finbarr worked with Cambridge Consultants Ltd., where he was a systems developer and consultant for four years. Other positions held include Consultant to the Department for Economic Development, Commonwealth of Massachusetts , Research Associate, Kennedy School of Government, Harvard University, and Consultant with Integral Inc., Boston.

As well as carrying out research within CEP, Finbarr is an active consultant to companies and government, working with large and small companies and many government bodies, and is a member of the management team of Cambridge Manufacturing Industry Links Ltd.

Finbarr's original training is in Physics, which he studied at University College Cork, Ireland (B.Sc. 1994). He also has a Diploma in Computer Science from the Computer Laboratory and Christs College, University of Cambridge (1995) and a Masters in Public Policy from the Kennedy School of Government, Harvard University (2001).

Jonathan Hughes

Jonathan is a Policy Fellow within the Centre for Economics and Policy, which he joined from the Distributed Information & Automation Laboratory in mid-2005. Jonathan attended university in Edinburgh and Toulouse before coming to Cambridge, and obtained degrees in French and Philosophy prior to joining the Engineering Department.

Jonathan's research interests within the CEP focus largely on industrial policy, examining government positions on science, technology, innovation and manufacturing in a variety of countries. He has worked both in the manufacturing side of the motor racing industry and in the field of structural engineering.

Eoin O'Sullivan

Eoin joined the Centre for Economics & Policy as a Senior Policy Fellow in 2007. He is also a Programme Director at the Cambridge-MIT Institute which he joined at the end of 2006. Before joining CMI, Eoin was Special Advisor to the Director General of Science Foundation Ireland. At SFI, Eoin managed several university-industry initiatives including the national Centres for Science, Engineering & Technology (CSET) programme. Eoin was part of the original team that set up SFI. He was both a Senior Policy Advisor at Forfas, The Irish National Policy & Advisory Board for Enterprise, Trade, Science, Technology & Innovation and a Senior Programme Officer for Information & Communications Technologies at the Foundation. Before moving back to Ireland, Eoin spent a couple of years as a Physics Editor at the Cambridge University Press. He has a BSc from University College Cork and a D.Phil. from the Physics Department of Oxford University.

Tim Minshall

Tim Minshall is a Lecturer at the University of Cambridge Centre for Technology Management and coordinator of the Technology Enterprise Group. His research interests are grouped around open innovation, funding of innovation and university-industry technology transfer. He is also a non-executive director of St John's Innovation Centre Ltd, Cambridge.

Prior to joining the University in 2002 he was a fulltime member of the management team of St John's Innovation Centre Ltd. He has managed a series of projects funded by the Gatsby Charitable Foundation to support the start-up and growth of new technology ventures, and to provide analysis of different systems for supporting technological innovation (through the publication of the 'Funding Technology' reports on, to date, the U.S.A., Israel, Germany and the UK – www.fundingtechnology.org). Tim was also a member of the start-up fundraising team, and then Programme Director for Research and Business Creation at the University of Cambridge Entrepreneurship Centre.

He has a bachelor's degree in engineering from Aston University, and a PhD from Cambridge University Engineering Department. Before moving to Cambridge in 1993, he worked as a plant engineer, teacher, consultant and freelance writer in the UK, Japan and Australia.

Rob Valli

After two decades of successful investment banking, technology venturing, and entrepreneurial leadership, Rob Valli joined the IfM in pursuit of a PhD. His documented exposure to academia via advising, lecturing, and mentoring gives him a perspective which is based on front line experience dovetailing business, higher education, leadership, and service - making him uniquely qualified to lend insight as to the role alliances might play in assisting new technology-based ventures achieve sustainable growth. Mr. Valli has served on the Alumni Board of Directors for The Stanford Graduate School of Business; the CAL, Berkeley, Executive Committee for the HAAS Arena; the Board of Advisors for the Office of Strategic Business Initiatives at the University of Illinois; the Board of Directors for the MIT/Stanford VentureLab; as well as, holding a Board seat at AIESEC-US, the largest non-profit international student run organization in the world. During his tenure at King's College, Rob was elected as the President of the King's Graduate Society, as well as, the Faculty Board of Directors for the Department of Engineering as the graduate student representative.