Analysis of Commercialsation Efforts in Denmark's Capital Region

Final report

April 2014

World-Class Science; World-Class Technology Transfer

Cambridge Knowledge Transfer

SQW

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Executive Summary

1. The Regional Council of the Capital Region of Denmark requested an analysis of the activities and the results stemming from the commercialisation of research results in the Capital Region at the region's universities and hospitals. Cambridge Knowledge Transfer and SQW were commissioned to undertake the analysis.

2. This report is mainly concerned with the commercialization of intellectual property rights (IPR) arising from research in the Region's hospitals and two universities through the licensing or sale of IPR and the establishment of spin-outs. However, it is important to place this commercialization in the context of the many other ways that universities contribute to innovation. Patenting, licensing and spin-outs have a high profile. They are easy to measure and, when successful, are visible indicators of the contribution that researchers are making. However, such metrics have limitations. In part, these are inherent; a disclosure or patent grant does not itself promote innovation, although they may be useful indicators of what is in the pipeline.

3. More important, the science base contributes to innovation in other ways, apart from the commercialization of IP. Many would put the production of highly trained people first and both KU and DTU are training large numbers of students. The universities are also working directly with businesses in other ways, including: providing continuing professional development; analysis and test facilities and consultancy. One of the most important is research sponsored by and/or in collaboration with businesses, since this provides an especially good opportunity for academics to gain insights into industry's needs as well as benefits to business. The hospitals also contribute to innovation above and beyond the exploitation of IPR. The Capital Region is involved in many diverse Public Private Innovation projects that could lead to commercial developments as well as improving patient care.

4. Much progress has been made since the 2000 change in the law vesting ownership of IP with the universities and the hospital. The three TTOs are now firmly established and have introduced procedures for handling inventions from the notification stage through to commercialization where appropriate. This in itself is a significant achievement. UK universities went through a similar process in the 1980s and it took many years for some TTOs to reach their current level of professionalism and effectiveness.

5. Top management at both the universities is committed to knowledge transfer and explicitly sees this as an important part of their mission and not a means to

generate revenue. This commitment is reflected in management structures and the establishment and operation of technology Transfer Offices. There are signs that researchers becoming more engaged with knowledge transfer but cultural attitudes remain a barrier to commercialization in both the universities and hospitals. This is a particular issue for IP commercialization, which typically requires a greater commitment to divert from mainstream academic activities than other forms of knowledge transfer, such as collaborative research.

6. Our general conclusion is that commercialization activities are working well given the relatively short history of the TTOs. In the interviews at the two universities we were impressed by what we saw. The key elements of best practice were evident in both KU and DTU: clear policies, visible support form senior management, confident leadership in the TTOs and well trained and experienced staff. Where the staff expressed frustrations (insufficient funding for developing their projects, too many projects per person to be able to give them adequate attention) these were no different than we would have heard in comparable universities in the UK (or the USA). It is an inherent part of the work that the opportunities always outstrip the resources and difficult decisions of prioritisation have to be made.

7. In the Capital Region the situation was different. As in the UK, technology transfer is much newer in hospitals than in universities. The goals are different and the sources of innovation much more widespread (i.e. not necessarily tied to grant funding of research). Despite this we saw some excellent examples of best practice in the Capital Region and top-level management in the Region fully supports research and innovation. The leaflets provided to market available technologies were first class and the people we interviewed had a positive attitude and had relevant experience. Our impression is that the leadership of the TTO in the Capital Region had undergone several changes and that the mission for technology transfer in the hospitals was not as widely disseminated as in the universities.

8. The scope of the current study has been limited in depth and scope. As such we put forward some suggestions for the institutions to consider rather than firm recommendations:

- *Restructuring the Capital. Region's technology transfer support*. The key issue we have identified is the limited capacity to take ideas from invention stage to commercialization. All the technology transfer offices have people with these abilities, but we doubt whether there are sufficient numbers given the volume of research underway in the region. The problem seems especially acute in the Capital Region Technology Transfer Office. One option would be to increase resources available to

the Capital Regions Technology Transfer Office and employ additional expert staff. However, there are alternatives. There are various options to consider including: a technology transfer office could be established in the hospitals; the technology transfer function could be sub-contracted to DTU or KU; a deal could be struck with an independent provider of commercialization services

- *Incentives for Researchers*. We would recommend that the incentive structure is regularly reviewed and consideration given to whether: knowledge transfer should be considered as a criteria for promotion; and whether researchers could be granted sabbaticals to pursue commercialization opportunities

- *Financial support from Government*. Government has given financial support for technology transfer since the 1999 law was introduced in 2000. As with incentive structures, government funding for technology transfer can only be analysed in the context of research and higher education policies as a whole, something we are unable to comment on. However, we would note that the successes of knowledge transfer in the UK has, in part, reflected continual and earmarked funding for knowledge transfer over a number of years.

- *The role of the Capital Region in stimulating innovation*. The Capital Region potentially has a role in stimulating innovation through the creative use of its procurement budget. This is already happening through the Public Private Partnerships. This general approach is under active consideration by the Region and we believe there is real potential to develop procurement policies further in this direction. It requires the Capital region to adopt additional roles to those of patent protection and exploitation and to also articulate needs and bring the different contributors together as illustrated in the last quote.

- Monitoring knowledge transfer. The focus to date has been on metrics such as patents applied for and number of licenses. They provide only a partial indicator of contributions to knowledge transfer and innovation and may not always give a useful view of IP commercialization. We think consideration should be given to extending the monitoring data to include: other forms of knowledge transfer, such as collaborative and contract research, consultancy and so on; and tracking the development of spinouts.

1. Introduction

1.1 The Regional Council of the Capital Region of Denmark requested an analysis of the activities and the results stemming from the commercialisation of research results in the Capital Region at the region's universities and hospitals. Cambridge Knowledge Transfer and SQW were commissioned to undertake the analysis. The aim of the study was to provide a factual over view of commercialisation activities in the Capital Region and to make recommendations for further development. Its purpose was to initiate a dialogue between technology transfer units in the Region.

1.2 The work was undertaken by David Secher of Cambridge Knowledge Transfer and Robin Brighton of SQW. It comprised a review of data from the Annual Commercialisation Survey in Denmark and of comparable data for selected UK universities. Consultations were also undertaken with stakeholders, technology transfer officers and researchers in the Region during one week in early February and two days at the end of the month. A list of those interviewed is provided in Annex C. The consultants reported to a steering group comprising the Capital Region and representatives from the technology transfer offices of the University of Copenhagen (KU) and the Technical University of Denmark (DTU).

1.3 The study was required to focus on three levels of authorities:

- The three institutions represented on the steering group
- The ecosystem in the Capital region
- Danish Government Authorities.

1.4 We have tried to address each of these levels during the study, but the scope and depth of our recommendations are necessarily limited by the short time period available for the study. In addition, the study was concerned with the commercialisation of intellectual property (IP). This is not, of course, the primary function of the health care and higher education sectors and a wide range of policies and programmes, which influence commercialisation, were introduced for quite different reasons. A review of these policies was outside the scope of the current study, but they would need to be carefully considered in a more thorough study of commercialisation.

1.5 The universities visited are world-class universities on a par with peers in the UK or the rest of the world. "League tables" are notoriously variable and capricious,

but give some confirmation of this. In the QS[1] 2013 ranking KU is ranked #45 in the world. Manchester is #33 and Glasgow #45 (Cambridge is #3). DTU is #134, with Liverpool at #130 and Cardiff #136. All those UK universities are members of the research-intensive, elite "Russell Group". Similar results can be derived from the AWRU ("Shanghai" rankings), where KU at #42 lies between Manchester (#41) and Edinburgh (#51). There is no equivalent data for research carried out in hospitals. Much of this is done in medical schools that belong to universities; the rest is not tabulated in either Denmark or the UK. One of the questions we posed in this report is "Is the commercialisation of the world-class research carried out in the universities and hospitals of the Capital Region also world-class?"

[1] http://www.topuniversities.com/university-rankings

2. Commercialisation in context

2.1 This report is mainly concerned with the commercialisation of intellectual property rights (IPR) arising from research in the Region's hospitals and two universities through the licensing or sale of IPR and the establishment of spin-outs. However, it is important to place this commercialisation in the context of the many other ways that universities contribute to innovation.

2.2 Patenting, licensing and spin-outs have a high profile. They are easy to measure and, when successful, are visible indicators of the contribution that researchers are making. However, such metrics have limitations. In part, these are inherent; a disclosure or patent grant does not itself promote innovation, although they may be useful indicators of what is in the pipeline. But, their limited scale also needs to be recognised. Table 2-1 provides some data from the UK to illustrate this. It shows spin-out and licensing activity in 2010/11 for the 10 largest universities[2] by research volume. The key points are:

- The ten are all large, long established with globally leading research in at least some (and in some cases all) disciplines
- The ten between them only generated 28 spinouts that year and fewer than 400 of all spinouts generated by those universities continue to exist as spinouts with university ownership. In some cases, generally the most successful, the university will have sold its shares in the company, but many will have ceased to trade
- Licensing income which reflects many years of research funding, is tiny (less than 2%) compared with the annual research funding

Table 2-1: UK universities (10 largest research grants 2010/11) and exploitation of intellectual property

Research grants (DKK m)	Spin outs (2010/11)	All spin-outs still active	IP income[3](DKK m)
19,900	28	381	263

Source: Based on HESA Planning Plus data

2.3 The exploitation of IP is important. When there are opportunities they need to be exploited and there are well-known examples of spin-outs developing into global corporations. But it is unrealistic to expect this to be the norm. It is a common misconception that early-stage technologies (inventions from universities or research institutes) can produce significant financial rewards in a short time frame. Data from the USA shows that only a handful of American

[2] Oxford, Imperial College, University College London, Cambridge, Edinburgh, Manchester, King's College London, Glasgow, Leeds, Bristol
[3] Sales and licensing of IP

universities make large profits from technology transfer[4]. Most universities do not cover their costs. And only 16% are self-sustaining, bringing in enough income, such that, after distribution to inventors and for research, there are sufficient funds to cover the costs of the programme. There are two reasons why revenue from the exploitation of intellectual property (IP) is not a good metric for Technology Transfer Offices:

- Technology transfer in academic institutions is about generating social and economic impact and providing a service to researchers to allow them to achieve that. The motivation is very different from a commercial investor, which will try to spot winners, or "cherry pick".
- Those institutions that are profitable have been lucky. Often the revenues generated are from one or a handful of inventions. For example, in Cambridge (UK), as in Columbia (New York) a single invention has dominated the revenues. These inventions are hard to predict and the process has been described as akin to buying lottery tickets: the more you buy, the greater your chance of winning.

2.4 The biggest revenue earners are generally pharmaceuticals for human therapy. Such drugs often take 10 years or more to reach the market, owing to the stringent regulatory requirements for safety and efficacy testing, before a new drug is licensed. This time delay contributes to the long time lag between establishment of an office and the generation of significant revenues.

2.5 A key lesson from this is to define clearly, perhaps in a mission statement, what the purpose of a technology transfer office is. The management of expectation of the leadership of an institution is a necessary factor in ensuring the success of technology transfer. However tempting it might be to point to the rare successes of $100m plus revenues, the reality is that this is an activity that can only be justified for its social and economic benefit.

2.6 The science base contributes to innovation in other ways, apart from the commercialisation of IP. Many would put the production of highly trained people first. Both KU and DTU are training large numbers of students and have also introduced entrepreneurship modules for post graduates. Student numbers are shown in

Table2-2: Student numbers 2012 (Full-time equivalents)

	KU			DTU		
	PhD	Masters	Undergraduate	PhD	Masters	Undergraduate
Medical subjects	2562	2,875	3,394			

[4] Abrams I, Leung G, Stevens, AJ (2009) Research Management Review 17 1-33

	KU			DTU		
Other Science and Technology	806	4,093	6,383	1,338	3,067	2,633
Total	2,098	6,968	9,777	1,338	3,067	2,633

Source: KU and DTU

2.7 The universities are also working directly with businesses in other ways, including: providing continuing professional development; analysis and test facilities and consultancy. One of the most important is research sponsored by and/or in collaboration with businesses, since this provides an especially good opportunity for academics to gain insights into industry's needs as well as benefits to business. In 2012:

- KU received DKK 719m in research grants from private[5] Danish sources, almost 40% of all research grants
- DTU received DKK 205m from business, 11% of total research. A further DKK253m of consultancy work was undertaken for public and private clients.

2.8 The hospitals also contribute to innovation above and beyond the exploitation of IPR. The Capital Region is involved in many diverse Public Private Innovation projects that could lead to commercial developments as well as improving patient care. Examples include:

- Optimising the handling of hazardous clinical waste
- Hand hygiene for children
- Automatic monitoring of the quality of endoscopies
- Replacement methods for limestone aquifers.

[5] This includes foundations and non-profit organisations as well as businesses

3. Commercialisation in the Capital Region

3.1 In 1999 the Act on Inventions at Public Research Institutions was passed which vested the ownership of IP with the employer. This replaced the previous system of "Professor Privilege" under which ownership was vested with the researcher/inventor. This meant the universities were now responsible for protecting and exploiting IP generated by their staff. Hospitals were also granted ownership of IP generated by their staff and the Capital Region assumed technology transfer responsibilities in relation to the hospitals when it was established. If one of the technology transfer offices decides to commercialize an invention then the inventor will generally receive one-third of the net revenue after the costs of patenting have been deducted.

3.2 Following the new act, universities, and later the Capital Region[6], needed to establish capabilities to handle IP including:

- educating staff and promoting opportunities
- protecting IP, in part because of commercial opportunities, but as owners the universities/Capital Region were now responsible for managing IP issues arising from research and other collaborations with external partners
- assessing the potential value of IP
- finding partners (as investors and managers) to take forward commercialisation

3.3 The new act coincided with a greater public policy emphasis on innovation and this is reflected in the mission statements and senior management structures of the universities. Both universities see innovation as part of their mission and are explicitly not engaged in IP exploitation for any financial returns which might be generated.

3.4 The situation in respect of the hospitals is analogous, but different. The aim of the Capital Region is to improve healthcare in the region; research and innovation are devoted to this. In many cases, commercial intervention will be required to provide a product, but improved health care may also result from innovative processes which will never show up in data on patents or spinouts.

[6] The Hospital's technology Transfer operations were undertaken by three organisations before the Capital Region came into being.

Region Hovedstaden

3.5 The Region Hovedstaden technology transfer office (TTO) currently consists of two units: Legal; and Business Development. The units are managed by two Heads of Office; one with a commercial background and with experience in managing innovation at hospitals, and one with a background in political sciences and funding.

- The Legal Unit consists of five lawyers, all with backgrounds in private industry or public/semi-public institutions
- The Business Development unit consist of four full-time employees: two lawyers with a background in biotech companies and law firms and two with a science background. They both hold a PhD degree; one in cell biology and the other one in molecular biology. Both with experience from both public organisations and private industry. Additionally, there are two consultants dedicated to a short-term spin-out project closing in December 2014.
- The Legal Unit advises hospitals on a variety of research related contracts including: Clinical Trials; Research Collaboration; Material Transfer; EU-Consortium; Consultancy; and Public Private Partnerships. Five hundred and ninety-one collaborative research agreements were signed in 2012 and 670 in 2013. In addition the legal unit handles 150 other types of agreements essential to collaboration between hospitals and private industry.
- The Business Development Unit assists with identifying, documentation, evaluation, protection, marketing and managing IPR accruing from hospital research. Business Developers also draft IP agreements with private parties. The Business Development team has an active portfolio of 50 different assignments comprising 100 inventions.

3.6 Finally, the unit comprises five Innovation Consultants who from time to time assist in the evaluation of medtech and IT innovation.

3.7 Expenditure (Table3-1) consists of expenses in IPR Protection and external consultants assisting with the commercialisation. Internal salary costs are not included.

University of Copenhagen

3.8 The TTO at the University of Copenhagen is part of the Research and Innovation Department headed by a Director of Research & Innovation. The Director reports directly to the Pro-vice-chancellor for Research & Innovation. The TTO is

responsible for evaluation, protection and negotiation and commercialisation of all University IP, be it through commercial agreements or research collaboration agreements. No other entity within the University of Copenhagen can negotiate agreements containing IP. There are 14 staff divided as follows:

- One Head of Office
- Six lawyers drafting commercial agreements as well as research collaboration agreements (excluding EU-related agreements - the EU Office handles that). This team also deals with all Material Transfer and Non-disclosure agreements and offers legal advice on matters related to IP (including copyright issues), publications, etc. Some lawyers come from private industry others from other research institutions or private/public organisations.
- Five business development officers (BDOs), who all have scientific backgrounds and previous experience from private/semi-private organisations. Three BDOs work mainly on licensing and two mainly on spin-out creation. They scout and evaluate invention disclosures, deal with patent agents, market and lead the dialogue with external partners, negotiate terms in commercial agreements as well as manage the portfolio of the University's 112 active licensing agreements. Two BDOs are working on the Copenhagen Spin-outs project. They assist researchers wishing to follow the spin-out route.
- Two project managers - one project manager on the project, Copenhagen Spin-outs, and one on the project, Copenhagen Cleantech Cluster. Both these projects come to an end in December 2014.

3.9 The University entered 17 licensing agreements in 2013 and established one spin-out. Expenditure (Table3-1) for commercialisation includes patenting costs, external consultants (commercialisation activities) and external legal advice.

3.10 In addition, the office has the following funds available for Proof-of-Concept:

- University Proof-of-Concept fund: Annual fund of DKK 5 million
- Copenhagen Spin-out mini-proof-of-concept funds: around seven funds of DKK 250.000 each
- Copenhagen Cleantech Cluster gap-funding: a similar number of funds of DKK500.000 each.

Technical University of Denmark

3.11 The TTO functions at DTU are shared with departments and central support functions. The university's executive board includes a Senior Vice President for Innovation and Entrepreneurship.

3.12 At central level the TTO is integrated in two units in the same office: Legal & Contracts; and Business Development & Entrepreneurship. Legal & Contracts consists of 17 legal officers of which around five full-time equivalents are working with commercialisation. The Business Development unit comprises 29 FTE's, of whom three are patent administrators and 14 are business developers with a background in engineering, science and economy, all with experience from the private sector and several with experience from spin-out companies.

3.13 DTU's 25 Departments and Centres all have their own innovation and contract managers, and some departments have employed their own business developers and innovation scouts. There is a close collaboration between the departments and the central units in the specific commercialisation projects. Furthermore DTU have two subsidiaries of importance to commercialization – The science park Scion-DTU and the pre-seed venture capital investor DTU Symbion Innovation.

3.14 DTU had an active portfolio of 350 inventions and patents by the end of 2012. In 2012 DTU's expenditure on IPR Protection and external patent consultants was more than DDK 15m. Internal salary costs are not included.

3.15 In 2014, DTU have proof of concept funds of approximately DDK 11 mill, mainly Regional and University-funded.

Resources

3.16 We have data on commercialisation activities between 2005 and 2012 and this is shown in Table3-1

Table3-1: Technology transfer staff and expenditure

Year	Region Hovedstaden		DTU		KU	
	Staff (FTE)	Expenditure (DKK 000s)	Staff (FTE)	Expenditure (DKK 000s)	Staff (FTE)	Expenditure (DKK 000s)
2005	4.5	2,271	3.25	3,572	4.7	3,140
2007	8	2,860	13.4	11,455	9.5	5,879
2008	10	4,780	13.5	11,809	8	5,700
2009	10	5,700	14.5	14,615	8	7,616
2010	10	6,300	15.5	14,010	8	5,009

Year	Region Hovedstaden		DTU		KU	
2011	10	8,239	14.5	14,063	8	4,470
2012	10	(-)	19	15,924	13	4,587

Source: Annual Commercialisation Surveys

3.17 In all three cases resources have grown significantly since 2005, but almost all growth was at the start of the period. The universities both increased resources in 2012 but, as is discussed in the next chapter, staff numbers appear to be low compared with some UK counterparts. We would note two other points:

- Staff turnover has been relatively high at the Capital Region, in part because of competition from the private sector
- For the same reason, there have been difficulties recruiting so that the offices have not always had their full complement of staff

Outputs

3.18 Various output metrics are shown in Table3-2. For the two universities, especially DTU, there has been a significant increase in output since 2005, broadly in line with the extra staff. The Capital Region outputs have, however changed little over the period. There is a concern in all three organisations that bottlenecks will arise in the pipeline as a result of staff constraints. In part this reflects the increasing portfolios to be managed; a constant flow per year of disclosures and patents will add to the stock that needs to be managed unless older ones are allowed to lapse. This is a problem common to TTOs throughout the world. The limiting factor in determining the number of licences or similar activity seems to be the number of staff employed in the office.

3.19 In the case of DTU the recent rapid increase in disclosures may create particular issues. These reflect efforts by the Technology Transfer Office to increase awareness within the academic community and it would be counterproductive if those with merit were not progressed to later stages of commercialisation. The Capital Region is working with a legacy of around 60 patents and cannot devote sufficient time to take all these forward. It recognises that many of these cases lack any real commercial potential and should be "closed", but the active portfolio is still too large for the TTO's capacity.

Table3-2: Technology transfer outputs

		Invention disclosures received	Patent applications filed	Patents issued	Licenses and assignments executed (incl. software)	License portfolio (excl. software)	Spinout companies formed
DTU	2005	44	28	2	27	2	3
	2007	77	44	6	13	6	3
	2008	67	39	6	20	6	0
	2009	73	44	12	21	9	2
	2010	87	46	6	22	10	2
	2011	103	60	23	20	12	2
	2012	147	68	21	20	21	5
KU	2005	21	4	7	8	18	1
	2007	72	16	0	11	37	1
	2008	74	21	0	19	43	3
	2009	45	17	2	15	50	0
	2010	40	11	2	18	58	0
	2011	58	12	3	26	79	0
	2012	49	10	3	19	96	5
Region Hovedstaden	2005	18	4	2	2	14	2
	2007	23	7	1	1	12	1
	2008	29	19	2	6	17	2
	2009	25	7	1	3	14	1
	2010	34	13	2	2	16	0
	2011	34	17	3	5	21	0
	2012	23	12	2	1	12	(-)

Source: Annual Commercialisation Surveys

4. Comparisons with selected UK organisations

4.1 This section presents comparisons between the Capital Region and selected institutions in the UK. The two universities are discussed first. There is greater diversity between the two countries within the higher education sector that then hospital sector, but we have richer data sets to make comparisons.

The Universities

4.2 In selecting the UK comparators we have tried to identify universities that are similar in their capacities to engage in commercialisation and knowledge transfer. The main factors we have drawn on are:

- *Scale*, as indicated by staff and student numbers. Staff includes post doctorates for comparisons with KU. The DTU data excludes post doctorates. We have sought to provide comparable data for the UK by excluding "research only" staff, the vast majority of which will be post doctorates since virtually all staff in research active universities are required to teach and research. Various measures of student numbers have been used.

- *Research grants,* which is also an indicator of scale, but also a surrogate for commercialisation potential. In comparing research grants we are neglecting, in both countries, 'core' funding for research via block grants.

4.3 In both cases we have distinguished between medical and other science and technology related disciplines. The commercial opportunities, time scales and potential returns to medical research are very different from many other scientific areas. All arts, humanities and social science disciplines have been discounted. This means that all of DTU's activity has been included but only a proportion of KU's.

4.4 The two universities kindly supplied us with the data required and the UK data has been taken from publicly available sources.[7]. The comparisons are for 2011. As will be clear from the discussion below, it is not possible to identify close comparators and the results must be read with this in mind.

[7] Most has been sourced from the UK Higher Education Statistics Agency's "Planning Plus" data (http://www.hesa.ac.uk/index.php?option=com_pubs&task=show_pub_detail&pubid=1711&Itemid=286) and the Higher Education Business and Community Interaction Survey (http://www.hesa.ac.uk/component/option,com_pubs/Itemid,122/index.php?option=com_pubs&task=show_pub_detail&pubid=1718&Itemid=286)

4.5 Before discussing the comparisons, it is worth noting that the UK university sector has a well-established track record of knowledge transfer and contributing to innovation, the modern origins of which can be traced back to the early 1980's. Until then, the ownership of any intellectual property arising from Research Council funded projects was vested in the Research Councils themselves and a public organisation (the National Research Development Corporation, later the British Technology Group or BTG) had first right of refusal on the IP. There were insufficient incentives for university themselves to engage in exploitation and there was also a perception (often disputed) that the UK had given away some important discoveries through a failure to protect and exploit properly. As a result, ownership was transferred to the universities and some technology transfer/industrial liaison offices were established[8]. However it was only in the late 1990s, when the UK Government started allocating funds specifically for universities to establish relationships with business, that a big expansion of university TTOs was seen.

4.6 Also in the 1980's, there was an increasing emphasis on using local and regional resources to promote regional economic development and less reliance on attracting inward investment from abroad and movement from the more to less prosperous regions within the UK. In this context, universities were seen as major local and regional assets and public authorities sought partnerships and invested in science parks and incubators.

4.7 The infrastructure for commercialisation has thus been established for some time and the UK is considered to be a leader, at least in Europe. At the same time there has been some financial support for knowledge transfer[9]. Perhaps the most important, and longest running, is HEIF (the Higher Education Innovation Fund). This is now allocated by a formula that reflects the volume of knowledge transfer performed in previous years. Some universities receive nothing; the maximum per university is capped at approximately DKK 28.5m per year. The total amount (around DKK1.4bn per year), is small compared to other higher education funding, but it is valued for funding specific initiatives and, more generally, raising the profile and legitimising knowledge transfer within higher education.

4.8 Pressure on UK academics to engage with business has continued, in part for academic reasons in some disciplines, but two other factors are also important:

- The quality of research in UK universities is assessed around every five years[10] and the results of the assessment have a direct influence on the

[8] Universities had to establish frameworks for exploitation before they were granted ownership of IP
[9] Information on current and past support programmes is provided in annex B
[10] In practice the interval between assessments has sometimes been longer.

block grant awarded for research purposes[11] . The total grant for England alone is around DKK 11bn per year. The most recent assessment exercise is now underway and universities have been preparing their submission for the last few years. For the first time the "impact" of research will be assessed and will account for 20% of the quality grade awarded. Impact is not restricted to economic impact, but this is a major factor in science and technology and has undoubtedly led universities to promote (and identify) such impacts.

- There are seven research councils in the UK that fund projects in universities. Their funding is extremely important to the universities. Their total budgets are round DKK 26bn. Beginning in 2009, all the research councils phased in a requirement that applicants for grants needed to provide a "Pathways to Impact" statement when applying for grants. This needs to specify who might benefit from this research and how. Applicants are also required to specify the activities that will generate impacts.

Technical University of Denmark

4.9 DTU is only active in science and technology disciplines and does not have a medical faculty. This makes it difficult to find UK comparators since most UK universities will comparable research efforts also undertake medical research. As a first comparison, we identified UK universities where medical research grants were less than 20% of total[12] grants. There were 12 active in science and technology in 2011. Key metrics for these and DTU are presented in Table A-1in annex A

4.10 The data in Table A-1refers only to science and technology activities and it is evident that DTU is substantially larger than any of the UK comparators. It has many more staff and research grants are substantially higher. There is less disparity in total student numbers, but DTU has many more post-graduate students (PG) than the others and (not shown in the table) a high proportion of research PG to masters students. Of the UK universities, only Warwick approaches DTU in scale, but it is still substantially smaller.

4.11 These differences in scale mean we have had to widen the comparator list to include universities with substantial medical research. The extended data is shown in Table A-2. Oxford, Cambridge, Imperial College and UCL have been included, because if DTU was located in the UK it would be ranked 5th in terms of research grants. However, the research expenditure at these UK universities is

[11] This is known as "QR" funding and universities have considerable discretion as to how they spend their allocation.
[12] Excluding arts, humanities and the social sciences.

substantially higher and medical research is a very large proportion of this. As such, they are not useful comparators.

- Clearly there are no close counterparts to DTU in the UK, but we have selected the following for comparator purposes: Manchester, which has the most similar profile, although a high proportion of medical research
- Edinburgh, which is also similar but smaller in terms of staff and research grants
- Glasgow and Leeds, which are significantly smaller but may provide some interesting insights.

4.12 Of course scale is not the only consideration when making comparisons and 'quality', however defined is also important. Table 4-1shows the THE[13] world university rankings for DTU and the comparators. The rankings are based on 13 performance indicators and claim to reflect research, teaching, knowledge transfer and international outlook. These, however, are correlated and research tends to be the dominant factor in the rankings. Rankings are available for the top 400 universities considering all disciplines and the top 100 for a breakdown by broad discipline. DTU is ranked approximately in the middle of the group so far as all disciplines are concerned, but is the highest ranked on engineering and technology; its principal area. The differences between DTU and Edinburgh and Manchester are quite small in terms of the actual score.

Table 4-1: THE rankings 2013/14

	DTU	Manchester	Edinburgh	Glasgow	Leeds
All discipline	117	58	39	117	139
Engineering & technology	34	37	55	Not available	87

Source: Times Higher

4.13 Table4-2 shows patenting and licensing activity for the five universities. It is striking that there is little relationship between scale and patenting activity, as far as the UK universities are concerned. On most of the indicators, DTU is lagging Manchester, its closest comparator, but this almost certainly reflects the later start to commercialisation at DTU. Compared with DTU, all the UK universities have larger patent portfolios that have been built up over many years. There are indications that DTU is catching up in this respect:

- Patent applications and awards were higher for DTU than the comparators, with the exception of Edinburgh
- As was mentioned in Chapter 2, disclosures at DTU have been increasing rapidly in recent years: 87 in 2010, 103 in 2011 and 147 in 2012.

[13] http://www.timeshighereducation.co.uk/world-university-rankings/2013-14/subject-ranking/subject/life-sciences

Table4-2: Patenting and licensing activity (average 2010 and 2011)

	Disclosures	Patent applications	Patents granted	Cumulative patent portfolio	Income from licensing (DKK 000s)
DTU	*95*	*53*	*15*	*66*	*2,338*
Manchester	328	45	7	239	6,111
Edinburgh	153	170	22	141	17,505
Glasgow	30	8	2	256	10,193
Leeds	51	34	9	342	6,201

Source: Higher Education Business and Community Interaction Survey and DTU

4.14 The average number of spin-outs (based on university-generated intellectual property) during 2010 and 2011 was as follows:

- DTU 2.0
- Manchester 1.5
- Edinburgh 6.0
- Glasgow 1.5
- Leeds 1.0.

4.15 There is very limited information, for any of the universities, on the size of these spin-outs or the longevity of earlier spin-outs. However, DTU has performed slightly better than the comparator group, with the exception of Edinburgh which has prioritised spin outs when appropriate. In 2012 DTU established five spinouts.

4.16 Finally we provide some data on resources devoted to commercialisation and knowledge transfer. The UK HEBCI survey[14] asks institutions:

> *How many members of staff at your HEI (full-time equivalent) are employed in a dedicated Business and Community (Third Stream) function?*

4.17 Separate responses are requested for engaging with commercial partners and engaging with public sector partners.[15] The responses are shown in Table4-3. The data is difficult to interpret and compare within and between countries. In some cases technology transfer offices will be able to call on legal expertise elsewhere in the university, in others this will also be a dedicated resource. There are also differences in responsibilities; in some cases there will be a

[1414] Op Cit

[15] Social community and cultural partners are a separate category

narrow focus on IP, in others staff will be responsible for a full range of interactions with business.

Table4-3: Dedicated business staff (FTEs)

	Commercial	Public sector	Total
The University of Leeds	74	74	148
The University of Manchester	52	26	78
The University of Edinburgh	30	6	36
The University of Glasgow	15	7	22

Source: Higher Education Business and Community Interaction Survey

4.18 However, the table does imply that the UK universities are devoting substantial resources to technology transfer. In 2012, DTU had 19 FTE central technology transfer staff dealing with a larger science and technology portfolio. There are additional resources in some departments, but the data does suggest that DTU is under-resourced in comparison with the UK comparators.

University of Copenhagen

4.19 KU undertakes medical research and in 2011 this was 51% of total (excluding arts, humanities and social sciences) research expenditure. This makes it somewhat easier to identify suitable UK comparators. There were 20 UK universities where the share of medical research was between 30 and 70% of all research. Four universities [16] where the volume of research was between 50 and 80% have been excluded. The remaining candidates are shown in Table A-3. Not surprisingly, the UK universities are the same as those in Table A-2since KU and DTU had similar amounts of medical, science and technology research grants.

4.20 Again Manchester is the closest comparator, followed by Edinburgh, with the others significantly smaller. We therefore decided to use the same comparators as for DTU, although this does not imply that DTU and KU are themselves comparable institutions.

[16] In descending order: Oxford; Imperial; UCL; and Cambridge

Table 4-4: THE Rankings 2013/14

	KU	Manchester	Edinburgh	Glasgow	Leeds
All discipline	150	58	39	117	139
Clinical, Pre-clinical and Health	59	41	27	71	82
Life sciences	42	55	21	44	91
Engineering & technology	>100	37	55	>100	87
Physical sciences	>100	50	37	>100	>100

Source: Times Higher

4.21 Table4-5 shows patenting and licensing activity for the five universities. In terms of the pipeline, KU is similar to Glasgow, but operating at a lower level than Manchester of Edinburgh. As was mentioned above, these universities have devoted significant resources to IP for a much longer period than KU.

Table4-5: Patenting and licensing activity (average 2010 and 2011)

	Disclosures	Patent applications	Patents granted	Cumulative patent portfolio	Income from licensing (DKK 000s)
KU	*50*	*12*	*2.5*	*Not available*	*4,410*
Manchester	328	45	7	239	6,111
Edinburgh	153	170	22	141	17,505
Glasgow	30	8	2	256	10,193
Leeds	51	34	9	342	6,201

Source: Higher Education Business and Community Interaction Survey and KU

4.22 The average number of spin-outs (based on university-generated intellectual property) during 2010 and 2011 was as follows:

- KU 0
- Manchester 1.5
- Edinburgh 6.0
- Glasgow 1.5
- Leeds 1.0.

4.23 As was shown in chapter 3, no spin-outs were generated during the period 2009-2011. However, in 2012 five were established and in that year there were 20 university spin-outs still active.

4.24 Table4-3 showed the dedicated business staff for the UK universities. Again we would emphasise that this data needs to be treated with caution since it is not clear what precisely is included, or how consistently UK universities responded to the survey. However, from 2008 to 2011 there were eight FTEs in KU's technology transfer office, increasing to 13 in 2012. The suggestion is that KU is devoting less resources that the UK comparators.

Region Hovedstaden

4.25 We are unable to make the same comparisons for hospitals as has been possible for the university sector. The main difficulty is that research, commercialisation and other data is not publicly available for individual hospitals in the same way as for universities. We cannot, therefore, identify comparator hospitals and compare commercialisation outputs. We have made direct request to individual UK agencies and also submitted a freedom of information request, but neither has provided useful data, so far.

4.26 The most relevant information we obtained relates to NHS (National Health Service) Regional Innovation Hubs. Seven hubs were established between 2002 and 2005 to encourage and facilitate innovation processes around health care institutions. These activates were meant to result in improved care and better outcomes for patients, and significant financial benefits for the NHS (through cost-savings, new income-streams, efficiency –savings and improvements in quality). These hubs were distributed around England in seven regions, and have a remit to provide services for all health trusts within their region which request them.

➢ The hubs provide innovation management services and expertise ranging from free advice to targeted chargeable services, including:

- A review and evaluation service to all ideas that are 'disclosed' to them. This process considers commercialisation possibilities including: Practicality and costs of making the idea reality; nature of the unmet need the idea fills; the potential market; any Intellectual Property that can be protected size etc.

- Following this, innovators with ideas judged to be feasible are able to benefit from the specialist services of the innovation hub for such activities as: Protecting Intellectual Property; Developing prototypes; Proof of concept feasibility studies; Identifying potential commercial partners; Negotiation of license to commercialise the idea

4.27 In many ways the Innovation hubs' activities are similar to those of Region Hovedstaden, but there are two important, and related, differences:

- The hubs do not own the IPR to any inventions generated within the hospitals. Ownership is vested in the Health Trust, the research funder or sometimes the inventor according to individual circumstances
- There is no requirement for the hospitals to use hub services and many have made alternative arrangements or use the hubs on a case by case basis according to needs. Indeed, it seems that the 'market' for innovation services in this area has become increasingly competitive.

4.28 Two hubs, NHS Innovations West Midlands and NHS Innovations Yorkshire and Humber, did provide limited information on their commercialisation activities. In 2010/11:

- West Midlands created one spin-out and made 17 licensing deals
- Yorkshire and Humber created 2 spin-outs and made 10 licensing deals.

4.29 There were 13 and 15 "NHS Foundation Trusts", which mange the hospitals, in the two regions respectively. There may be more than one hospital site under each Trust. The populations of the two Regions is 5.6 m and 5.3 m respectively; around five times the size of the Capital region of Denmark. This puts the low number of spin-outs in the Capital Region in context, although we would again emphasise that the innovation hub data may not capture all activity in the UK Regions.

5. Conclusions and options for the future

Conclusions

5.1 Much progress has been made since the 2000 change in the law vesting ownership of IP with the universities and the hospital. The three TTOs are now firmly established and have introduced procedures for handling inventions from the notification stage through to commercialisation where appropriate. This in itself is a significant achievement. UK universities went through a similar process in the 1980s and it took many years for some TTOs to reach their current level of professionalism and effectiveness.

5.2 Top management at both the universities and the Capital Region are committed to knowledge transfer and explicitly sees this as an important part of their mission and not a means to generate revenue. This commitment is reflected in management structures. At DTU a Director for Innovation and Entrepreneurship is a member of the University's Executive Board and is responsible for the TTO. KU has a Pro rector for Research and Innovation and has established a Council for Research and Innovation comprising vice deans from the faculties.

5.3 There are also signs that researchers in the universities and hospitals are becoming more engaged with knowledge transfer, including commercialisation of IP. Cultural attitudes, however, remain a barrier to commercialisation in both the universities and hospitals and there are wide variations between disciplines and individuals in their enthusiasm for, and experience of, knowledge transfer. This is a particular issue for IP commercialisation, which typically requires a greater commitment to divert from mainstream academic activities than other forms of knowledge transfer, such as collaborative research. In part this reflects incentive structure academics face where the traditional academic research publication and teaching quality are still the main criteria for advancement. It was also pointed out to us that the norm in wider Danish society is to seek paid employment rather than an entrepreneurial path, although this is believed to be changing with the universities playing an important role in promoting change.

5.4 Our general conclusion is that commercialisation activities are working well given the relatively short history of the TTOs. This is consistent with the findings of a more substantive study undertaken by DEA

> *DEA's analysis shows that there has been a considerable and positive development in the technology transfer effort over the past ten years or so. The efforts at the Danish universities have been continually adjusted, as the universities and the political*

system have developed a more nuanced understanding of how to best support technology transfer[17]

5.5 In the interviews at the two universities we were impressed by what we saw. The key elements of best practice were evident in both KU and DTU: clear policies, visible support form senior management, confident leadership in the TTOs and well trained and experienced staff. Where the staff expressed frustrations (insufficient funding for developing their projects, too many projects per person to be able to give them adequate attention) these were no different than we would have heard in comparable universities in the UK (or the USA). It is an inherent part of the work that the opportunities always outstrip the resources and difficult decisions of prioritisation have to be made.

5.6 In the Capital Region the situation was different. As in the UK technology transfer is much newer in hospitals than in universities. The goals are different (saving money in procurement of goods or services may be worth more than a licence or a spinout deal) and the sources of innovation much more widespread (i.e. not necessarily tied to grant funding of research). Furthermore in Denmark as in the UK, the collection of metric data and the setting of benchmarks is less well established for hospitals. This makes the management of technology transfer in hospitals more difficult. Despite this we saw some excellent examples of best practice in the Capital Region. The leaflets provided to market available technologies were first class and the people we interviewed had a positive attitude and had relevant experience. We got the impression that the leadership of the TTO in the Capital Region had undergone several changes and that the mission for technology transfer in the hospitals was not as widely disseminated as in the universities.

5.7 Given that one of the aims of our report is to "initiate a dialogue between technology transfer units in the Region", we have tried to suggest recommendations that capitalise on the combined experience of the TTOs in the Copenhagen region (see paragraph 5.12). Whilst the TTOs we visited compare favourably with peers in the UK, it may be worth considering whether any recent trends in the UK might have relevance for Danish universities.

5.8 Some UK universities have set up their commercialisation activities as a separate, wholly owned subsidiary company. Examples include UMIP (Manchester), Isis Innovation (Oxford) and Cambridge Enterprise. Any university where the business of commercialisation has the prospect of becoming a significant part of the turnover of the institution should consider this model and take professional advice. Imperial College went one step further and

[17] Tech transfer in Danish universities- what have we learned from ten years of trying to make money on research? DEA 2013

invited external investors to buy shares in its company, Imperial Innovations, by floating the company on the AIM stock exchange in London. This model is definitely not for every university. We are aware of one other UK university that tried to float its company, but failed to generate sufficient interest from investors and so withdrew its plan.

5.9 As in Denmark, the UK Government closed a very popular seed funding scheme for spinout companies. The University Challenge Seed Funds provided seed capital to universities. When the scheme was closed, several universities set about raising funds from private investors. Examples include the Oxford Invention Fund and Cambridge Discovery Fund.

5.10 Several universities have adopted a different approach to raising funds for their spinout companies. IP Group is a public company that has set up partnerships with more than a dozen UK universities, including many in the Russell Group. IP Group offers management and business advice, as well as funding, in return for a first option to invest and a share of the spinout companies. IP Group recently acquired its competitor, Fusion IP Ltd., which had similar arrangements with some other UK universities.

5.11 But, we also believe that there is scope for improvement and the technology transfer system needs to continuously evolve in order to build on the foundations that have been put in place. As mentioned in the introduction, this study has not been of sufficient depth to make firm or detailed recommendations for commercialisation. Instead, we put forward some options for the institutions and authorities to consider.

Options

Restructuring the Capital. Region's technology transfer support

5.12 The key issue we have identified is the limited capacity to take ideas from invention stage to commercialisation. This requires a combination of commercial and technology skills that is hard to find and also in demand by the private sector. All the technology transfer offices have people with these abilities, but we doubt whether there are sufficient numbers given the volume of research underway in the region.

5.13 Although we saw some excellent examples of best practice in the Capital Region, and top-level management in the Region fully supports research and innovation, the problem seems especially acute in the Capital Region Technology Transfer Office. A small number of staff are struggling to cope with a relatively large patent portfolio and we believe that this is the main issue to be addressed. One response is, of course, to increase the budget available for technology transfer by

the Capital Region and chapter 4 suggested that the university offices might be under-resourced, at least in comparison with their UK counterparts. However there may be other solutions.

5.14 The key question is whether resources could be shared between the two universities and the Capital Region in order to build a critical mass of commercialisation expertise. We are aware that there has been some discussion of a single technology transfer office for the Region, and indeed the country, but we believe there could be problems with this. Knowledge transfer and commercialisation are not simply about skills and expertise. At least as important is engagement of the research community with knowledge transfer strategies and actions. All things being equal, this is more likely to happen if the office is part of the institution with which it is working and KU and DTU certainly have sufficient research budgets to justify their own offices. The Capital Region technology transfer office is in a different position. It is not a part of any of the hospitals it needs to work with, yet at the same time has limited capacity to process the ideas which are emerging from the hospitals. In our view this suggest three options for consideration:

- A technology transfer office could be established in the hospitals. Clearly, there could not be a separate office for each but one or two offices, based in the major research hospitals but servicing all, might be feasible. This option would have the advantage of bringing technology transfer functions closer to the researchers. We would note that this is likely to lead to higher costs of coordination and management as the technology transfer would be spread between more than one office
- The Capital Region's technology transfer function could be sub-contracted to DTU or KU. The main advantage would be to increase critical mass of commercialisation expertise with the potential for greater specialisation on technologies/markets by staff. It was outside the scope of this project to assess the capabilities, and willingness, in KU and DTU to undertake such a role and further assessments would be necessary. We would also note that any contract with external providers would ned to be actively managed by the Capital Region and these costs would need to be balanced against the potential benefits
- More speculatively, the Capital Region could consider a deal with an organisation like the IP Group (paragraph 5.10). Again the management costs would ned to be considered alongside the potential benefits.5.14)

Incentives for Researchers

5.15 It would be unrealistic (and almost certainly undesirable) for all researchers to be actively engaged in commercialisation. Nevertheless the TTOs believe there is scope for more to be engaged and this was echoed by the other staff we consulted in the universities and hospitals. Part of the issue is awareness and the TTOs, and others, have done much to increase awareness of the opportunities for, and the implications for researchers of, commercialisation. However, IP commercialisation makes substantial demands on researchers and, in most cases, will not contribute to career advancement. Culture changes happen slowly. Identifying, celebrating and publicising successful role models is one way to catalyse such change. Another is to encourage and support student entrepreneurship. Students adapt to change much more readily than established researchers and can create an environment where commercialisation is an aspiration.

5.16 The financial incentives in place in the Copenhagen TTOs are in line with those found in the UK. One third of revenues to the inventor is common. There are all sorts of variations such as sliding scales where the inventor gets a bigger share of the early revenues, but experience suggests that financial incentives play a smaller role than the esteem of their peers and the role played by commercialisation in the criteria for academic promotion. The share of revenue which the inventor is entitled to is in line with other countries, although the absolute returns will generally be small, but there are other ways in which incentives could be improved. We recognise that incentive structures must reflect an institution's strategy and aspirations and cannot be designed simply to maximise IP commercialisation. But we would recommend that the incentive structure is regularly reviewed and consideration given to whether:

- Knowledge transfer should be considered as a criteria for promotion
- Whether researchers could be granted sabbaticals to pursue commercialisation opportunities

Financial support from Government

5.17 Government has given financial support for technology transfer since the 2000 law was introduced; most recently in the form of proof of concept funding which was discontinued in 2012. As with incentive structures, government funding for technology transfer can only be analysed in the context of research and higher education policies as a whole, which we are unable to comment on. However, we would note that the successes of knowledge transfer in the UK has, in part, reflected continual and earmarked funding for knowledge transfer over a number of years.

The role of the Capital Region in stimulating innovation

5.18 This study has focused on the Capital Region's TTO, but Capital Region potentially has a role in stimulating innovation through the creative use of its procurement budget. This is already happening to some extent through the Public Private Partnerships, some of which have the capability to generate new businesses as well as directly meeting the Regions health and other needs. This general approach, often referred to as demand-side innovation policies, is under active consideration by the Region as illustrated by the quotes below:

> *The public private partnerships are a very good way of stimulating innovation, as well as improving services in the Region*[18]

> *There is scope for the Region's procurement policies to stimulate innovation locally (as well as provide enhanced services). The universities and the hospitals have an important role through working with businesses to deliver innovative outcomes*[19]

> *The Capital Region Development Strategy needs to create strategic alignment between industry, universities/hospitals and the Capital Region, working together on the innovation eco system*[20]

5.19 We believe there is real potential to develop procurement policies further in this direction. It requires the Capital region to adopt additional roles to those of patent protection and exploitation and to also articulate needs and bring the different contributors together as illustrated in the last quote.

Monitoring knowledge transfer

5.20 In chapter 2 we drew attention to the deficiencies of focusing on metrics such as patents applied for and number of licenses. They provide only a partial indicator of contributions to knowledge transfer and innovation and may not always give a useful view of IP commercialisation. We think consideration should be given to extending the monitoring data to include:

- Other forms of knowledge transfer, such as collaborative and contract research, consultancy and so on
- Tracking the development of spinouts

5.21 The UK Higher Education Business and Communication Interaction Survey (HEBCI[21]) would be a useful starting point to consider.

[18] Lars Gaaardoj. Member of the Regional Council
[19] Claus Bjørn Billehøj – Director, Capital Region of Denmark, Center for Regional Development
[20] Kristian Johnsen, Vice Director, Capital Region of Denmark, Center for Regional Development
[21] http://www.hefce.ac.uk/whatwedo/kes/measureke/hebci/

Annex A: Data on UK Universities

Table A-1: DTU and UK universities without substantial medical research

University	Ratio of medical research to all research	Staff	PG students	UG Students	Research grants (DKKm)
DTU	*0%*	*1,680*	*4,334*	*2,464*	*1,672*
Cranfield	0%	289	2,268	0	389
Loughborough	3%	732	1,721	5,877	287
Surrey	6%	486	1,391	3,115	214
St Andrews	8%	340	576	1,723	263
Lancaster	8%	235	509	1,712	155
Durham	10%	366	564	3,663	258
Reading	10%	493	979	2,807	235
Warwick	14%	761	1,797	3,938	552
Sussex	17%	328	583	2,008	171
Strathclyde	18%	681	1,399	4,951	258
Bath	19%	380	974	4,662	177
York	19%	530	940	2,921	275

Table A-2: DTU and selected universities (Medical and science and technology activities aggregated)

	Ratio of medical research to all research	Staff [22]	PG students	UG Students	Research grants
The University of Oxford	63%	735	230	2,668	2,942
Imperial College of Science, Technology and Medicine	54%	1,156	3,155	5,169	2,618
University College London(#5)	66%	1,464	4,610	8,566	2,444
The University of Cambridge	40%	918	3,339	6,415	2,361
DTU	*0%*	*1,680*	*4,334*	*2,464*	*1,672*
The University of Manchester	45%	1,323	4,689	14,878	1,603
The University of Edinburgh	45%	934	3,082	7,897	1,470
King's College London(#5)	88%	1,116	2,972	8,304	1,174
The University of Glasgow	65%	750	1,905	8,235	1,079
The University of Leeds	51%	912	2,767	10,414	1,016
The University of Liverpool	69%	886	1,723	9,017	959

[22] Excludes post doctorates

	Ratio of medical research to all research	Staff [22]	PG students	UG Students	Research grants
The University of Bristol	50%	766	2,140	8,057	930
The University of Sheffield	31%	841	3,345	8,873	854
The University of Birmingham	58%	786	2,638	8,259	826
The University of Nottingham	39%	1,220	3,511	13,391	821
The University of Southampton	30%	856	2,777	8,925	777
The University of Newcastle-upon-Tyne	50%	768	2,662	7,411	757
Cardiff University	54%	981	2,957	9,752	676
The University of Warwick	14%	505	2,373	5,168	644

Table A-3: KU and selected universities (Medical and science and technology activities aggregated)

University	Ratio of medical research to all research	Staff[23]	PG students	UG Students	Research grants
KU	*51%*	*3,399*	*8,775*	*9,692*	*1,720*
The University of Manchester	45%	3,001	4,689	14,878	1,603
The University of Edinburgh	45%	2,242	3,082	7,897	1,470
The University of Glasgow	65%	1,525	1,905	8,235	1,079
The University of Leeds	51%	1,738	2,767	10,414	1,016
The University of Liverpool	69%	1,496	1,723	9,017	959
The University of Bristol	50%	1,710	2,140	8,057	930
The University of Sheffield	31%	1,750	3,345	8,873	854
The University of Nottingham	39%	2,174	3,511	13,391	821

[23] Includes post doctorates

Annex B: UK Knowledge transfer support programmes

Higher Education Innovation Funding (HEIF)

B.1 Available in England and Northern Ireland. HEIF was first introduced in in 2001and provides financial support for knowledge transfer activities in universities. Originally, funds were allocated through a competitive bidding process with universities submitting proposals for funding. Most proposals for the first round of HEIF included funding for dedicated knowledge transfer staff. The programme has evolved over time and funds are now allocated through a formula based on recent knowledge transfer performance. The main metric in the formula is income generated by knowledge transfer activities and institutions which would be allocated less than approximately DKK 2.5m via the formula receive nothing. Universities are required to submit their strategies for knowledge exchange which are assessed by HEFCE [24]and these are publicly available. Current funding is approximately DKK 1.5bn.

B.2 Similar schemes operate in Scotland and Wales which have their own Funding Councils

http://www.hefce.ac.uk/whatwedo/kes/heif/

The Research Councils

B.3 There are seven research councils in the UK which fund research projects in the universities. As was described in the main report. They require applicants for grants to prepare pathways to impact statements as part of the proposal. They also provide direct funding for knowledge transfer. The schemes vary between councils but the list of Engineering and Physical Sciences Research Council schemes is a god indication of what is offered:

- KNOWLEDGE TRANSFER ACCOUNTS, Grants that have been awarded to 12 universities to ensure that their EPSRC research is exploited to maximum effect, and to contribute to a culture of knowledge transfer. Decisions about how KTA funding is deployed are made by the university holding the grant.
- KNOWLEDGE TRANSFER SECONDMENTS. Grants that have been awarded to universities to support secondments of EPSRC funded staff into organisations which can exploit their research results. KTS funding can also be used to host researchers from industry.
- INDUSTRIAL DOCTORATE CENTRES, Operate at 18 centres across the remit of EPSRC and provide an industry-focussed alternative to the PhD for research engineers. Students spend around 75 per cent of their time working directly with the collaborating company.
- DOCTORAL TRAINING ACCOUNTS, Held by UK universities to fund postgraduate training, with around 10 per cent of the awards converted into Industrial CASE by working with user organisations.

[24] The Higher Education Funding Council for England which proves HEIF funding for English universities

- KNOWLEDGE TRANSFER PARTNERSHIPS, Help companies to access university expertise and transfer knowledge into their business. Partnerships employ high-calibre associates to work for up to three years on projects that are core to the strategic development of a business.

- INDUSTRIAL CASE, Funding for PhD studentships where businesses take the lead in arranging projects with an academic partner of their choice. The student spends at least three months at the company.

- INDUSTRY FELLOWSHIPS, Opportunity for industrial researchers to carry out research or course-development in a UK university, or academic researchers to work in a UK business. Projects can be at any stage from fundamental science to industrial innovation.

http://www.epsrc.ac.uk/innovation/business/schemes/Pages/opportunities.aspx

Scottish Enterprise Proof of Concept

B.4 The Proof of Concept Programme (PoCP) is a Scottish initiative managed by Scottish Enterprise (the development agency for the devolved administration). Researchers in Scottish research institutes, universities and hospitals are eligible to apply for funding. It was launched in 1999 and by 2008 had supported 201 projects (through public funding of £36.4m) 38 spin-out companies had been established and 35 licencing deals concluded, leading to the creation of over 500 jobs. The programme had leveraged £207m of public and private investment.

http://www.scottish-enterprise.com/services/support-for-entrepreneurs/proof-of-concept-programme/overview

University Challenge Funds

B.5 UCF provided early stage seed funding to universities. The aim was to establish seed funds rather than fund on a project-by-project basis. It was launched in 1998 with approximately DKK 450 m funding. Universities were required to bid for funding and provide their own funds to at least 5% of the total value of the fund. There were 15 successful bids in the first round, most involving groups of universities. A further DKK 150m was made available in 2001 and five successful bids. There have been no subsequent rounds. Some of the funds have continued post-government funding but in many cases universities struggled to find alternative funding sources.

Science Enterprise Centres

B.6 The aim of the SEC was to establish a network of centres in UK universities specialising in the teaching and practice commercialisation and entrepreneurship in science and technology. Approximately DKK 450m was made available over the period 1999-2004. The majority of the Centres were collaborative and they undertook research into enterprise training as well as delivering programmes to students. There was no subsequent funding for

the Centres, but it is now common for under and post graduates in UK universities to have access to enterprise training.

Annex C: Consultations

Organisation	Consultee	Position
Regional Council	Lars Gaardhoj	
Capital region	Niels Clausen	Business Developer
	Susie Andersen Ruff	Head of Unit, Technology Transfer and Innovation
	Claus Bjørn Billehøj	Director, Capital Region of Denmark, Center for Regional Development.
	Kristian Johnsen	VD, Capital Region of Denmark, Center for Regional Development
	Lars Nørregaard	Business Developer
	Kirsten Vang Nielsen	Business Developer
Centre for Cancer Immune Therapy	Mads Hald Andersen	Vice Director
Hvidovre Hospital	Ove Andersen	Head of research,
Nordsjællands Hospital	Lise Tarnow	Head of Research,
Rigshospitalet	Jannik Hilsted	Chief Medical officer
DTU	Rolf Henrik Berg	ProfessorDTU Nanotech
	Adam Hillestrøm	Senior Business Developer –
	P K Kristensen	Business Developer
	Jesper Lundeman	Business Developer
	Anders Permin	VD DTU FOODS
	Marianne Thellersen	Director for Innovation and Entreprenuership
KU	Karen Laigaard	Head of Technology Transfer. Research & Innovation
	Thomas Bjørnholm	Prorector Research and Innovation,
	Sven Frøkjær	Prodean for Industry Collaborations, University of Copenhagen
	Kristian Helin	Founder EpiTherapeutics, Director BRIC
	TTO staff	
Styrelsen for Forskning og Innovation	Kåre Jarl –	Senior Executive Advisor, Agency for Research and Innovation
DEA	Maria Theresa Norn	Senior Consultant