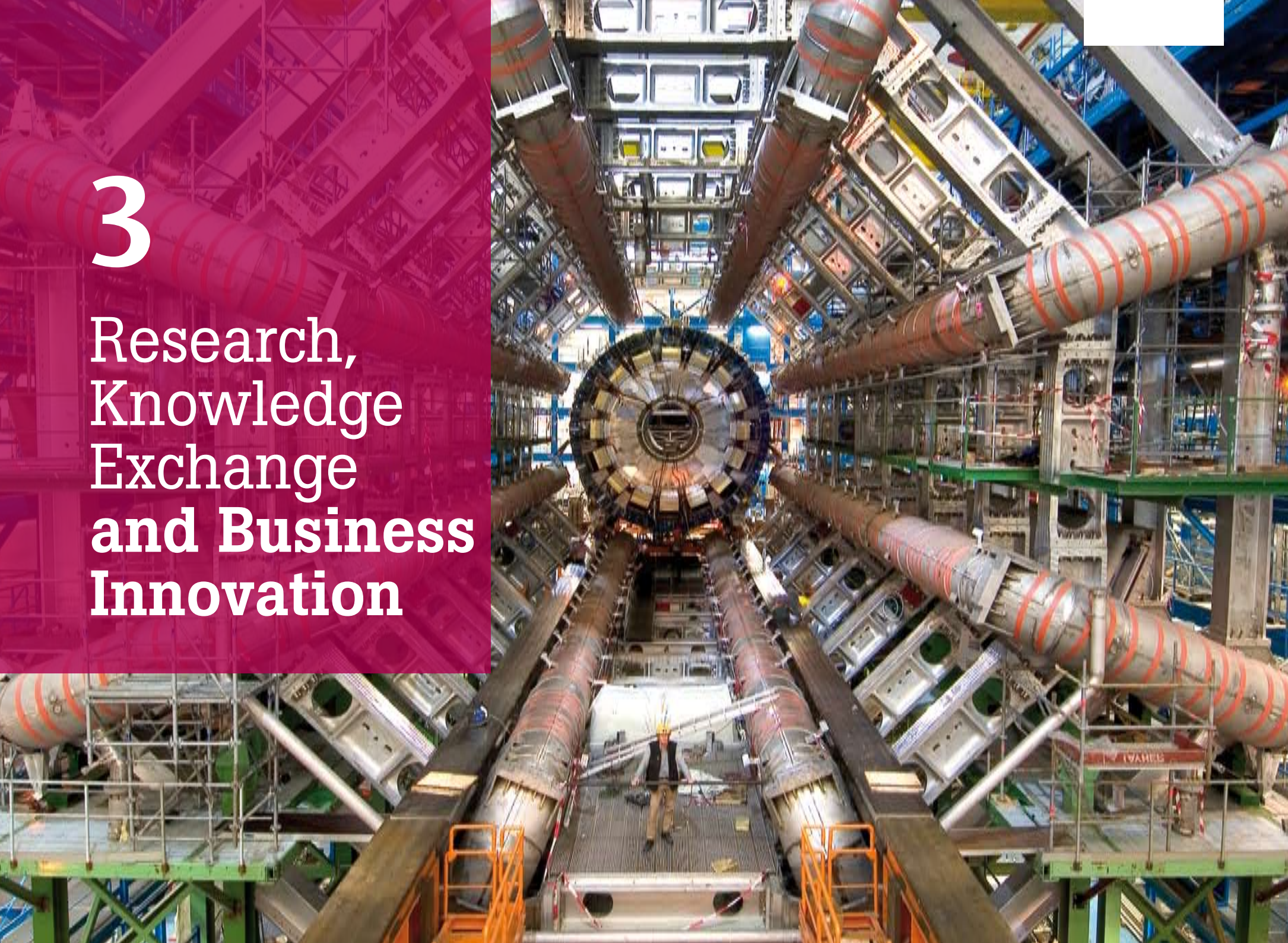


# 3

## Research, Knowledge Exchange and Business Innovation



Government's ambition is to build on the UK's world-class research base<sup>7</sup> and to broaden the traditional knowledge exchange agenda to encompass new disciplines, new sectors, new businesses and those who work in the development and delivery of public services.



<sup>7</sup> See also the Annual Report 2008 on the Science and Innovation Investment Framework 2004 – 2014 published alongside this document.

## 3.1 THE RESEARCH COUNCILS

### KEY FACTS

The annual budget for science and research in the UK will rise to £6 billion in 2010/11<sup>8</sup>

The UK is 3rd in the world after US and China on production of scientific papers<sup>ix</sup>

The UK has a 12% share of citations in leading scientific journals, second in the world after the US<sup>9</sup>

The Research Councils support innovation through their funding of research, training, knowledge transfer and public engagement. Their total annual budget will rise to £3.4 billion in 2010/11, an increase since 2007/8 of between 12 and 30% for individual Research Councils (Table 1).

In October 2007 Research Councils UK (RCUK) published *Excellence with Impact*<sup>x</sup> which reported progress and future plans to increase the economic impact of the UK Research Councils. Their delivery plans published in December 2007 included a commitment to delivering a step-change in economic impact and included targets for knowledge transfer.

Many of the big research challenges over the next ten to 20 years require novel, interdisciplinary approaches. Six **cross-council programmes** are underway<sup>xi</sup>:

- The *Research Council Energy Programme* (led by EPSRC) which addresses international issues of climate change and security of energy supply

- *Living with environmental change* (led by NERC) which is a major interdisciplinary research and policy partnership to tackle environmental change and the societal challenges it poses
- *Global uncertainties: security for all in a changing world* which will address four inter-related global threats to security – crime, terrorism, environmental stress and global poverty looking at causes, detection and possible interventions to prevent harm
- *Life long health and wellbeing* (led by MRC) which will provide substantial longer term funding for new interdisciplinary centres targeting themes of healthy ageing and factors that may affect health and wellbeing in later life
- *Nanoscience through Engineering to Application* (led by EPSRC) which will focus the UK research effort through a series of Grand Challenges in areas of societal importance such as energy, environmental remediation, the digital economy and healthcare

<sup>8</sup> Including Research Council funding and the HEFCE block grant for universities in England

<sup>9</sup> 2007 data. Indicator for PSA 4 Promote world class science and innovation in the UK

- *Digital Economy* (led by EPSRC) which will concentrate on areas where the management and presentation of information can have maximum transformational impact: healthcare, transport and the creative industries

**Table 1. Comprehensive Spending Review allocations to Research Councils<sup>xii</sup>**

£'000	2007/8	2008/9	2009/10	2010/11	Total	Increase
Arts & Humanities Research Council	96,792	103,492	104,397	108,827	316,716	12.4%
Biotechnology & Biosciences Research Council	386,854	427,000	452,563	471,057	1,350,620	21.8%
Economics & Social Research Council	149,881	164,924	170,614	177,574	513,112	18.5%
Engineering & Physical Sciences Research Council	711,112	795,057	814,528	843,465	2,453,050	18.6%
Medical Research Council	543,399	605,538	658,472	707,025	1,971,035	30.1%
Natural Environment Research Council	372,398	392,150	408,162	436,000	1,236,312	17.1%
Science & Technology Facilities Council	573,464	623,641	630,337	651,636	1,905,614	13.6%
<b>Total</b>	<b>2,833,900</b>	<b>3,111,802</b>	<b>3,239,073</b>	<b>3,395,584</b>	<b>9,746,459</b>	<b>19.8%</b>

Source: *The Allocations of the Science Budget, December 2007*<sup>10</sup>

<sup>10</sup> Note that this table shows planned allocations. See each Research Council's Economic Impact Reporting Framework for more details on actual allocations.

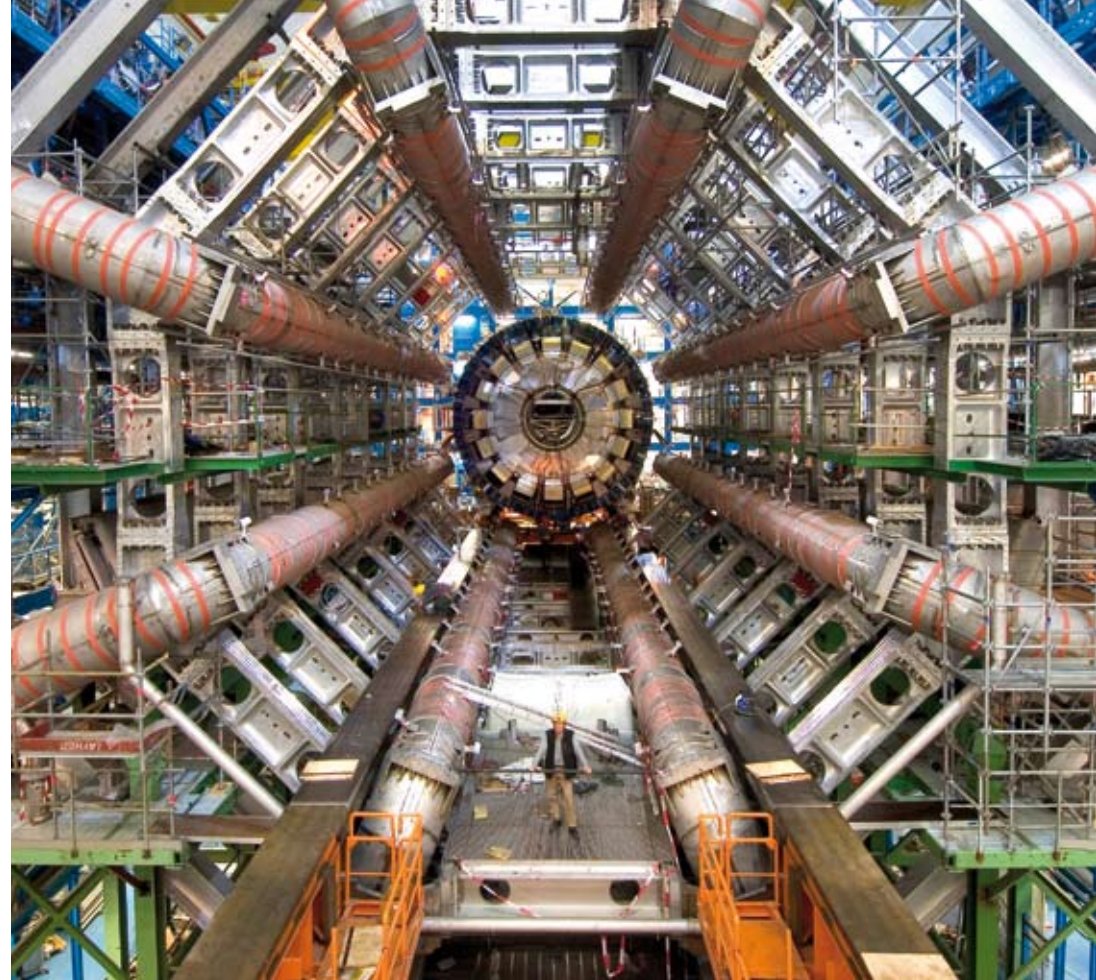
# CASE STUDY

## TECHNOLOGY SPIN-OFFS FROM THE LARGE HADRON COLLIDER

The Large Hadron Collider (LHC) is the world's most powerful particle accelerator and will seek answers to some of the most fundamental mysteries of our Universe from anti-matter to dark matter and the existence of extra dimensions.

With a stake of £510 million (from 1995 to the present), the UK is one of the biggest contributors to LHC, based at CERN, the European Particle Physics Laboratory near Geneva. Through the Science and Technology Facilities Council (STFC) the UK has contributed vital hardware, computing and scientific knowledge.

More than 20 research groups across the UK have been involved in preparing for the LHC and UK industry has won more than £270 million of contracts from CERN. CERN pushes technologies in engineering, science and computing to their limits, often leading to new developments. The previous major experiment at CERN, called LEP, led to the creation of the World Wide Web. Preparation for the LHC has already led to a number of spin-off technologies in health care but its greatest potential technology benefit is the Grid – a whole new way of computing invented as a successor to the Web.



*Photo courtesy of CERN*

Staff at the Rutherford Appleton Laboratory (RAL) have been extensively involved in developing and building components. As part of the UK's computing effort for the LHC, called GridPP, RAL is home to the UK's Tier 1 Centre – the first point in the UK to receive, store and distribute the LHC data and handle processing for scientists across the world.

## 3.2 THE TECHNOLOGY STRATEGY BOARD

### KEY FACTS

In the period 2008-2011 the Technology Strategy Board will coordinate a £1 billion programme in partnership with the Regional Development Agencies (RDAs) and Research Councils. The Technology Strategy Board's own allocation will rise by a third from £193.8 million in 2008/9 to £263.8 million in 2010/11

889 collaborative R&D projects are being supported with total project costs of £1.2 billion

The Technology Strategy Board and partners' investment is £540 million

Projects involve 3000 businesses and 98 HEIs

Six challenge-led Innovation Platforms are underway

The Technology Strategy Board<sup>xiii</sup> was established in July 2007 as a business-focused organisation encouraging and supporting technology-enabled innovation. It has an important leadership role in providing greater coordination of RDA, Devolved Administration, Research Council and Government Department activity to stimulate business R&D and innovation across all important sectors of the UK economy. Its first strategic plan Connect & Catalyse was published in May 2008 and describes three main areas for investment:

- **Challenge-led innovation** aims to stimulate business research and innovation focused on addressing key societal challenges and maintaining a world leading position. This includes Innovation Platforms and will account for approximately 50% of the Technology Strategy Board's overall budget. There are currently five active Innovation Platforms, three of which have been launched since September 2007. A sixth innovation platform in the area of detection and identification of infectious agents was announced in October 2008

- **Technology-inspired innovation** focuses on core technologies that provide underpinning capability alongside investments in the commercialisation of emerging technologies that potentially underpin the growth sectors of tomorrow.
- **Innovation Climate** continues support for networking activities through Knowledge Transfer Networks and knowledge transfer through people with Knowledge Transfer Partnerships. The Technology Strategy Board will also support UK engagement in a range of European and international innovation activity such as the Eurostars scheme for research-performing SMEs.

Technology Strategy Board highlights include a commitment of £24 million for future collaborative research projects on high tech manufacturing<sup>11</sup> and the recently announced Low Carbon Vehicles Innovation Platform with DfT, EPSRC, AWM and ONE committed to invest £100 million on fundamental and collaborative research and an ultra-low carbon vehicle demonstration competition, which will see up to 100 innovative ultra low carbon demonstration vehicles around the UK by the end of 2009.

### Technology Strategy Board support for the Creative Industries

The Technology Strategy Board and Arts and Humanities Research Council have jointly established a programme to support the creative industries<sup>xiv</sup> with a £10 million call for collaborative R&D and a Knowledge Transfer Network for the sector. Over 130 initial applications were received for £7 million of grant funding for large collaborative R&D projects amounting to a total £63 million of research effort and demonstrating a significant appetite for R&D within the creative industries. Thirteen of these projects were funded, 11 of which involved collaborations with Universities.

Across the whole of the £10 million programme, over 170 UK companies have received support to date, the majority of which are creative industry SME or even micro companies. A second £5 million programme from the Technology Strategy Board is to be launched in March 2009 focusing on commercialising content in a digitally networked age.

Following a competitive process the Technology Strategy Board contracted a consortia led by University of the Arts London and including Imperial College London, Royal Institute of British Architects and TIGA (the trade association for computer games developers) to provide a national knowledge transfer network for the creative industries – The Creative Industries Technology & Innovation Network. The mission of the network is to help the creative industries sector prepare for and fully exploit the potential of existing and future technologies as the driver of new products and services.

<sup>11</sup> Announced in the Government's Manufacturing Strategy, September 2008

Other calls for proposals for collaborative R&D are as follows:

Calls for Collaborative R&D since July 2007	New Competitions
<ul style="list-style-type: none"> <li>• Materials for Energy (12 million)</li> <li>• High Value Manufacturing (£23 million)</li> <li>• Cell Therapy (£10 million)</li> <li>• Low Carbon Energy Technologies (£10 million)</li> <li>• Advanced Lighting, Lasers and Displays (£10 million)</li> <li>• Technologies for Health (£15 million)</li> <li>• Gathering Data in Complex Environments (£10 million)</li> <li>• Creative Industries (£10 million)</li> <li>• Components and Materials for Low Impact Buildings (£4 million)</li> <li>• Low Carbon Vehicles (£20 million)</li> </ul>	<ul style="list-style-type: none"> <li>• High Value Manufacturing: Step Change in Competitiveness; Value Systems</li> <li>• Photonics: Photonics21 – Next generation optical internet access</li> <li>• Materials: Sustainable materials and products</li> <li>• Energy Generation and Supply: Maximising recovery of UK’s oil and gas resources</li> <li>• Energy Generation and Supply: Fuel cells and hydrogen technologies</li> <li>• Creative Industries: Accessing and commercialising content in a digitally networked world</li> <li>• Intelligent transport systems and services: Informed personal travel</li> <li>• Network Security: Interdependency, Risk and Complexity</li> </ul>

# CASE STUDY

## NETWORK SECURITY INNOVATION PLATFORM

The next few years will see governments and businesses around the world making substantial investments in identity management infrastructures. In order to prepare UK businesses for competition in this global market, practical and cost effective solutions need to be developed which inspire public confidence by improving privacy and enabling consent as an integral part of future procurements.

The Technology Strategy Board, working with the Engineering and Physical Sciences Research Council and the Economic and Social Research Council have backed projects with an investment of over £5.5 million to help ensure privacy of personal data. The projects will help to develop the next generation of secure identity management systems. EnCoRe, a collaboration involving Hewlett-Packard, HW Communications, QinetiQ, the London School of Economics, the University of Oxford and the University of Warwick focuses on the issue of providing more rigorous means for individuals to grant and revoke their consent for the use, storage and sharing of personal data bringing together technological, procedural and regulatory developments.



### 3.3 KNOWLEDGE EXCHANGE AND BUSINESS INNOVATION

## KEY FACTS

7500 staff in HEIs are employed in commercialisation or industrial liaison

The Higher Education Innovation Fund will increase to £150 million

The average income generated from research, consultancy and licensing agreements by HEIs and PSREs increased from £514 million in 2003/4 to 2005/6 to £568 million in the 3 year period 2004/5 to 2006/7

Patent applications have doubled since 2000 to 1913 in 2006/7

975 Knowledge Transfer Partnerships are in operation

R&D tax credits are worth £600 million per year and are expected to increase by £80 million per year following changes to the tax relief for SMEs.

Government with the Research Councils, Universities and the FE sector has put an increasing emphasis on supporting effective knowledge exchange (or knowledge transfer) activities between educational institutions and businesses. *Innovation Nation* made several commitments in this area<sup>12</sup>:

- Work has been underway to develop the capability of specialist networks to support businesses through **FE knowledge and technology transfer** activities, funded by a FE Innovation and Specialisation Fund. A competition over the summer attracted 130 entries, far exceeding expectations and five pathfinder projects were announced on 1 December.
- **Knowledge Transfer Partnerships (KTPs)** managed by the Technology Strategy Board now involve 437 departments in 102 HEIs and nearly 1000 businesses (Table 2) with plans to double the number of KTPs, increase their flexibility and applicability to a range of institutions including FE colleges.

<sup>12</sup> Further detail on progress on all the *Innovation Nation* commitments is given in Annex 1

- Alongside AWM, the LDA, NWDA and SEEDA have rolled out their **Innovation Voucher** schemes, with more RDAs due to roll out over the next few months.
- Knowledge transfer activity between higher education institutions and **service sectors** such as the creative industries, financial services, management and hospitality is set to increase with the help of funding from the Higher Education Innovation Fund.
- In August of this year, BERR and NESTA with DIUS support published the *Innovation in Services* report which recognised the importance of innovation in the service sectors to the UK economy and made a number of recommendations that are now being taken forward.
- DIUS announced the outcome of the fourth round of the **Public Sector Research Exploitation Fund** in June 2008. This will provide £68 million, including co-funding from other organisations, to increase the economic impact of research carried out by a wide range of public sector bodies including Research Council Institutes, Government Laboratories, NHS hospitals and major museums and galleries.
- The updated **Lambert tool-kit** was launched in October. Its resources now include a set of model consortium agreements for research projects which may involve several parties as well as a decision guide and interactive learning and training elements
- As part of the Business Support Simplification Programme, DIUS with BERR and the RDAs in consultation with businesses have finalised the types of innovation support that will be made available by April 2009.



**Table 2. Business involvement in Knowledge Transfer Partnerships (2008)**

Company sizes	Micro	Small	Medium	Large	Total
Employees	< 10	10-49	50-249	250+	
No of partnerships	91	352	301	231	975
Proportion of portfolio	9%	36%	31%	24%	100%

There are currently **24 Knowledge Transfer Networks (KTNs)** with 35,000 members – these are national networks in a specific field of technology or business application which bring together people from businesses, universities, research, finance and technology organisations to stimulate innovation through knowledge transfer. The Technology Strategy Board has undertaken a strategic review of the KTNs and implementation of the results are in progress to provide more focused access for business.

Recent Research Council knowledge transfer activities have included:

- A significant expansion of the MRC collaborative studentship scheme to allow more postgraduate students the opportunity to gain experience in both academia and industry.

- The support by EPSRC for five years of up to 15 Industrial Doctorate Centres with £112.5 million total funding potentially available. Students will spend around 75% of their time working directly within their collaborating company.
- Research Councils have shared knowledge and developed skills through Sandpits – intensive, interactive and free-thinking events where a diverse group of 20-30 people from a range of disciplines meet over a number of days to explore innovative solutions to real problems. Recent Sandpit topics have included cargo screening (in conjunction with the Home Office) and nutrition for older people (part of the cross-Council programmes initiative; see 3.1).



**Table 3. Knowledge exchange between higher education and business**

Indicator	2000/1	2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	% Change
Number of Patents granted	250	199	377	463	711	579	647	159%
Number of licensing agreements	728	615	759	2154	2,099	2,707	3286	351%
Income from licensing intellectual property (£ million)	18	47	37	38	57	58	58	222%
Number of spin-outs	248	213	197	161	148	187	236	-5%
Income from business (value of consultancy contracts) (£ million)	104	122	168	211	219	242	288	177%
Income from business contract research (£ million) **	262	328	289	577	617	651	782	198%

Source: Higher Education Business-Community Interaction Survey 2008.

\*\*2000-2003 Income from business data does not include contract research with non-commercial organisations

The impact of previous rounds of HEIF and other activities that have helped effect a significant culture change within both the institutions and an increasing number of businesses is illustrated in Table 3. It shows very strong progress on almost all the key indicators of knowledge transfer with significant growth in most cases in recent years (the decline in spin-outs starting in 2002/3 and 2003/4 was due to tax changes which have now been corrected).

### 3.4 The UK Infrastructure Supporting and Developing Innovation

Three components of this infrastructure are considered in this section: the National Measurement System, the academic IT network and the UK's intellectual property regime. Other important components include the UK's standards and accreditation system which supports innovation by involving businesses in agreeing and accrediting the performance characteristics of products and services. The work of the British Standards Institution (BSI) and the United Kingdom Accreditation Service (UKAS) in managing this system will be covered in detail in the 2009 Annual Innovation Report.

#### UK National Measurement System

The UK's National Measurement System provides an infrastructure of national measurement standards, facilities, expertise and leading edge science and research programmes which together are key drivers of innovation:

- The NMS supports innovation by developing improved measurement techniques and instrumentation. It enables high-accuracy calibration and testing services and promotes good measurement practice.
- About 80% of the NMS work is carried out at the Government-owned National Physical Laboratory (NPL).
- DIUS will publish technology road-maps for eight measurement research programmes that will chart the development of the programmes over the next ten years.
- Next spring DIUS will produce a Strategic Plan for the NMS for 2009 – 2012 which will include how it will work with the Technology Strategy Board.
- A survey<sup>xv</sup> showed that as a result of interaction with National Measurement Institutions, 51% of direct customers introduced new products or developed existing products and 38% introduced new or developed existing processes.



*The new Clinical Linac facility at the National Physical Laboratory, funded by DIUS and the Department of Health, is used to calibrate radiotherapy equipment ensuring safe operation*

## COMMENTARY

### PETE LOFTUS

#### HEAD OF MEASUREMENT CAPABILITY AT ROLLS-ROYCE

As a world-leading provider of power systems and services for use on land, at sea and in the air, Rolls-Royce is critically dependent on capable measurement. The company is conscious of the need to deploy measurement best practice consistently and rigorously, of the opportunities to use cutting edge measurement technology to deliver world class product and business performance and of the benefits of promoting a wider understanding of measurement capability in planning and decision making.


The entire life cycle of the company's products and the services derived from them is underpinned by measurement: measurements that validate engineering models and characterise material properties even before a product can be designed; measurements on test to prove safety and specification compliance; in-process and final inspection measurements during manufacturing; the control, monitoring and inspection of products in service; monitoring of disposal processes; and a wide range of supporting processes such as the control and monitoring of manufacturing plant.

Several hundred people in Rolls-Royce are engaged in measurement directly and thousands make use of it, or are engaged in it through the supply chain, indirectly. The company directly uses hundreds of thousands of items of measurement equipment.

The support of the NMS and the National Measurement Institutes provided through measurement standards and their deployment, through research and technology, and through best practice advice and training is central to the company's ability to deploy best practice in measurement and to continuous improvement of product and business performance.

## IT infrastructure

The UK's academic IT infrastructure is founded on the JANET network, managed by the Joint Information Systems Committee (JISC), which underpins communications and e-resources across education and research. It also includes data centres, collaborative environments and support services; and research: significant investment has also been made in the development of virtual research environments. The value of this infrastructure to UK innovation includes the following:

- JANET provides the basis for a transformation in teaching & learning and research built upon one of the fastest, most secure and resilient networks in the world
  - The high bandwidths available unleash creative and innovative ideas and improve the delivery of services such as remote working
  - Research is increasingly carried out through distributed collaborations enabled by the Internet. Such collaborations are built upon an infrastructure of grid computing software giving shared access to, for example, large data collections, advanced tools for data analysis, large scale computing resources and high performance visualisation
  - Digital repositories support innovation by making research and other content openly available. The UK has benefited from a £15 million investment in this area
- 
- The UK Access Management Federation funded by JISC and Becta will develop next generation access management systems bringing the UK education and research sector closer to a situation where a single login allows access to network and online resources.
  - The use of online resources is growing steadily with an increase of 35% in 2004/5 compared to 2003/4. JISC research estimates that the time saved by the JISC community by using e-resources was worth £156 million in 2004/5 and that the benefits achieved almost a fivefold return on investment<sup>xvi</sup>.

## COMMENTARY

### PROFESSOR ANTHONY FINKELSTEIN

HEAD OF DEPARTMENT  
OF COMPUTER SCIENCE,  
UNIVERSITY COLLEGE LONDON

The UK's IT infrastructure constitutes an important base on which the success of innovative businesses and the development of novel products and services depends.

There is a growth in demand for large-scale computation and the handling of ultra-large-scale data reflecting improvements in both computing and data storage technologies. For IT products and services, an effective IT infrastructure is of the essence. Even for non-IT based products and services IT underpins the commercial structures such as billing and distribution on which innovative businesses depend. Much design, testing and experimentation is now virtual with manufacture wherever materials are plentiful and labour cheap. This design, testing and experimentation, the core of innovation, will take place wherever the skills are but also wherever the IT infrastructure is best. Innovative businesses will be looking to the global challenges of climate, energy, transport and health for opportunities. These are complex systems problems and IT is likely to lie at the

heart of the innovations that will help us understand and ultimately address them.

The UK possesses much of the required physical infrastructure but is critically lacking in its software and system development capabilities and in people with the skills to link the requirements of innovative businesses and the technical actions necessary to meet them. The UK has a world-class research capability in computer science that should provide it with a competitive advantage but UK businesses remain poorly equipped to realise this advantage.

[My view is that] we should address the shortfall in high-level skills caused by the drop in students studying computer science, develop new methods for engaging UK businesses with the knowledge- base focusing particularly on innovative SMEs and invest in UK research on key infrastructural technologies, networks, software engineering, distributed systems and ubiquitous computing.<sup>14</sup>

<sup>14</sup> These points are being addressed through the DIUS High Level Skills Strategy, RDA-funded Innovation vouchers and JISC's ongoing work programme

## The Intellectual Property infrastructure

The national and international intellectual property (IP) infrastructure influences innovation by allowing companies to gain maximum commercial value from their work. UK's IP policy and services to businesses are led by the UK Intellectual Property Office (UK-IPO). The challenges are to promote effective use of IP in business and research and significantly raising the awareness of IP issues. While there has been a modest increase in the number of companies rating different methods of innovation protection as important between the 2005 and 2007 Innovation Surveys, the latest results show that only 19% of respondents rated patents as of some importance compared to 16% in the 2005 survey. For trademarks, 26% compared to 21% of respondents rated them as having some importance in protecting innovation.

Copyright underpins the creative industries which together accounted for 7.3% of GVA in 2005 and on average grew at twice the rate of the economy as a whole between 1997 and 2005. The challenge here is to ensure that the copyright framework allows new businesses to evolve in the creative sector and creators, authors and artists to get remuneration for their efforts. The UK-IPO will lead the development of a UK copyright strategy and will be taking a full and active part in discussions in Europe to help ensure these goals can be delivered. It will also be shaping international patent policy to reduce costs and inefficiencies in processing which hinder businesses in obtaining protection for technical innovations.

The coming year will see enhanced support for business intermediaries such as Business Link and UKTI as well as online resources for collaborative research (the Lambert toolkit) and



business to business licensing. To increase awareness of IP the UK-IPO will sponsor a major IP awareness campaign centering on an exhibition at the Science Museum in collaboration with Aardman Animations. To enhance the patent system, UK-IPO is also working towards mutual recognition between IP offices internationally and progressing the establishment of a single European Patent Court to help companies protect their inventions in Europe.

## COMMENTARY

### JOLY DIXON

#### STANDING ADVISORY BOARD ON IP (SABIP)

Economic growth in the modern world is increasingly knowledge-driven and it is therefore essential for the UK to have a well co-ordinated and effective intellectual property infrastructure to support and reward innovation and provide incentives for its disclosure.

Technological change and globalisation are undermining many aspects of the IP framework and especially the copyright system. Both creators and rights holders on the one side and users on the other side feel cheated or dissatisfied at best and debates are serving only to polarise opinion further rather than to find a satisfactory balance. It is crucial, therefore, that the UK-IPO and SABIP work with the relevant stakeholders to develop a fuller understanding of the interplay between IP and innovation and creation. We should then be able to work towards a system which works on fundamental principles of acceptance and participation rather than compliance and enforcement.

We are also very interested in the important work the UK-IPO is doing in an effort to make patent granting more effective around the globe. The principles of mutual recognition between IP offices and a single European Patent Court both potentially represent huge progress in this area and SABIP will look to add value where possible.

SABIP was established in June 2008 and represents a significant addition to the UK's IP policy-making infrastructure at a crucial time. Our role will be to stimulate debate amongst the relevant people and organisations, commission high-quality research and present Ministers with evidence-based recommendations.

## 3.5 INNOVATION SUPPORT PARTNERS

### Design Council

## KEY FACTS

Design-aware companies outperformed the FTSE 100 and FTSE All Share indices by more than 200% over ten years<sup>xvii</sup>

Rapidly growing businesses are six times likelier than static ones to see design as integral to their operation<sup>xviii</sup>

On average UK businesses expected a return of 50% on their most successful design project in 2004, but actually got a return of more than 75%<sup>xix</sup>

The Design Council is the national strategic body for design. Its mission is to inspire and enable the best use of design in the UK to create a more competitive, innovative and sustainable nation. Design is the process that links creativity and innovation. Creative industries, such as design, are a source of innovation for businesses that are increasingly using design to compete. The Design Council runs practical programmes for business and for the public, design and education sectors.

As well as the development of the Public Services by Design programme, in the last 12 months Design Council activities have included:

- The continued roll-out of Designing Demand, a business support programme delivered by the RDAs in England and designed to help SMEs become more competitive, increase their profits and boost performance through the strategic and effective use of design. Over 1,200 SMEs in six regions have participated and early indications are that the programme has helped them achieve increased sales, turnover, profit and market share.
- The development of a national competition to raise awareness of the value of design to universities in developing and commercialising technology projects, building on the success of the Designing Demand programme for business. The competition will be launched early in 2009 and successful university Technology Transfer Offices will gain access to expert design advice.
- *Designs of the Time* (Dott), a grass roots innovation programme aimed at involving local people in the design and development of the services that they use. The Dott 07 programme was run in partnership with One NorthEast over a year and involved more than 200,000 local people.
- The launch of *Good Design Practice*, a campaign to help ensure that designers have the right skills to enable them to support UK businesses and build our competitive edge.



- A collaboration with the Home Office and the Design and Technology Alliance to develop and promote crime-reducing innovations, providing a clear business opportunity for the manufacture of crime-reducing designs.
- A partnership with the Department for Health and the NHS Purchasing and Supply Agency on a design innovation project to design and prototype new furniture, equipment or services for hospital wards to help reduce healthcare associated infections such as MRSA and *C.difficile*. The project will highlight how infections might be reduced if the design and operability of furniture and equipment were aligned with the needs of infection prevention and control.

# CASE STUDY

## AXON AUTOMOTIVE

Design-led strategic thinking has been helping Axon Automotive get its plans for an energy-efficient carbon-fibre car on the road. The company had developed a revolutionary type of carbon fibre which could be made into much more complex shapes than the panels and sheets already on the market. Axon wanted to create a fully carbon-fibre car with its new technology – one that could run using 30% less fuel thanks to its lightweight chassis.

Axon joined a pilot of the Design Council's *Designing Demand Innovate* service for hi-tech start-ups. The short-term goal for the business was to create a compelling corporate identity and to launch itself at the Oxford Venturefest new technology showcase in July 2005. Working with a team of designers Axon developed a new corporate identity, a website and an eye catching stand for the show in just three months.

The launch proved a big hit, winning an award for best stand and helping the company to build relationships with important funding partners. In 2006 Axon secured an award from the Energy Saving Trust for £650,000 – 45% of the £1.4 million required to build a prototype vehicle and is the lead partner in a £5.8 million Technology Strategy Board collaborative R&D project looking at the manufacturability of novel vehicle structures. Since then "the company has not looked back" says Managing Director Steve Cousins. In March 2007 at the Sexy Green Car Show at the Eden Project in Cornwall, Axon Automotive was officially launched – the first new general-purpose British car company to be launched for about 50 years.



## National Endowment for Science, Technology and the Arts (NESTA)

# KEY FACTS

In 2007/08, NESTA made 21 investments totalling £2.3 million to help early-stage companies

As at March 2008, NESTA held a portfolio of seed and early stage investments totalling £9 million in 48 companies with individual investments ranging from less than £100,000 up to £500,000

NESTA's investments leverage significant private co-investment with every £1 invested by NESTA since October 2003 attracting on average £5 in private investment

The National Endowment for Science, Technology and the Arts delivers its mission – to transform the UK's capacity for innovation – in three main ways:

- by delivering practical programmes to help innovation flourish;
- by providing innovators with access to early stage capital; and
- by driving forward research into innovation, with a view to influencing policy.

NESTA is supporting *Innovation Nation* by developing an Innovation Index, establishing an innovation research centre with DIUS, ESRC and the Technology Strategy Board and establishing a public services innovation laboratory.

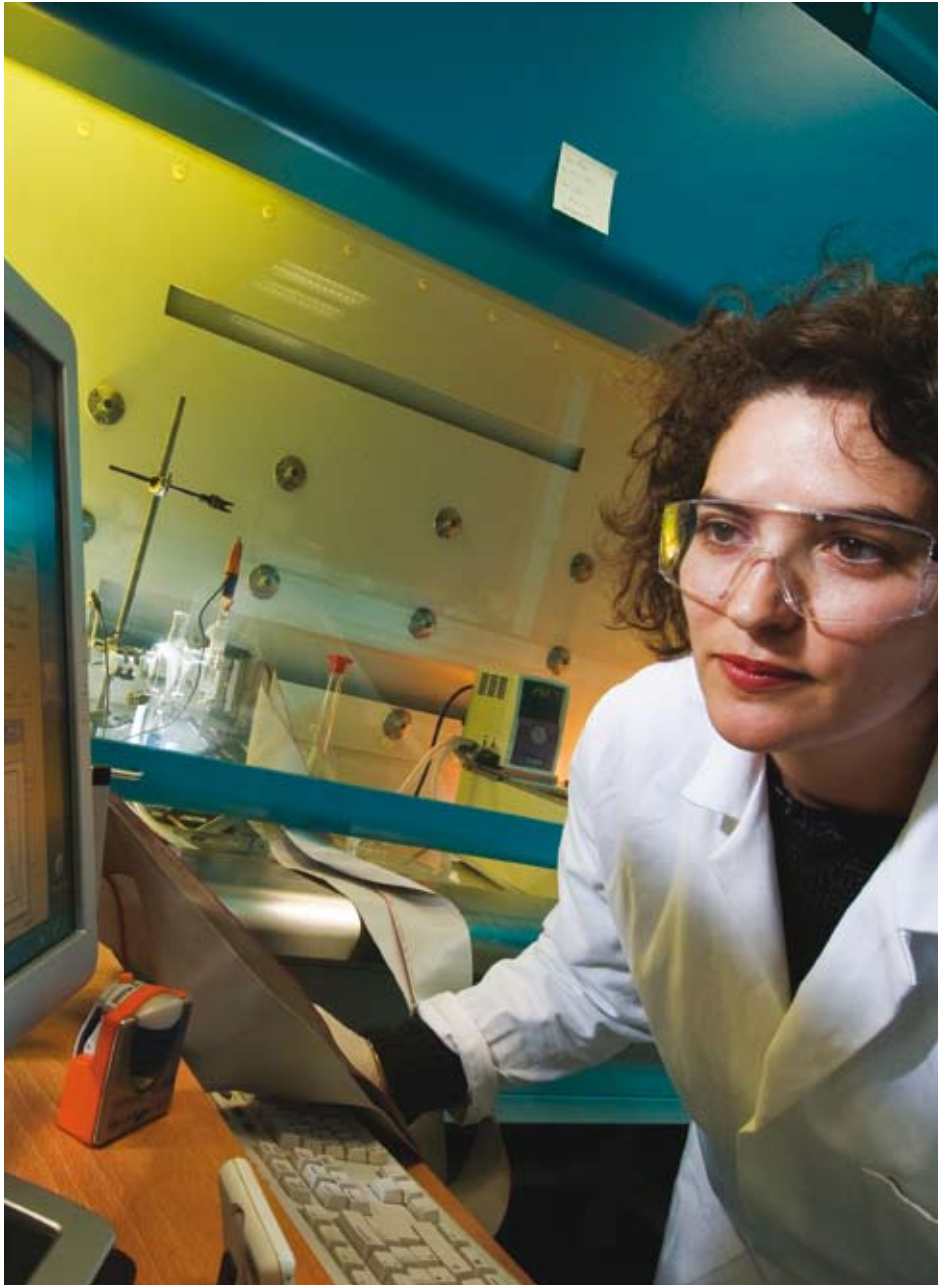
Examples of recent innovative activities include:

- NESTA's Seedcamp is a Europe-wide initiative to support the next generation of technology entrepreneurs by providing essential seed funding plus access to successful entrepreneurs and mentors. At the heart of the initiative is Seedcamp Week – a chance for young entrepreneurs to show what they would be able to

achieve with investment, support and the right connections. A start-up company itself, Seedcamp is backed by funding and support from NESTA Investments.

- The Big Green Challenge is a £1 million prize fund to encourage community groups to work together to find imaginative ways to tackle climate change. In September, NESTA revealed the ten finalists who will compete for a slice of the funds. Selected from over 350 initial entries, they now have a year to put their approach into practice and demonstrate a reduction in CO<sub>2</sub> emissions.





- The NESTA Procter & Gamble (P&G) Corporate Open Innovation Challenge is designed to identify and develop innovative ideas from small firms outside the P&G research laboratory. Over 70 ideas were submitted and the eight most promising applicants were given access to funding, mentoring and business support, worth up to £25,000, to transform their ideas into commercially viable concepts. The four successful applicants – two in the fabric care category and two in the health and wellness – presented their ideas in June to P&G, who will now investigate their potential. P&G will have first refusal on the ideas and the applicants, who retain the IP, are free to approach other companies if P&G decide not to pursue.

- ix DIUS (2008) *Economic impacts of investment in research and innovation*
- x RCUK (2008) *Excellence with Impact* <http://www.rcuk.ac.uk/cmsweb/downloads/rcuk/economicimpact/excellenceimpact.pdf>
- xi <http://www.rcuk.ac.uk/research/ccprog/default.htm>
- xii [www.ahrc.ac.uk](http://www.ahrc.ac.uk); [www.bbsrc.ac.uk](http://www.bbsrc.ac.uk); [www.esrc.ac.uk](http://www.esrc.ac.uk); [www.epsrc.ac.uk](http://www.epsrc.ac.uk); [www.mrc.ac.uk](http://www.mrc.ac.uk); [www.nerc.ac.uk](http://www.nerc.ac.uk); [www.stfc.ac.uk](http://www.stfc.ac.uk)
- xiii [www.innovateuk.org](http://www.innovateuk.org)
- xiv DCMS (2008) *Creative Britain: New Talents for a New Economy* [http://www.culture.gov.uk/reference\\_library/publications/3572.aspx](http://www.culture.gov.uk/reference_library/publications/3572.aspx)
- xv National Measurement System (2005) *Impact Assessment 2005 – Final Report*
- xvi [http://www.jisc.ac.uk/publications/publications/pub\\_valueofjisc2007.aspx](http://www.jisc.ac.uk/publications/publications/pub_valueofjisc2007.aspx)
- xvii Design Council (2004) *The Impact of Design on Stock Market Performance*
- xviii Design Council (2005) *The Business of Design*
- xix Public and Corporate Economic Consultants (2004) *National Survey of Firms*, Cambridge [www.pacec.co.uk](http://www.pacec.co.uk)



# 4

## Inward Investment & International Collaboration **in Science & Innovation**



# KEY FACTS

The UK is second only to the US for attracting inward foreign investment and top in Europe for pharmaceutical and biotechnology R&D

Almost 50% of leading research investors have R&D centres in the UK, 2nd only to the US

The percentage of UK papers produced in collaboration with research groups in other countries rose from 29% to 40% between 1996-2000 and 2001-2005 – the largest increase of any country

The UK research base is strongly cosmopolitan – 35% of doctoral STEM students and 20% of academic staff came from overseas in 2005/6

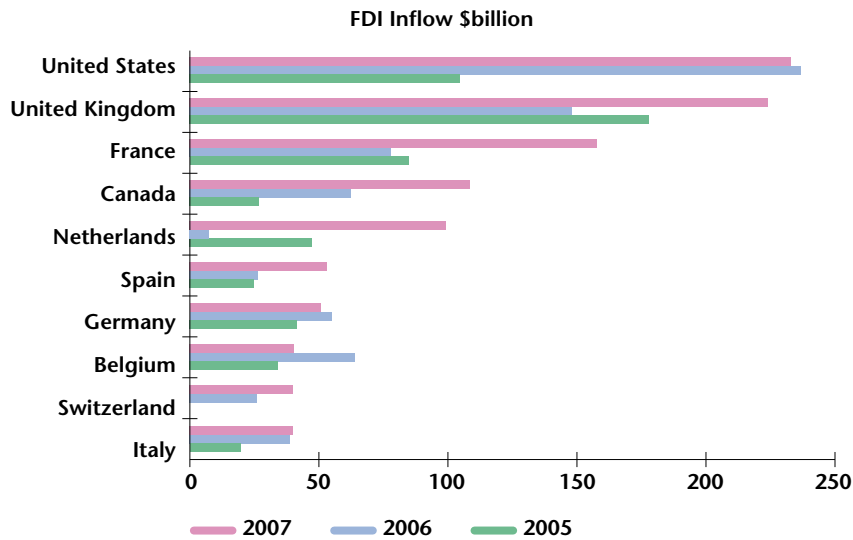
The UK is identified as an Innovation Leader in the 2007 edition of the European Innovation Scoreboard, placing the UK in the leading group with Japan, US and several other EU countries

Innovation is not constrained by international boundaries. The UK needs to become increasingly competitive on the world stage and the challenges are even greater in the current world economic climate. *Innovation Nation* set out the opportunities and challenges faced by the UK from the globalisation of R&D, supply chains and customer bases in a climate of competition from developing economies around the world.

In 2007 the UK was the top destination for **inward investment** in Europe<sup>xx</sup> with \$224 billion of investment. Globally the UK was second after the US (Figure 15). The UK remains the most popular location in Europe for investment in pharmaceutical and biotechnology R&D.



**Figure 15. Foreign Direct Investment**



Source: UNCTAD

Data from the United Nations World Investment Report 2008 shows that over the last three years the UK has consistently outperformed every country in Europe in attracting inward foreign investment.

However, despite the UK's strong achievements in this area, there is still more to be done in addressing some relatively unfavourable perceptions from the business communities in the US, China and India<sup>xxi</sup>. For example, respondents tended to rate the UK as being open and accessible and practical rather than innovative or technologically advanced.

In the European sphere, the UK Government has been influential in positioning research and innovation as core Lisbon priorities.

The Spring European Council of March 2008 launched the 2008-2010 cycle of the **Lisbon Strategy** which re-emphasised four priority actions: investing in knowledge and innovation; improving the business environment; increasing employment opportunities for the most disadvantaged; and defining a climate and energy policy for Europe. In September 2008 the Government published a UK National Reform Programme covering the 2008-10 period<sup>xxii</sup>.

Early results for UK participation in the Seventh Framework Programme for Research and Technological Development 2007-13 (FP7) are broadly in line with those for FP6: UK has the second highest share of funding after Germany (13.4% as against 14.2% in FP6) and the UK participates in a larger proportion of FP7 projects (40.7%) than any other country. FP7 has so far been worth around €531 million to UK researchers. UK academia accounts for a large part of the UK share of funding and the Technology Strategy Board are looking at increasing business success.

The UK remains active in Eureka and is participating in 51 projects with a total budget of €37 million. Of the 83 UK organisations participating, 40 are SMEs. There has also been strong interest in the related Eurostars programme.

Recent international programmes include the **Newton International Fellowships** scheme, a partnership between three of the UK's leading academies (British Academy, Royal Academy of Engineering and Royal Society) launched in June 2008. A total of 716 applications were received from international researchers wishing to work in the UK. Of these, 391 applications were in natural sciences, 143 in engineering and the remainder in the humanities and social sciences.

A first round of **Science Bridges** was funded by the UK Government in 2006 to support existing collaborations between the UK and USA and take research results towards commercialisation. The second round is intended to enhance linkages with India, China and the USA and 10 proposals from each country are being reviewed. The total value of the awards from the UK will be about £12 million.

Following discussions at Government level and within the Global Science and Innovation Forum on increasing international engagement for the UK the Research Councils have opened three new offices in China, the US and India. These offices are working to help deliver the strategic objectives of the RCUK International Strategy and have made good progress in developing links with key individuals and organisations. In India this has already resulted in the leverage of funds to joint initiatives in energy and the digital economy.

Progress on the *Innovation Nation* commitments in this area is as follows<sup>15</sup>:

- The Science and Innovation Network with over 90 staff worldwide, first established by the FCO in 2000, is now led and managed by DIUS.
- The DIUS international strategy, currently under development, is expected to cover a number of themes including: the development of partnerships with key countries and their institutions to collaborate on education, skills and R&D;

<sup>15</sup> Further detail on progress on Innovation Nation commitments is given in Annex 1

improving the UK position as a destination for international students; assisting the FE and HE sectors build a strong global element into students' learning; ensuring the UK contributes to international work to address global challenges such as sustainable development, climate change and security; and focusing on the EU Lisbon agenda for economic and social reform.

- The Technology Strategy Board is enhancing the national support available to businesses to compete for grants in FP7 through national contact points for which it has responsibility and the FP7UK website. A new service to coordinate European support activities across the UK will be launched next April.

xx The United Nations Conference on Trade and Development (UNCTAD) 2008 *World Investment Report* [www.unctad.org/fdistatistics](http://www.unctad.org/fdistatistics)

xxi UKTI (2008) *UK Reputation in Overseas Markets baseline survey*

xxii [http://www.hm-treasury.gov.uk/documents/international\\_issues/european\\_economic\\_reform/int\\_lisbonstrategy\\_jobs.cfm](http://www.hm-treasury.gov.uk/documents/international_issues/european_economic_reform/int_lisbonstrategy_jobs.cfm)

# CASE STUDY

## UNIVERSITY OF HERTFORDSHIRE FORMS LINK WITH SILICON VALLEY

Universities have tended to pursue a traditional model of engagement overseas with inward recruitment to UK courses and franchise delivery through international partners. The University of Hertfordshire's new International Strategy adopts a broader response to a challenging international HE market. Its strategy includes study-abroad opportunities, networking opportunities, summer schools at home and abroad, joint student academic projects and joint academic programmes.

The university entered a formal partnership in April this year with San Jose State University (SJSU) in California's Silicon Valley – this will be the university's first Global College partner. The two institutions, which share a mission to help drive their local economies through high-level skills and innovation, were introduced in 2006 when the East of England Development Agency and the City of San Jose entered into an economic development agreement.

The key step forward is to go beyond student exchange and the partnership will develop professional and academic staff exchanges, internships, joint programmes and partnership in research and innovation. The institutions share not only a business-facing ethos but also key areas of expertise including film and media, life sciences, journalism and computer science.



The partnership in applied research and innovation has great potential. SJSU carries out its applied research through its Research Foundation, an “entrepreneurial framework” for partnering with business, government and other organisations. The University of Hertfordshire is also in the process of setting up a foundation to drive economic development in Hertfordshire based on the SJSU model. The two universities are exploring the potential for joint projects that benefit university collaboration and business innovation as well as economic development in the respective regions.

5

Skills for  
**Innovation**



# KEY FACTS

There has been a 7% increase since 2000 in A level entries by young people in England taking science subjects

HEFCE has committed £160 million to increase the demand for and supply of students doing strategic and vulnerable subjects with the majority to be spent on STEM subjects (science, technology, engineering and mathematics)

Graduates from STEM subjects (excluding psychology and sports science) at UK HEIs increased by 5% from 2002/3 to 2006/7 to 114,000 UK students and 16,100 overseas students. Postdoctoral graduates<sup>16</sup> increased by 18% over the same period to 7,300 resident in the UK and 4,400 overseas

Highly skilled people with excellent technical, business and life skills are the lifeblood of innovative organisations whether they are developing new technologies or knowledge for cutting edge products or services, using existing knowledge or technologies to bring new products or services to market or working directly with customers or in support functions.

Progress on the skills commitments made in *Innovation Nation* is as follows<sup>17</sup>:

- Good progress is being made in implementing the **Leitch agenda** and in particular, level 4 achievements are on track.
- DIUS is making good progress against the initial target of **National Skills Academies (NSAs)** in every major sector of the economy. There are now 16 NSAs. The four new academies announced on 7 October – Enterprise, Power, IT and Social Care – which are proceeding to the business planning stage will add to the existing network of twelve NSAs, ten of which are operational and two others are in business planning.

- The **Higher Level Skills Strategy consultation** closed on 7 July 2008 and the responses broadly endorsed the overall direction of the strategy. An analysis of the responses is available on the DIUS website<sup>xxiii</sup> and DIUS will shortly set out the next steps in taking forward the strategy.
- The National Council for Graduate Entrepreneurship is working with RDAs, corporate sponsors and universities to develop the University Enterprise Networks, 3 of which were launched in November.
- DIUS has led a cross-Government project to gain a clearer picture of the **demand for STEM skills** consulting widely with RDAs, sector skills councils and professional bodies. Emerging findings indicate that the situation is complex and that requirements vary significantly by sector. Many employers in the science and technology area look in addition for a broad range of “softer” skills such as business acumen and team working skills which they

<sup>16</sup> Indicator for PSA 4 Promote world class science and innovation in the UK

<sup>17</sup> Further detail on progress on *Innovation Nation* commitments is given in Annex 1

say are not always present in STEM graduates. The full STEM labour market study will be published shortly.

Other progress across the education and skills system includes a range of activities led by DCSF:

- DCSF funding for enterprise education is being increased from £60 million to £75 million per year by 2011 to extend enterprise education continuously from primary through secondary to post-16 education
- GCSEs in physics, chemistry and biology (triple science) are being made more accessible to pupils who would benefit
- A range of initiatives is in place to increase the number of science teachers and improve the quality of teaching
- DCSF is building on the network of Science Learning Centres, funded jointly with the Wellcome Trust and business to provide a range of good quality continuing professional development opportunities
- DCSF is planning a careers and communications campaign that will inform young people of the wide range of careers and exciting opportunities that are open to those who choose study STEM subjects up to and post-16
- Five 14-19 diplomas were introduced in September. The diplomas combine applied and academic learning, providing the skills needed by employers and giving a path into higher education. The engineering diploma, for example, can include modules on innovation, design and enterprise.

A National Science Competition has been developed to find the **UK Young Scientist of the Year** and the **UK Young Technologist of the Year**. The competition, funded by DIUS, is open to anyone aged 13-19 who has completed a significant science, technology, engineering or mathematics project. The best 35 entries will be chosen to attend the final of the competition which will take place at the UK Young Scientists and Engineers' Fair, *The Big Bang*, on the eve of National Science and Engineering Week in March 2009 where the winners will be announced.

DIUS and DCSF continue their support for the next three years for activities through STEMNET to enrich and enhance the curriculum. STEMNET reached its target for the DIUS-funded Science and Engineering Ambassadors, now a 20,000-strong cohort of role models who inspire young people in STEM at school and college. Representing over 1,000 different employers, the ambassadors have worked with over 750,000 pupils aged 5-19 undertaking a variety of activities including Science and Engineering Clubs. DCSF's recent commitment to fund an additional 250 of these has been taken forward by STEMNET and there are now 500 in operation.

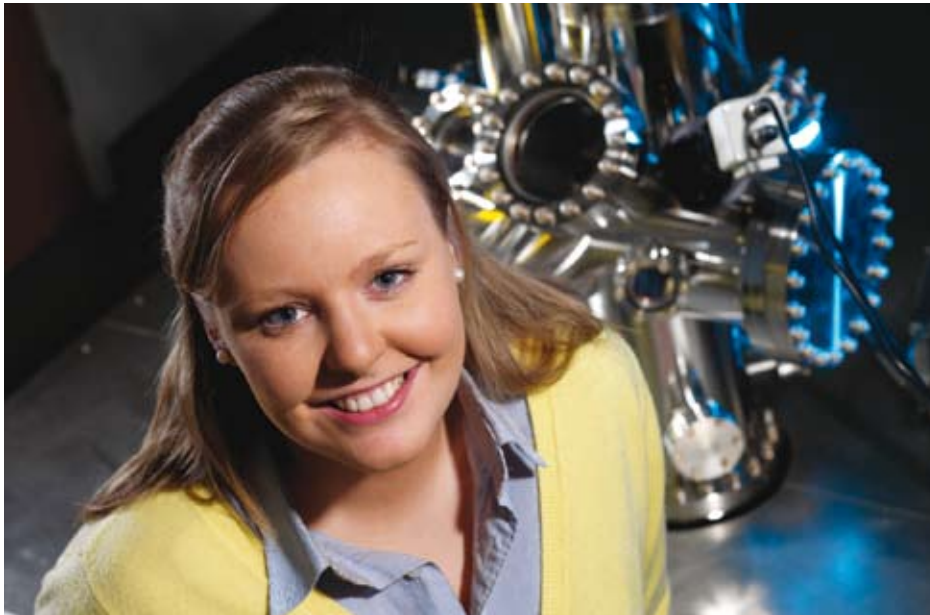
The FE sector makes a considerable contribution to delivering the STEM agenda, especially in delivering the skills needed for technician-level work. An extension of the STEM teaching and learning programme for the post-16 sector, run by the Learning and Skills Improvement Service, will offer local grants to support the dissemination of best practice.

### Key FE and skills statistics for 2006/7

Over 445,000 learners in information and communication technology are supported by the Learning and Skills Council funding for further education, work-based learning and adult and community learning

There are nearly 95,000 learners in science and maths and 216,000 in engineering and manufacturing technologies

25% of science A-levels and 24% of maths A-levels are undertaken in the FE sector

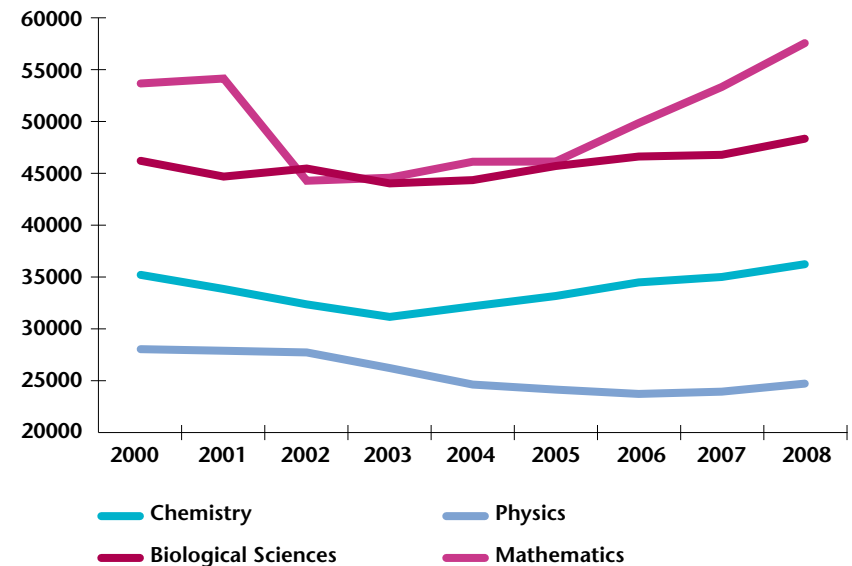


Laurie Winkless – a science and engineering ambassador from the National Physical Laboratory.

### STEM Skills Indicators

The number of A level entries from young people in maths, physics, chemistry and biology is a lead indicator for the flow of future higher-level scientific skills.

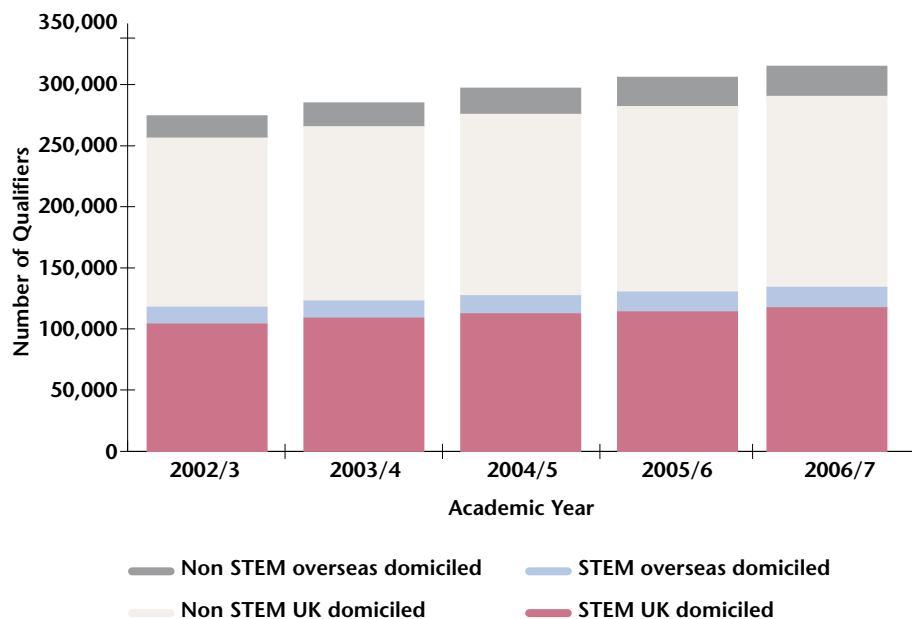
Figure 16. GCE A level entries by subject



Source: DCSF<sup>xxiv</sup>

The take up of GCE A level STEM subjects has increased but the recent growth in physics is weaker than the other subjects (Figure 16).

**Figure 17. First degree qualifiers from UK Higher Education Institutions**

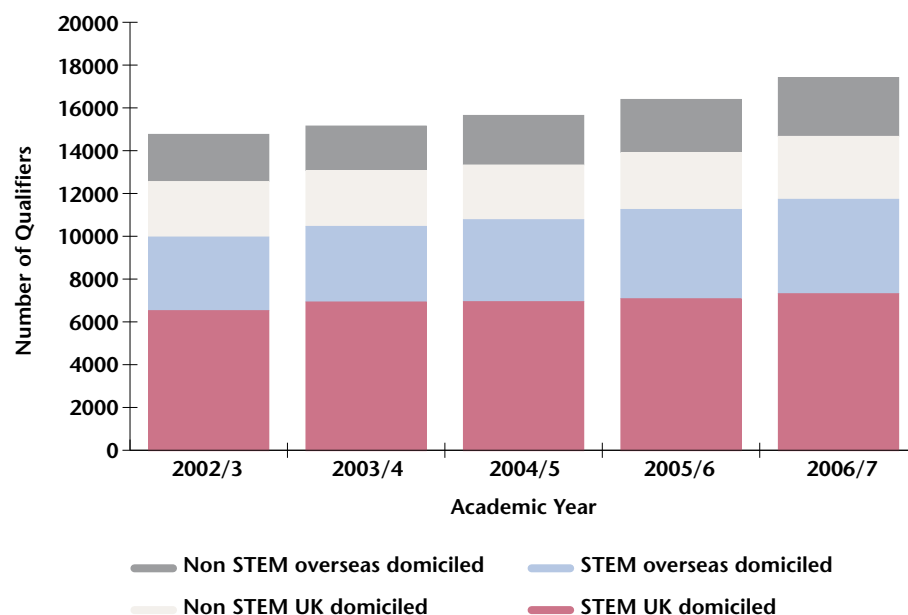


Source: Higher Education Statistics Agency (HESA) Student Record

Figures exclude those qualifying from the Open University due to inconsistencies in their method of recording subject of study over the time period.

The number of those obtaining first degrees in science, technology, engineering and mathematics (STEM) remains strong. Overall, the number of STEM first degree qualifiers from UK HEIs has increased by 11% over the period 2002/3 to 2006/7 (Figure 17). The number of applicants accepted for entry to first degree courses in 2008/9 is up on the previous year by 6.0% in physics, 5.1% in chemistry, 8.3% in maths and 6.5% in engineering subjects. The proportions of UK to overseas STEM graduates has remained roughly constant over the period at approximately 86% UK graduates.

**Figure 18. Doctorate qualifiers from UK Higher Education Institutions**

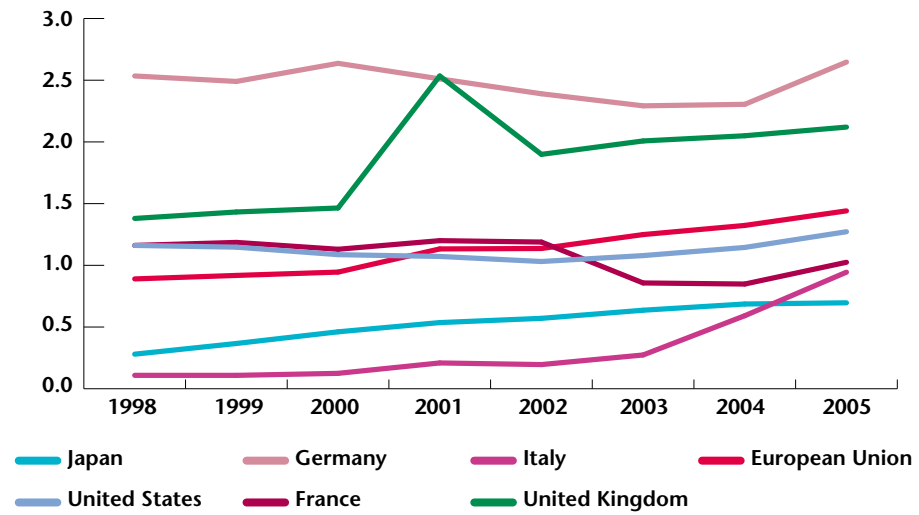


Source: Higher Education Statistics Agency (HESA) Student Record

Figures exclude those qualifying from the Open University due to inconsistencies in their method of recording subject of study over the time period.

Overall, the total number of PhD graduates in STEM subjects has increased by 18% over the period 2002/3 to 2006/7 (Figure 18), though as with first degrees growth is not uniform across subjects. The UK is a particularly popular destination for overseas students wishing to study STEM subjects at post-graduate level. The UK is ranked 2nd to Germany in the G7 on the total number of PhD awards per head of population and has maintained this position since the mid 1990s, though the gap with Germany has narrowed (Figure 19).

Figure 19. PhD awards per thousand population



Source: DIUS<sup>xxv</sup>

xxiii [www.dius.gov.uk/consultations/con\\_0408\\_hiss.html](http://www.dius.gov.uk/consultations/con_0408_hiss.html)  
 xxiv DCSF (2008), *GCE/VCE A/AS and Equivalent Examination Results in England, 2007/2008* Table 2, <http://www.dcsf.gov.uk/rsgateway/DB/SFR/s000769/SFR02-2008-corrected.pdf>  
 xxv DIUS (2008) *Comparative Performance of the UK Research Base* <http://www.dius.gov.uk/publications/IntComparativePerformanceUKResearch.pdf>



# CASE STUDY

## NATIONAL SKILLS ACADEMY FOR NUCLEAR ADDRESSES STEM SKILLS SHORTAGE ACROSS THE SUPPLY CHAIN

The nuclear sector is entering a period of fundamental growth and development with a resultant increase in demand for skilled staff. Over the past two decades the number of apprentices recruited into the sector has been in decline and this is a particular challenge in the supply chain where lack of certainty about future contracts has led to even greater reticence in employing apprentices.

To address this, the Nuclear Decommissioning Authority (NDA) has invested £2 million in the Nuclear National Skills Academy to drive up the number of apprentices entering the supply chain, especially through SMEs. This innovative programme offers an apprentice wage subsidy to employers in the supply chain that take on apprentices for the first time or appoint an increased number of apprentices. This programme has proved very successful and in the first six months of operation 41 new apprentice places have been offered across 12 companies.

The nuclear industry has also reported a shortage of suitably trained, engineers and technicians. Together with the Nuclear Skills Academy the new Nuclear University Enterprise Network (UEN) will tackle this. The development of this UEN is being led by the North West Development Agency – some 60% of the



nuclear industry is based in this region – and will be supported by Westinghouse UK and based in Preston. The first university to formally commit to being involved with the network is the University of Central Lancashire (UCLan). UCLan has strong links with the industry and with key bodies such as the Office for Nuclear Development. The university recently seconded its then Dean of Academic Development jointly to the Nuclear Decommissioning Authority and Sellafield Ltd to assist the industry with its skills planning process, build understanding of the sector's operations and strengthen links with the university.