A year ago, the Council for Industry and Higher Education became the National Centre for Universities and Business. The NCUB is funded by the four higher education Funding Bodies, the UK’s Research Councils, the Technology Strategy Board, major corporates and universities. Its Leadership Council consists of Vice Chancellors, CEOs, Chairs and group board members, and it is therefore well placed to review the State of the Relationship between businesses and higher education institutions.

This, our first *State of the Relationship* report, drawn on our membership and research team to celebrate success, review the challenges, and explore solutions. We look forward to working with others to increase the quality, diversity and intensity of collaboration over the next twelve months.

Richard Greenhalgh

*Chairman, National Centre for Universities and Business*
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"Humans are not special because of their big brains. That’s not the reason we can build rocket ships – no individual can. We have rockets because 10,000 individuals cooperate in producing the information."

Kim Hayes, Professor of Anthropology at Arizona State University

The National Centre for Universities and Business (NCUB) was born out of a deep belief – based on sound evidence - that open, sustained, networked collaboration between universities and business is a key to prosperity and a good society. Each year we will produce a State of the Relationship report to measure the growth of this connectivity through index-based surveys of attitudes, outputs, inputs and other hard sources of evidence. In this, our inaugural year, we have used case studies, long essays and short arguments to explore myriad ways to turn inventiveness into successful innovation and develop high-quality graduate talent.

We have addressed many of the frequently asked questions raised by students, teachers, academics, business leaders and policy-makers. These include:

- What is the connection between universities & economic growth?
- How are higher education institutions woven into the UK’s innovation system?
- What are the best ways of linking small companies to universities?
- Is there evidence for government interventions to promote collaboration that work?
- What must businesses do better to absorb university inventiveness?
- What must universities do to improve their bridging skills?
- Are there serious skills shortages and how does the education system address them?
- What kinds of attributes do graduates need to contribute to the knowledge economy?
- And how do universities act as anchor companies in regions?
**Only connect - innovators**

Most international comparators show the UK is already a success at innovation and connectivity. It is ranked third behind Switzerland and Sweden in the 2013 Global Innovation Index¹, and sixth for university-industry collaboration by the World Economic Forum survey². And it is second only to the US in academic research – as measured by the volume and quality of citations. This world-class performance must not result in the UK being the best contract researcher for other countries’ economic growth. It must be turned into profit and jobs in the UK. To do so, as many of our essayists argue, we must understand and intensify the connectivity in the innovation system³.

Policy-makers must focus on linkages that increase the quality and intensity of collaboration. Reflections on the golden triangle of business, university and government must be accompanied by deeper thinking about the role of infrastructure, labour markets, finance and intermediary bodies, such as Local Enterprise Partnerships, the Technology Strategy Board, the Catapult Centres and the Research Councils. The geometry is more like an innovation pentangle (Figure 1). And the more intense the means and patterns of connectivity, the more successful universities can become as anchors for the regions in which they are set and as smart innovation partners for companies.

As our case studies of BP, Rolls Royce, Boeing and Lloyds demonstrate, big businesses are the major drivers of successful invention in the UK. Indeed in 2011 small independent firms contributed less than 6 per cent of R&D expenditure, as compared to 56 per cent from the top 50 funders. And in 2012, more than 50 per cent of UK R&D was funded by companies headquartered outside of the country⁴. This extreme outlier compared to other countries is simultaneously a tribute to the openness and excellence of the UK’s research base and a prod to action. Major companies can go anywhere for their R&D and therefore government investment into the public sector research and development system – principally its universities is a vital economic necessity.

Commercialising research is inherently risky, and failure rates are high. Big corporations plan for dead ends, but in smaller companies these often end catastrophically. Publicly-funded innovation should be a vital resource for such businesses. Reviews of impact and the case studies of small company success in this report repeatedly demonstrate that when businesses develop the capacity to absorb the research they can extract value from universities⁵.

However, as the NCUB’s Brighton Fuse and London Fusion projects exemplify, different sectors approach innovation in fundamentally different ways. Processes designed for big science or engineering are likely to be unnecessarily complex and cumbersome for creative and software companies working in product cycles that last months rather than years. Understanding and designing processes for different sectors will help secure specialized technology or business clusters around universities. But of course, one of the most important roles universities play in innovation is the development of high-quality graduates.

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¹ www.globalinnovationindex.org/content.aspx?page=GII-Home
³ www.ncub.co.uk/reports/growing-value-business-university-collaboration-for-the-21st-century-2.html
⁵ See also: Enhancing Impact: The Value of Public Sector R&D Alan Hughes and Ben Martin. www.ncub.co.uk/reports/impactsummary-3.html
Suitably updated, this list of attributes is precisely what employees of modern businesses require. And in the report we highlight innovative ways of using work experience, different types of degrees, placements and continuous professional development to help bring about the rounded graduate. We also explore how graduates perform across their career. A great deal of focus is placed on a graduate's first job, overlooking the fact that critical skills and qualities of the high-performing employee in his or her fourth job were first developed at university.

In our analysis of how best to understand specific shortages in science, technology, engineering and mathematics (STEM), we challenge some myths. For example, only 3 per cent of engineering students go into the City, and physics graduates struggle to get jobs just as much as those with creative degrees. And endeavor to get under the skin of real industry challenges. Although unemployment rates suggest there are more STEM graduates than businesses can absorb employers continue to express concern about the quality of some graduates in key sectors.

We believe this could best be remedied by attracting high quality female employees into the MTEC (manufacturing, technology, engineering and computing) industries. Our Target 2030 project aimed at attracting girls into physics, shows that we need to change the way we think about the MTEC challenge.

Furthermore, as the Brighton Fuse essay demonstrates, high-growth firms are often driven by super-fused companies, which are led by arts and humanities graduates who are able to harness the technical abilities of software specialists. Simplistic analysis of recruitment problems leads to simplistic supply-side policy solutions.

The NCUB has also been working with universities, government and businesses to explore how work experience and placements can close the gap between employer expectations and university experience. This is vital to a well-functioning graduate market, but remains a challenge of scale and persuasion. There are 2,340,275 students studying in UK higher education. The challenge of connecting them to employers is a vital task for the system.

Only connect - graduates

The education of the whole person is as relevant today as it was when Cardinal Newman wrote his celebrated The Idea of a University in the mid-19th century. According to the great man, a graduate should know how to:

- Get to the point.
- Detect sophism.
- Disentangle a skein of thought.
- Master different subjects.
- Accommodate themselves to others.

- Have common ground with every class.
- Know when to speak, and - as importantly - when to be quiet.
- Ask questions pertinently and gain a lesson seasonably.
- A pleasant companion; someone you can rely on.

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Only connect, always collaborate

‘Only connect’ has become somewhat of a cliché. The words are, of course, EM Forster’s from Howards End. But in the novel, the context is surprising to a modern reader. The book’s passionate heroine is engaged to an upright materialistic businessman and she reflects on how she would change him:

She would only point out the salvation that was latent in his own soul, and in the soul of every man. Only connect! That was her whole sermon. Only connect the prose and the passion, and both will be exalted...”
Unilever in partnership with UK universities: working together in pursuit of sustainable scientific progress

Trust and mutual understanding are the foundations of ongoing research relationships aimed at scientific breakthroughs that support sustainable growth.

Unilever is one of the world’s leading producers of fast moving consumers goods and includes among its brands household names such as Persil, Domestos, Cif, Dove, Wall’s, Lipton, Knorr and Hellman’s. The company’s products are sold in more than 190 countries and on any given day two billion consumers worldwide use them. Unilever is committed to making sustainable living commonplace and works to develop new ways of doing business that will reduce its environmental impact and increase positive social impact. Only by creating innovative and environmentally friendly new products will the company grow sustainably.

The company’s roots are in Port Sunlight, Wirral, on Merseyside. Originally home to the company’s first purpose built research centre, Port Sunlight is still the site of one of Unilever’s largest research and development centres employing more than 750 scientists. Unilever R&D has always collaborated with university departments across the UK. Over recent years the need to form external partnerships has become increasingly strategically important if Unilever is to develop the science and breakthrough technologies necessary to create innovative and sustainable products. It is a challenge too great for the company to tackle alone.

Partnerships with academic institutes and universities has now been formalised in what is called the Science Grid - a network of carefully selected leading academic centres around each of our six global strategic sites to form an innovation ecosystem. Universities and institutes are chosen for their expertise and capability in fields of science which complement Unilever’s scientific priorities.

In the north west of England, R&D Port Sunlight has signed partnership agreements with the Universities of Liverpool and Manchester and the STFC Hartree Centre for high performance computing at Daresbury. The Grid connects the partner institutes not only with each other and Unilever Port Sunlight but also Unilever R&D worldwide.

At the University of Liverpool, our links are built around shared capability and facilities. Unilever is a partner at the Centre for Materials Discovery where it has its own lab and office space; it is a collaborator at the Ultra-Mixing and Processing Facility; and a funding partner, with the HEFCE, at the Materials Innovation Factory. In August 2013 the University and Unilever announced a new three-year partnership to create a centre of excellence in the identification of sustainably-sourced ingredients. Part funded by the Department for Business, Innovation and Skills, this project is expected to deliver the next generation of interesting surfactants and polymers, bringing environmental benefits to home and personal care products.

Meanwhile, research projects between Unilever and Manchester University cover all four of its faculties in areas of sustainable consumption, process engineering, biophysics and systems biology, as well as aspects of inflammation, toxicology and hair biology.

Each partnership is supported by a framework agreement on projects, timing, governance etc. Unilever appoints a Relationship Director who works closely with a colleague at the university on the day-to-day running of the collaboration. They are overseen by a joint steering committee who set strategy and direction.

A collective willingness to make the partnership work is cited as key to success. Both organisations must benefit from the collaboration and share a clear vision on what the partnership can bring each other. From this comes trust and mutual understanding.
The Open University and the National Skills Academy for Nuclear: a new training certificate for tomorrow's nuclear professionals

When the National Skills Academy identified a graduate skills gap in the valuable nuclear sector, they partnered with The Open University to create a programme that could address it.

The UK's nuclear industry employs more than 40,000 people and generates almost a fifth of the country's electricity. As older nuclear power plants are decommissioned and plans created for new ones to be built, the industry found that it needed new ways to equip engineers with the necessary skills. The Open University's work with the National Skills Academy for Nuclear has opened a new pathway for the nuclear professionals of the future with the Certificate in Nuclear Professionalism (CoNP).

Jean Llewellyn OBE, Chief Executive of the National Skills Academy for Nuclear says the partnership began because employers were having issues with the skills of graduate entrants. “They were not getting the ‘work-ready’ graduates they needed,” she says, “specifically around communication, project management, team leadership, commercial awareness and some technical nuclear skills. So The National Skills Academy for Nuclear started working with employers to understand exactly what skills were needed. It was decided we needed a flexible new programme for the industry that could be rolled out across the country. The Open University’s accessibility and expertise made it the ideal lead partner.”

The Open University has been involved from day one and helped the academy develop the overarching programme. This course was developed with feedback from the academy’s 100 employer members across the nuclear industry. The key issue that emerged from this feedback was that employers wanted generic engineers and scientists - not necessarily those with nuclear specific degrees, but rather entrants who understood the industry and held ‘softer’ skills. While graduates technical skills and knowledge may have been high, the commercial skills needed to cost or manage a project were lacking.

“This partnership is an innovative training model and a unique collaboration between industry and university,” says Llewellyn. “I don’t believe something like this has been developed before. I see this qualification becoming the UK’s benchmark for nuclear professionalism with the potential to become globally recognised.”

Magnox Ltd is the largest employer sponsor of the qualification with more than 30 employees undertaking the programme, including the first graduates to receive the certificate.

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Mandy Walker, L&D Manager, Magnox Ltd

The successful Certificate of Nuclear Professionalism qualification was recognized with an award from the influential Nuclear Engineering International magazine in its first year of presentation. Award judge Ulrik von Estorff, operating agent at the European Human Resources Observatory for the Nuclear Energy Sector, called the The CoNP “a very innovative and professional course with a high involvement of the nuclear industry in its design.”

Find out more about the Certificate in Nuclear Professionalism at: www.nuclear.nsacademy.co.uk/products-services/certificate-nuclear-professionalism
02
Connecting innovators
Almost 30 years ago, Rolls-Royce began formalising its key university partnerships, concentrating effort with leading groups of academics, and committing to long-standing relationships that would help deliver world-class technology, tools, processes and skills. This became known as the Rolls-Royce University Technology Centre (UTC) network. The first two universities to join in 1990 were Oxford and Imperial College London, partnerships that remain strong to this day. Today, this network has expanded to include universities from around the world in Europe, North America, and Asia.

This global network allows Rolls-Royce to work closely with an array of talented people, bringing academics, researchers, and students together with the company’s own senior engineers through a combination of regular dialogue, secondment, and shared challenges. It is an approach that has brought advantages for all parties, providing stability, engendering trust, and giving access to a wider scope of expertise and experience than might otherwise be possible. Evidence of its success can be seen in many of the Rolls-Royce products in use today. For example, the highly efficient wide-chord fan blade, seen at the front of the Trent 900, drew on technology developed in partnership with at least six different UTCs, covering disciplines as diverse as material properties, manufacturing capability, aerodynamic design and noise modelling.

Of course, committing to a long-term partnership is not without risk, and both the company and the university devote effort to ensuring an alignment of goals and aspirations. Quality of research remains high through the dedication of individuals who continually challenge each relationship.

As the network grows, synergies between different groups become more apparent. Just one example is the approach taken to develop future high temperature alloys. An individual turbine blade in a modern engine endures a centrifugal load equivalent to hanging a double-decker bus at its end, whilst operating in temperatures some 200°C above the alloy melting point. This requires an understanding of the latest technology to model and cool the blade, coupled with knowledge of alloy behaviour and the manufacturing processes required to make it usable. Continuous material development will be a requisite moving forward.

As a result, Rolls-Royce committed to working with the Engineering & Physical Sciences Research Council (EPSRC) to help train the highly qualified materials specialists required by the aerospace industry, and to supporting the leading-edge research required for the UK to remain competitive.

Originally involving the Universities of Cambridge, Birmingham, and Swansea, this integrated programme of materials research and training now includes other universities, several supply chain companies, and has launched over one hundred new PhD research studentships. Patents have been filed from the research, and many of the students and researchers have gone on to take up employment with Rolls-Royce and other organisations within the supply chain, or to remain in university research - thus taking on the challenge of leading the next generation of research.
**Should growth programmes take a national or local approach?**

**Sir Andrew Witty’s report Encouraging a British Invention Revolution generated a great response from across the education sector.**

A few weeks after its publication, delegates to the NCUB’s Annual Lecture were able to benefit from a lecture by Sir Andrew that focused upon the contents of his report, and which raised important questions about the complex relation between maximising local and national impact of research investment.

Sir Andrew’s lecture contained a strong focus on kindling the fires of innovation, something he said would require “being much more collaborative within the country, recognising that the real competition to win is a global race, not a regional race, not a domestic race”.

While insisting that “the country has got bubbling up inside its universities more than enough ammunition to win a global commercial war”, Witty outlined how currently too many state and central initiatives “start with geography and bureaucracy and hope that some technology will land there, creating unnecessary competition and disappointment”.

Sir Andrew emphasised how, for long-term success, countries should focus on what they are good at. In his view, it is vital to have the “technology idea first, invest behind that, [and] allow the location to self-declare based on comparative advantage”. Maximum national impact could subsequently be achieved by concentrating resources among the best in the business, “connecting centres of excellence in a particular research field to bulk up our chance of being the winner in a technology race”.

This points towards moving away from local growth programmes and instead towards universities taking a national perspective and creating an economic ‘Team GB’ that can be pitted against the best of the rest of the world.

Witty also recognised the large economic role that many universities play locally within cities. He gave the example of how Lincoln University has worked to develop graduates that meet the talent demands of Siemens, which is based in the city, a partnership that is playing a crucial role in ensuring jobs remain in the UK.

If universities aim to create wealth, who and where are they aiming to create wealth for? Many institutions are rightly proud of their status as anchors in the local community and will naturally seek to contribute towards its development.

It is likely that there will be as much diversity in the delivery of the ‘third mission’ of wealth creation as there are within research and teaching. Just as basic research for fundamental understanding and applied research for immediate use have different aims but are equally vital to world-class research institutions, innovation to create new industries is distinct but equal in importance to growing local areas today.

Sir Andrew’s report sets out a blueprint for a strategic, national approach to foster innovation for the country. For this to be achieved, it will require countering incentives for local competition and in some areas a change of culture away from a regional ‘spread’ towards comparative advantage. However, while this approach clearly has the potential to offer many benefits, this should not preclude universities playing a vital role locally in support of their communities.
Keeping a sense of perspective: which businesses collaborate with universities, why do they do it and how can collaboration be enhanced?

There is great current interest in the contribution of universities to innovation and growth. In discussing this contribution it is extremely important to keep a sense of perspective about the role that universities play in the innovation system. This article revisits the importance of universities as a collaboration partner with business and as a source of knowledge for corporate innovation activity.

The role of universities in the innovation system is best appreciated within the wider range of collaborative and knowledge sourcing activities in which businesses are engaged. For example more than 20 per cent of innovative firms surveyed for the UK Innovation Survey¹ cite universities and other higher education institutes as co-operation partners and this should be seen as sitting alongside and complementary to the 70 per cent who cite customers or suppliers as collaborative partners. The central role of customer and supplier relationships in the innovation process also means that 40 per cent of innovating firms rank clients and customers as of high importance as a source of information for their innovative activities whilst 3 per cent cite universities.

This is not to deny that there are some businesses or sectors for which interactions with the university sector may be relatively more important or be ranked more highly than these averages suggest. Moreover, the evidence is not to be taken to suggest that the role of universities is unimportant. Rather it is to emphasise that universities are only one part of the innovation eco system and that many other actors have extremely important parts to play.

Which businesses interact with the university sector? Detailed analyses of the interactions of individual firms with the university sector suggest that they are strongly influenced by the innovation strategy of the firm itself. Those which have relatively open innovation strategies and search widely across sources of knowledge are more likely to draw from universities as part of their portfolio of knowledge sources. Those with high levels of R&D relative to their sales activity, and which conduct long-term R&D programmes, are also more likely to interact with universities.

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¹ BIS (2013) First Findings from the UK Innovation Survey 2011 (Revised), Science and Innovation Analysis, May, Department for Business Innovation and Skills (BIS).
This reflects the two faces of R&D expenditure. Not only does it enhance the ability of a company to increase its innovative activity per se, but it also enhances its ability to absorb and understand information from external sources.

In reading the evidence it is important to bear in mind that independent small firms employing less than 250 people account for less than 4 per cent of R&D activity in the UK. They are, for that reason alone, less likely to be involved in university interactions than larger firms.

Finally, large as opposed to small firms are likely to have higher levels of use of universities as a source of information. Large firms also rate universities as a source more highly than smaller firms. A strategy of encouraging engagement to promote innovation which is linked to R&D and scientific research is unlikely to attract a significant proportion of SMEs. A wider perspective is required.

R&D and technology driven knowledge for new product and process innovation are not the only reason for businesses to source knowledge from the university sector. Hughes and Kitson’s 2013 study considers in detail the reasons for university-business interactions and among many findings notes that firms source knowledge for a much wider range of business functions than innovation. These include the development and provision of service, marketing and sales activities, human relations management, and logistics.

\[\text{Source: Hughes and Kitson (2013)}\]

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**Figure 1: Motives to interact, primary activities (percentage of interacting firms).**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inbound Logistics</td>
<td>10.2%</td>
</tr>
<tr>
<td>Operations</td>
<td>20.9%</td>
</tr>
<tr>
<td>Outbound Logistics</td>
<td>33.8%</td>
</tr>
<tr>
<td>Marketing and Sales</td>
<td>26.4%</td>
</tr>
<tr>
<td>Service</td>
<td>29.9%</td>
</tr>
<tr>
<td>Introduction of New Product and/or New Process</td>
<td>29.9%</td>
</tr>
</tbody>
</table>

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**Figure 2: Percentage of UK businesses citing different interaction pathways with the university sector.**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>41.8%</td>
</tr>
<tr>
<td>Supervising</td>
<td>33.8%</td>
</tr>
<tr>
<td>Curricular</td>
<td>20.9%</td>
</tr>
<tr>
<td>Conferences Help Participation</td>
<td>35.8%</td>
</tr>
<tr>
<td>STD Setting Forums</td>
<td>9.0%</td>
</tr>
<tr>
<td>Involving Lecturers</td>
<td>19.4%</td>
</tr>
<tr>
<td>Networks</td>
<td>29.9%</td>
</tr>
<tr>
<td>Sitting on Advisory Boards</td>
<td>13.2%</td>
</tr>
<tr>
<td>Enterprise Education</td>
<td>9.0%</td>
</tr>
<tr>
<td>Community-Based Activities</td>
<td>7.5%</td>
</tr>
<tr>
<td>Public Exhibitions</td>
<td>11.9%</td>
</tr>
<tr>
<td>Lectures for the Community</td>
<td>14.9%</td>
</tr>
<tr>
<td>Joint Publications</td>
<td>6.0%</td>
</tr>
<tr>
<td>Informal Advice</td>
<td>14.9%</td>
</tr>
<tr>
<td>Research Consortia</td>
<td>10.4%</td>
</tr>
<tr>
<td>Inviting Academics</td>
<td>17.6%</td>
</tr>
<tr>
<td>Joint Research</td>
<td>17.6%</td>
</tr>
<tr>
<td>Consultancy Services</td>
<td>10.3%</td>
</tr>
<tr>
<td>Setting of Physical Facilities</td>
<td>14.9%</td>
</tr>
<tr>
<td>Problem-Solving Activities</td>
<td></td>
</tr>
</tbody>
</table>

Source: Hughes and Kitson (2013)

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Narrowly defined commercialisation pathways involving licensing, patenting and business spin-offs are a small part of the story. In fact only around 2.5 per cent of UK businesses employing more than 500 people report that they acquire patents or licenses from UK higher education institutions (HEI), and the figures for smaller firms are much lower than that. Around 5 per cent of larger businesses report collaboration with a HEI spin-out. As shown in Figure 2 (derived from Hughes and Kitson, 2013) these narrow commercialisation pathways are far less frequent than a much wider range of people-based and problem-solving interaction pathways. It is significant, however, and relevant for policy design, that in all cases larger firms (outer balloons, 500 plus employees) interact much more frequently than smaller ones (inner balloons, up to 10 employees).

In addition to keeping a wider perspective on pathways, it is important to understand barriers to collaboration. Unsurprisingly, different constraints apply to different types of collaboration by partner or activity. In business activities and sectors where intellectual property (IP) protection and patenting play an important role, disagreement over patent protection will loom as a relatively larger constraint. However, only a minority of university-industry relationships involve IP issues, as these are in fact only a small part of corporate strategies in some sectors and for smaller firms. As demonstrated in Figure 3, the result is that IP disagreements are cited infrequently among collaborations of all sizes and sectors.

**Figure 3: Constraints on interactions: businesses and academics engaged with private sector only (per cent of respondents).**

Source: Hughes and Kitson (2012)

Similarly amongst UK businesses in general, differences in required timescales are rarely cited as a critical constraint. In general, the evidence for the business community as a whole shown in the constraints chart suggests that the most important factors relate to the time and capacity required to manage relationships with the university sector. A similar ranking of constraints emerges as top of the list for academics. It can be inferred that, because university sector career prospects and promotions are enhanced by research publications, rather than external interactions, and because corporate careers are to an extent inhibited by sideways movements into university collaboration, there may be personal inhibitions to interaction despite organisations benefiting overall from increased interrelationships. This suggests that close attention needs to be paid to internal incentive and human relations structures when developing university-industry links. It also suggests that care should be exercised in establishing the most effective form of partnership and collaborative engagement. These must match the corporate strategy of the industrial partner and the knowledge exchange strategy of the university.

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Lancaster University has long recognised the need to work closely with industrial partners to ensure that high-quality research meets real-world demands, providing opportunities for business and economic growth as well as ensuring graduate researchers are better equipped for the start of their careers.

Last year, in a novel approach to foster large-scale industry collaborative research, a partnership led by Lancaster University, and including the University of Liverpool and science and technology commercialisation company, Inventya Ltd, opened the £9.8m Centre for Global Eco-Innovation – which was part-funded by the European Regional Development Fund (ERDF).

The Centre’s graduate researchers use the collaborations with aspirational high-tech companies as the basis of three-year PhD programmes and are supported by senior academics. These placements augment the academic strengths of a conventional PhD with the practical benefits of linking research to real-world needs of sponsoring companies.

As well as providing an invaluable launch pad for their careers, the centre addresses the need to improve levels of research and innovation within SMEs. It also helps to increase the export performance of SMEs, creating additional value and employment within the UK economy.

The businesses also benefit from the time, resources, contacts and expertise from Lancaster University and its partners, creating a research and development package worth more than £100k.

To date, 50 post-graduates have been placed on collaborative research and development projects with 50 ambitious high-tech businesses. In addition the Centre will support a further 235 short-term partnerships involving students and SMEs.

The project stands as one of the largest-scale collaborative centres of its kind in using PhD researchers to underpin substantive programmes of collaborative research. It currently involves a team of around 200 people and has an ambition of creating £45m of wealth for north-west England’s economy. The centre aims to work with more than 280 SMEs, develop 150 new products and services, and create 268 new jobs.

Getting the Centre up and running posed significant operational challenges. Finding and matching 50 SMEs and PhD students with an even geographical split across the North West region, including almost a third in the Merseyside area, proved a demanding task, particularly as this had to be done within a narrow time-frame due to funding constraints. It took around two and a half years of hard work and involved working with multiple funding bodies, including the European Regional Development Fund (ERDF), which part-funded the project – a first for a PhD programme in the north west of England.

The efforts are now starting to pay dividends and the Centre for Global Eco-Innovation has had a lasting impact on how the university seeks new ways to collaborate with business. With benefits across a range of indicators including business growth, developing research impact, academic teaching and boosting graduate employability the university feels that the Centre is performing well and is actively looking to pursue additional variants of the model.

**Lancaster University: at the forefront of eco-innovations**

PhD graduate researchers at Lancaster and Liverpool lead the way in ecological innovations.
The past two decades have seen tremendous advances in materials science and engineering - advances which are being successfully applied across a range of industries. As the challenges of finding and exploiting primary energy resources grow, from conventional hydrocarbons to low-carbon alternatives, the time is right to translate advanced materials technology more effectively into the energy sector. In tune with this effort to deepen knowledge and broaden capabilities in advanced material science and engineering, BP has established the BP International Centre for Advanced Materials (BP-ICAM), committing at least £59.9m ($100m) over 10 years.

The BP-ICAM is experimental in terms of its research ambitions and partnership model. It brings together capabilities from four leading universities, with the University of Manchester acting as the hub and the Universities of Cambridge, University of Illinois at Urbana Champaign and Imperial College as the spokes. Research programmes will be delivered both individually and collaboratively in order to leverage the extraordinary expertise the BP-ICAM brings together.

The BP-ICAM builds on a prior heritage of university partnerships dating back to the BP Institute for Multiphase Flow at Cambridge, established over a decade ago, and the Energy Biosciences Institute in the US formed in the mid 2000’s. Each was consulted extensively in order to accelerate and simplify establishing the BP-ICAM. Their track record of delivering directly attributable business value greatly aided the ultimate decision to invest in the BP-ICAM.

Established in September 2012, the BP-ICAM has a cohort of more than 50 researchers involved in 14 research programmes across four main topic areas: structural materials, functional materials, separations, and smart coatings. The objective is to drive insight by applying advances in science over the previous two decades in computing, modelling, characterisation and imaging, and synthesis onto materials operating under real world conditions. These insights will underpin the meeting of future technology challenges in the energy sector.

BP-ICAM’s vision is a partnership between BP and selected universities that enables application of advanced materials to energy challenges, with a mission to drive a step change in the understanding of materials impacting safety, reliability and performance across BP operations, enabling improved utilisation of existing, and access to new resources. The aspiration is to establish a benchmark for university-industry partnerships delivered through an integrated, synergistic collaboration serving as a catalyst for deepening and extending the BP-ICAM network. This will be underpinned by the creation of a platform to access, convene and develop leading skills in the advanced materials field primarily for BP, while also extending across the broader energy industry and associated supply chains.

The delivery of the BP-ICAM is underpinned by a clear set of values:

- **Innovation**: Discovering and developing new and more efficient technologies and processes
- **Excellence**: High standards of safety and technology management
- **Collaboration**: Creating a community of common purpose and mutual trust
- **Capability**: Building skills, capacity and infrastructure
- **Impact**: Delivering solutions that make a real difference to BP and the wider industry
How best can we balance talent and inventiveness in the UK?

In a speech given at the NCUB 2012 annual lecture, Martin Sorrell, Chief Executive of WPP discussed a multitude of opportunities that, if not addressed in time, will become threats for the UK economy.

“Business needs growth, and growth comes from innovation...Innovation needs new thinking, it needs new concepts and it needs new ways of thinking to be successful,” he said.

One opportunity not to be missed is to draw inspiration from developments in the BRIC (Brazil, Russia, India and China) countries.

According to the International Monetary Fund BRIC countries accounted for 20% of world economic output in 2012, a fourfold increase in the last ten years. They are also playing an increasing role in global governance by strengthening their weight in international cooperation. For example, a study by Global Health Strategies showed that between 2005 and 2010, China’s foreign assistance spending rose about 24% a year, while Brazil’s grew by about 20% and India’s by 11% – far more quickly than growth in development assistance from the G7 countries, according to data from the OECD.

What can the UK learn from the BRIC countries and where does interplay between our businesses and universities step in to help alleviate the problem?

The UK government has introduced short-term austerity measures to tackle some of the key economic challenges. However, a strategic element is missing – one that makes the most of both the invaluable intellect that academia can offer to business and the resources business can offer in return.

World-class talent undoubtedly resides in UK institutions but whilst our graduates have all the necessary qualifications, many are shocked to find that they are still unemployable after a demanding three to four years of hard work. Simply put, they look impressive on paper but in the workforce are a far cry from the types of employees many companies would find if they handpicked them elsewhere, including abroad.

Businesses must step in and support those who will provide the intellect required to create a thriving UK economy in the future.

As Sorrell explained in his lecture, some of the best brains do not have the means required to maximise chances of success. Internships and apprenticeships provide an invaluable platform for students to gain the necessary skills catered towards their area of desired work, helping to balance both talent and inventiveness. Santander’s Universities Entrepreneurship awards is a prime example, supporting some of the most talented graduates across the UK financially and commercially with their cutting-edge business ideas but also giving them the necessary support and direction too. We should not shy away from training up talent abroad to contribute to the UK either; WPP is one example of a company that offers a range of global fellowship programmes.

If we want to set ourselves above and beyond competitive countries, business and academia should work hand in hand to balance the talent we already have with the inventiveness provided by our businesses.
The University of Manchester and BP Strategic Partnership

Over six years helping to ensure the company has the technical capability and strong leadership to stay at the leading edge of its field.

The partnership began with a number of individual research and graduate recruitment activities, but has evolved into a strategic alliance that has had major benefits for both organisations and is helping to drive the innovation and research agenda. Today, we work together across a number of key areas:

RESEARCH

The University of Manchester is working with BP on a range of research projects across the University, such as BP’s International Centre for Advanced Materials (BP-iCAM), which is supported by a $100m, ten year investment from BP. It is a unique collaboration between five research partners: BP, The University of Manchester, the University of Cambridge, Imperial College London, and the University of Illinois at Urbana-Champaign, bringing together the full spectrum of academic knowledge in the field of advanced materials.

There is also a collaborative research programme with the University’s School of Materials and Massachusetts Institute of Technology (MIT), to investigate corrosion science and technology for oilfield exploration and production, which includes a BP-funded research laboratory at Manchester and a Chair in Materials and Corrosion, plus support for a large number of researchers and academic staff.

There are also other smaller research projects in place reflecting the breadth of interaction between the two organisations.

RECRUITMENT

Science and engineering education is critical to the UK’s long-term future and we work with BP to promote careers in the energy sector. Our joint team works raises awareness of intern and graduate opportunities at BP, while BP’s Early Engagement Programme offers 1st and 2nd year undergraduates practical insights into working for the company.

SCHOLARSHIPS

Each year BP provides scholarships to students at the University of Manchester to support the next generation of engineers and scientists. BP’s programme at Manchester includes undergraduate bursaries for up to 100 students per annum and a select number of MSc scholarships.

APPLICATION OF SCIENTIFIC KNOWLEDGE

BP shares its expertise and experience with staff and students through additional activities ranging from guest lectures and case studies, to sitting on advisory boards and developing the curriculum.

This is now a genuine strategic alliance that has developed with the support of executive level sponsorship enabling BP to benefit from intellectual insights from world-leading researchers, the sharing of knowledge, materials and equipment, and access to a pool of talented students and graduates. The University of Manchester benefits from a unique commercial insight that informs our research agenda, and enhances our teaching, ensuring its applicability to real-life industry challenges.

EXECUTIVE EDUCATION

In 2008, BP selected the University to host its Managing Projects and Engineering Management courses. The two professional development programmes are delivered collaboratively by subject matter experts from BP and academic staff from the university. More than 600 BP senior staff have now completed the programmes designed to boost high-level engineering and project management skills.

For more information, visit: www.manchester.ac.uk
Small companies and universities
City University London and CityStarters: nurturing London’s tastiest tech start-up

Recently, the programme kicked-started Eatro, a home cooked dinner delivery service initiated by City graduate Daniel Kaplansky and his two childhood friends, Bar Segal and Zifeng Wei.

The three friends began their young business because they were passionate about homemade food and wanted to share this passion with the world. Today, Eatro is making headlines everywhere from The Financial Times to The Evening Standard.

The three graduates began their business journey a year ago with an initial concept, but their idea was refined through CityStarters. The trio’s concept is simple. Eatro is an online platform that allows time-poor Londoners to connect with ‘home chefs’ in their neighbourhood, company-vetted home cooks who want to sell extra portions of food prepared in their own kitchens.

Eatro aims to “challenge and democratise the take-away industry” by offering an alternative to the “mass-produced, unhealthy and tasteless” meals consumed by people on the go. Instead of getting a supermarket ready meal on their way from work, a hungry Londoner could pick up a healthy and delicious homemade dinner from their local home cook. The business has been tipped to become a new Silicon Roundabout success story.

Daniel, Bar and Zifeng believe in the ‘sharing economy’ and their business concept fits with their collective vision. Eatro appeals not only because of its social nature, but also because it helps reduce food waste and mobilises a new breed of food entrepreneurs.

The Eatro team were regular participants at CityStarters’ start-up business events, prize winners of CitySpark, the University’s enterprise competition, and have received mentoring and advice from Ben Mumby-Croft, a marketing expert and Enterprise Education manager at City. They are currently benefitting from CityStarters’ formal mentoring scheme that pairs student start-ups with successful local entrepreneurs.

For more information, visit: www.city.ac.uk/enterprise

City University London has come a long way since it was founded in 1894 as the Northampton Institute. Today, City’s research covers areas as diverse as compressor technology, climate change, optometry, data visualisation and economic theory.

Few universities are as deeply embedded in professional industry as City, and organisations can benefit from a comprehensive range of business services: from student placements and internships, collaborative research projects including Knowledge Transfer Partnerships, consultancy and commercialisation, through to continuing professional development, executive education and short courses. Start-ups and small enterprises can take advantage of City’s incubation support programmes or benefit from co-working space in the heart of Tech City. Undergraduates and graduates learn vital professional and entrepreneurial skills during their time at the University, leaving them ready to join employers of any size when embarking upon their chosen career path.

One of the University’s top priorities has been to create an effective support environment to help launch the next generation of tech start-ups. CityStarters – the enterprise education arm of City University London – exists to fulfill this mission. CityStarters organises extra-curricular events and competitions, and offers business support services and web resources for budding student entrepreneurs who want to see their bright ideas get off the ground.
Policy makers frequently extol the virtues of the small business sector as a generator of jobs and as spearheads of innovation and technical change.

This is linked to studies suggesting first that the small firms create the bulk of new jobs and second, that this contribution is nearly all accounted for by a tiny percentage (about 6 per cent) of small firms who grow exceptionally fast. In the UK this has led to an emphasis of the ‘six percenters’ and the design of policy to enhance their role.

Smaller firms may, at times, exhibit faster growth rates on average than larger ones, but there is very little persistence in their growth and they exhibit much bigger variations in growth rates. The fastest growing small firms in one period are most likely to suffer falls in growth rates in the next. When focusing specifically on innovative firms, similar processes emerge – a very large component of chance and relatively little persistence in growth.

It is not surprising that a small proportion of superfast growing small firms (about 6 per cent) should account for the bulk of employment change in any period. But...

Six percenters growing rapidly in one period are very unlikely to be the same group of firms in the next period. Gains on the roundabouts are lost on the swings.

Pursuing the fabulous six percenters in one period is likely to have the outcome described in Lewis Carroll’s The Hunting of the Snark. When one of the intrepid hunters is seen to be in the process of finally capturing a Snark, it turns out to be something completely different – a Boojum.

The implications for policy makers are sobering. Rather than pursue such elusive targets as six percenters it may be more preferable to focus on the role played by smaller firms in specific sectoral or technological systems. Here their role alongside medium and large firms can be evaluated and the system as a whole supported. After a long period in the policy wilderness industrial policy is making a comeback. Enterprise policy should be adapted to it.

These ‘six percenter’ findings are quite consistent with two very long established ‘stylised facts’:

1. The first is that, over time, industries tend towards a size distribution of firms in which a relatively small number of businesses account for a disproportionate share of activity.

2. The second is that empirically the factors driving the growth of firms behave as a random process determined by chance events. On average a firm’s growth over one period will be no guide to its growth in the next. A handful of firms will, however, experience runs of luck over many periods. These runs of ‘luck’ tend to be the driving forces which lead to the emergence of a small number of very large dominant firms.

Hunting the Snark? In pursuit of the fabulous six percent.

Centrica and the University of Oxford: driving solutions and nurturing talent through student consultancy

A four year partnership between the University of Oxford’s Student Consultancy Programme and Centrica has given students the opportunity to tackle pressing energy issues while allowing the businesses to develop and recruit undergraduate problem-solving talent.

The Oxford Student Consultancy is a programme open to students from any discipline at the University of Oxford. The programme positions undergraduates as consultants, helping businesses to solve critical problems and challenges. Following a week of training students are assigned a client, which may be a small business, charity, arts organisation or university department, which has a key business issue it would like the student to explore and find solutions to. The consultancy programme provides students with a chance to gain solid entrepreneurial experience, contribute to local businesses, develop employability skills and gain awareness of business environments.

The consultancy programme enables Centrica, one of the UK’s leading energy companies, and the University of Oxford to work together to address key business questions while developing the skills of both undergraduates and employees. The partnership is now entering its fourth year and has expanded from its initial home in the power generation side of Centrica’s business to a much wider brief across the whole organisation.

Oxford students undertake paid research and analysis-based projects, gaining valuable work experience whilst making a significant contribution to the business. The projects initially supported the work of senior Centrica executives who were part of the General Management talent development programme, but now consists of business-sponsored projects. From a recruitment perspective, the success of the partnership has helped to build Centrica’s profile as a graduate employer at Oxford.

The initiative has three key goals:

- To develop mid-level managers through the management of teams of four undergraduate participants. This often includes overseeing undergraduate presentations to senior business leaders.

- To solve important business issues – in 2013 these focused on energy resource questions relating to tidal, solar, nuclear and wind. Student solutions to these pressing concerns were described by the Executive Sponsor of the 2013 programme as “excellent”.

- To build Centrica’s presence and awareness in Oxford among the undergraduate population and the careers service. This presence will ideally translate into the recruitment of the very best Oxford graduates.

From the 2011 cohort, 25 per cent (three out of 12) of the participants secured undergraduate summer placements with Centrica after completing the Oxford Student Consultancy and applications are regularly made by participants for the graduate programme.

Currently, the goal is to continue with the programme, expand it across Oxford and apply a similar principle to initiatives with other universities. Oxford Career Services has been an instrumental support in achieving excellence within this partnership. It is hoped that, moving forward, the benefits will continue for all involved.

To find out more, visit: www.careers.ox.ac.uk/category/work-experience-and-employability/our-work-experience-schemes/the-student-consultancy
The UK has long held a leading position in the global research landscape and continually punches above its weight internationally¹. Realising the benefits of this research investment has often been unbalanced between large and small businesses. In the UK, engagement is traditionally concentrated in the hands of a few very large companies and the small number of industrial sectors in which they are based². Small and medium sized businesses, employing fewer than 250 people, accounted for only around 3.5 per cent of the total R&D spend in the UK in 2009. Findings from the UK business representative Community Innovation Survey demonstrated that collaboration for innovation purposes is an activity undertaken by a minority of businesses with 10 or more employees: 20 per cent of collaborating smaller business do so with universities, against for example 73 per cent of collaboration agreements with clients and customers³.

Despite significant investment in recent years to encourage engagement with the research base and incentivise university knowledge-exchange activities⁴, barriers for small businesses are still apparent.

Travelling the length and breadth of the UK in the first part of 2014 has been an eye opening experience to get first hand insights from small businesses about their engagement (or lack of it) with universities. Close to three-quarters of all the small businesses we spoke to were not even aware of the opportunities available to them in universities. For those that were aware, the uptake of these opportunities was often limited by not knowing who to speak within the university, the responsiveness of the university to requests and simply finding the time to engage with universities in the first place.

These barriers and challenges are being addressed and across the UK, universities and intermediary organisations such as Interface Scotland and Connected Northern Ireland are out there raising awareness of opportunities. Universities in the UK are, to borrow the strapline from the business engagement team at the University of Birmingham, ‘open for business’ but more can and needs to be done. It is also important to stress that the small business base in the UK is extensive and diverse, and engagement with universities will not be suitable for all. However, there is a need to raise awareness of the wealth opportunities available to innovating small businesses across the UK.

Engagement and awareness needs to be framed in a language and approaches that are tailored to the requirements of small businesses. It must maximise and integrate with other communication channels that make it as easy as possible for small business to get the information and contacts they need. The internet has entirely transformed how we find, search and connect with prospective resources, opportunities and partners. What was once entirely physical is now primarily digital. Costs are radically reduced, scale and liquidity massively increased and matching speeds theoretically happening at the speed of light.

Unlocking this opportunity is a strategic priority for the NCUB and we will be working across the UK with partners and funders to ensure more smaller businesses are made aware of the fantastic opportunities available in our world leading universities.

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¹ BIS (2013) International Comparative Performance of the UK research base. A report by Elsevier Ltd.
A service to businesses: how the University of Hertfordshire supported Extremis Technology and Demco Europe

Extreme weather simulation and statistical modelling were just two of the services offered via the university’s business support team.

The University of Hertfordshire’s business services team provide access to dedicated expertise, leading facilities and support from talented graduates helping businesses to grow.

Two recent success stories of how the university supports businesses are provided by Extremis Technology Ltd and Demco Europe Ltd:

Extremis Technology designs, develops and builds transitional shelters for population displacements due to war or adverse weather conditions. It plays a pivotal role in disaster relief providing robust shelters for those in need.

The company has developed two transitional shelters designed to be flat packed and portable - ideal for easy distribution and set up. Their main purpose is to provide high quality shelter for displaced people that can also withstand hurricane force winds.

While the team at Extremis had spent significant time on the innovative design, they needed independent, high quality testing to validate their performance claims before the shelters were accepted in the market. The University of Hertfordshire was an obvious choice and partnered up with Extremis Technology to test and validate the performance of the hurricane shelters under simulated extreme conditions.

The university supported the business by carrying out ‘Computational Fluid Dynamics’ (CFD) testing which helped to determine the maximum wind speed that the shelters could withstand. A detailed report was provided to Extremis Technology and possible improvements to the shelters were discussed. The university also created and supplied numerous 3D animations to showcase findings.

The outcomes of the project provided Extremis Technology with robust and validated data to support the performance claims of their innovative transitional shelters.

Extremis sees this as a long-term partnership and intends to work with the team again in 2014 on their next shelter project.

“Everything went so much better than we could have hoped for and we are moving rapidly toward overseas deployment, months before we have originally expected.”

Andy Gowen, Operations Director at Extremis

Demco Europe Ltd offer a wide range of resources, specialist supplies, furniture and innovative design to library and education professionals in the UK, Europe and internationally. The University of Hertfordshire’s market research service was approached to assist Demco in identifying market changes, behavioural developments and the impacts of reform on procurement and financial patterns.

The university conducted a two-phase study involving a pilot followed by a national study in nine regions. The research methods focused on qualitative data analysis and thematic approaches to disseminate the key inferences and patterns.

In addition, researchers conducted an extensive literature review and audit to explore market developments and statistics covering the reform. Statistical modelling and mapping was exploited to ensure the research was significantly representative.

The research provided key insights with pragmatic values for the businesses, informing their business systems and empowered alignment with academy procurement processes, strategies and suitable routes to market.

“They went above and beyond our expectations to deliver an outstanding presentation and detailed report. I would have no hesitation in recommending their market research service to other businesses.”

Demco Europe

More information about the university’s business services can be found at: www.herts.ac.uk/about-us/case-studies/business-services
The Research Council portfolio is a crucial part of the Government’s investment in UK innovation. Investing around £3bn per year in research funding and training, supporting 40,000 research projects, delivered by 30,000 high-quality researchers – this is a world-class UK resource for business to engage with.

Opening up access to this portfolio has been at heart of the Gateway to Research (GtR) initiative launched in 2013. Accessed online at http://gtr.rcuk.ac.uk, GtR provides a search interface for users to interrogate over 40,000 research projects and their outcomes. It allows users to find out about emerging areas for research and the researchers behind them.

For companies like BAE systems the introduction of GtR has helped them better identify opportunities to engage with academics and exploit the outputs of Research Council-funded projects. In particular, the cross-Research Council nature of Gateway to Research has enabled BAE Systems to explore a greater range of Research Council funding that they had previously considered.

Since the launch of GtR, BAE Systems have used it to find out about Engineering and Physical Sciences Research Council (EPSRC) for metamaterials, EPSRC and the Natural Environment Research Council (NERC) projects relevant to launch and recovery, and human factors research supported by the Economic and Social Sciences Research Council (ESRC).

More specifically BAE Systems are now using Gateway to Research to inform three different aspects of their work. Firstly, it provides input to their Technology Foresight Team, allowing them to see what research has been funded several years before publications appear. For any business being able to keep updated on game changing technologies is invaluable in an ever increasingly competitive global economy.

Secondly, Gateway to Research helps BAE Systems identify who they could work with at universities once they have identified topics of interest. For example, in the area of additive manufacturing – 3D printing using a variety of materials, there is a lot of interest within BAE Systems. Using Gateway to Research, BAE Systems are keeping a track of who in the UK is studying additive manufacturing as well as what funding they have received. This early information allows the company to approach the academic at an early stage of the research project and can help ensure the outputs of the research are of use to industry, increasing the impact of the research.

Finally, BAE Systems are using GtR to search out new capabilities. In particular as a company they are always looking for opportunities to stitch together several things to make an even bigger thing.

For the Research Councils opening up their portfolio of investments has provided a critical interface to engage with business. This is an important two way process. The Research Councils want to engage with business to ensure that the outputs of the research and training investments are fully exploited. By opening up this interface and dialogue there is an opportunity for business to feed in their research and training needs back into the Research Councils to shape future strategies and decision making.
Goldsmiths University of London: new models of innovation and collaboration

The MA Innovation in Practice and graduate apprenticeship scheme offer businesses the opportunity to benefit from strategic thinking and expertise at an affordable price.

Mike Waller of the Goldsmiths Design Department studies innovation as a process and helps companies understand how they can cultivate and sustain a culture of innovation. His research is practice-based, taking an in-depth look at an ongoing project and using this as a starting point to enable companies to think strategically about their products, services and markets.

Waller uses his knowledge and experience to pioneer new ways in which businesses can collaborate with the university. For example, in 2007 Waller received funding from the Manufacturing Advisory Service to conduct workshops and in-person diagnostics, and to place a student at the company to help implement his recommendations. For one homewares firm, a new rapid prototyping procedure greatly increased their production speed. Another company that manufactures high-tech plastic for the automotive industry hired a new sales manager after Waller established they were missing out on major markets.

Through his work, Waller found that some companies could benefit from a longer, more comprehensive intervention, but that the cost of hiring an academic as a consultant was often prohibitively expensive, especially for SMEs which often require the most support. He identified the need to develop a higher-value offering for companies that allows them to embed innovation into their day-to-day work.

As a result Waller founded the MA Innovation in Practice. This course enables a company chief executive or other member of senior management to sign up for the MA to work on a discrete project, which would form the basis of an in-depth study of the practice of innovation. Alternatively, a student could ‘champion’ the project on behalf of the company on the MA programme, thus embedding knowledge within the organisation in a way that would be impossible through conventional consultancy.

Following an ERDF-funded pilot, the MA launched in 2010 and has grown from a single student to ten by 2013-14. The model has been adapted by Trinity College Dublin and Kyung-Hee University in South Korea, which have launched similar programmes in collaboration with Goldsmiths.

The MA has also formed the basis of a new Innovation Apprenticeship scheme, which is linked to the London Fusion awards and opens up training in innovation and unique, strategic thinking to companies who specialise in anything from manufacturing to the digital and creative industries.

The award programme offers £10,000 vouchers for companies to purchase consultancy from a university. Under the apprenticeship scheme, half of the £10,000 can be used to fund an MA student who is placed at the company while the remainder pays for a team of expert mentors from across college. The package offers extraordinary value for the company which benefits from a team of long-term consultants for the price of one short-term project. Two SMES are currently benefiting from this scheme: Innovare Design, a retail design consultancy, and RollyGolf, a company developing motorised trolleys for the luxury golf sector.

There are challenges associated with this model, such as those arising from the increased cost of higher education and differences in cultures between universities and companies, which may not think to look to an MA programme for project support. However, these are not insurmountable and as such the MA Innovation in Practice and the Post Graduate Innovation Apprenticeships both offer unique ways of leveraging university teaching expertise, innovation, and a hands-on approach to collaboration and consultancy.
Policies for collaboration
The benefits of research collaboration have long been recognised by those working in the public and private sectors as reducing transaction costs and delivering economies of scope and scale by pooling risks and exploiting synergies across partners.

While these benefits most often relate to collaboration between firms, several also apply to collaborations between universities and business.

Through collaboration, academics seek to access industrial capabilities and resources, to commercialise research ideas or test their commercial potential, to develop ‘real world’ links or to develop potential career pathways for students. Firms seek to access leading-edge research knowledge, research infrastructures or research services, to develop in-house capabilities or to identify potential future employees, and so on.

A recurring challenge, encountered in even the most advanced and innovative economies, is that the outcomes of publicly-supported research often fail to be effectively translated into new products, processes and services for the benefit of the private sector and society more broadly. Consequently, there is a long tradition of implementing measures to foster longer-term cooperation between science and industrial actors and these now represent a significant part of the portfolio of innovation policies in many countries.

Howells, et al. (1998), note that industry-academic links can be traced back as far as the late 19th century where they represented the main mechanism by which industry funded research. However, it was not until the 1970s when their industrial and policy significance began to be fully recognised.

Given the compelling motives for science-industry cooperation to occur endogenously, what justifies the use of public resources for its support? Cunningham and Gök recently reviewed for NESTA reasons for and the effectiveness of policies to foster science-industry collaboration.

Collaboration is important for bridging boundaries within the innovation system. It also enables the sharing of knowledge, skills, capabilities and competencies in order to promote innovation and drive competitiveness.
More specifically, collaboration allows:

- Human and capital resources to be combined leading to outcomes that cannot effectively be achieved independently.

- Higher quality and more effective, integrated and robust outcomes, since each partner brings a differing perspective and experience to the process.

- Development of critical mass and overcoming fragmentation caused by factors such as distance, diverse jurisdictions and a smaller resource base.

- Government and government agencies to be partners, rather than just facilitators, particularly when promoting public good, not-for-profit research, and solving social and environmental problems.

- The cross-fertilisation of ideas and mutual understandings, nurturing commitment to decisions and outcomes.

- The formation of linkages between research providers and research end-users, encouraging the transfer of skills and knowledge and the translation of new ideas into products and services.

- The sharing and management of risk in high-risk areas.

An extensive array of measures to support collaboration has been developed by governments and, over time, there has been a shift in their primary rationale, from addressing barriers to ‘technology transfer’ to enabling ‘knowledge transfer’. This shift in policy objectives aims to optimise a broader range of innovation modes which build on a systemic view of innovation, involving less tangible interactions and feedback loops between parties. Consequently, a more sophisticated policy design is needed in order to optimise the full range of potential benefits that may arise from the collaboration.

A short typology could encompass the following categories of support measures:

- Project-based approaches – grants and subsidies conditional upon collaboration.
- People-based approaches – industrial secondments or studentships.
- Multi-actor networks either co-located (Science Parks, Collaborative Research Centres) or facilitated by technology (virtual networks) or new approaches such as Technology Strategy Board’s Catapults.

Higher Education Institutions also undertake collaboration independently of any formal support mechanism:

- Knowledge-based approaches – licensing and IP, generally at the level of individual institutions; spin-outs.
- Informal contacts and advice provision.
- Contract and collaborative research performed for industry.
- Property-led initiatives in the form of science parks.

Despite a plethora of governmental support complemented by universities’ own initiatives, evidence from a range of studies indicates that significant barriers to science-industry cooperation persist. O’Kane (op. cit.), found that although businesses that engaged in collaboration were 70 per cent more likely to achieve ‘new to the world novelty or creative innovation’ in Australia, such collaboration was much more likely to occur with other firms rather than with research organisations, universities or governments. The data showed that of the 26 per cent of innovating businesses, only some 2 per cent were engaged in collaboration with HEIs.

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Similarly, work by Cohen, et al. (2002) found universities had two different roles – suggesting new ideas and completing existing projects: universities were less important in the innovation process than other industrial actors. Moreover, the most important sources of spill overs were informal meetings, publications and conferences.

These findings are consistent with more recent evidence for the UK: data from the 2011 UK Innovation Survey shows that, only 3 per cent of responding firms ranked universities and other HEIs as of ‘high importance’ sources of information for innovation. Government or public research institutes were ranked ‘high’ by 2 per cent of responding firms. Thus, it seems that significant barriers to science-industry collaboration remain. What might these be?

Despite its headline finding that “Since the Lambert Review there has been a huge change in both the quantum and the quality of [UK] business–university collaboration”, the Wilson review of university-business collaboration cites research conducted by Imperial College which points to a number of reasons why university-business collaborations may not progress beyond the stage of initial discussions.

These are:

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

Part of the problem lies within the overall policy mix within which universities operate. Internal conflicts with incentives faced by research were already noted by Howells et al. (1998) and later by Lambert in his 2003 review. The Research Excellence Framework (REF) is the process by which UK university block grant funding is allocated and is designed to follow research quality (as per the so-called Haldane principle). Lambert noted that “on the one hand, [the REF] has helped to raise the quality and productivity of research in the UK. On the other, it has tended to homogenise the research efforts of the entire university system by driving all universities to aspire to the same benchmarks. It may also have encouraged universities to take on more research work than they can sensibly afford”. The funding mechanism induces competition for high quality, single author publications and the implications for career progression of being perceived as not ‘research active’ can provide disincentives to business-university collaboration.

Although policy attempts have been made to re-balance the ‘incentives seesaw’ in favour of interaction with business through for example the Higher Education Innovation Fund, the internal perception of the overriding importance of the REF perhaps requires modification from within, to shift the balance of career progression towards a more receptive view of business collaboration alongside academic and teaching quality.

It should be noted that this analysis is based on a simplistic view of collaboration. In addition to knowledge exchange, further modes of collaboration can be found that address motivations such as skills, graduate or industrial training, enhanced employability prospects, etc. As noted by Wilson (2012), university-business cooperation operates within a rich ecology of interrelationships (often involving a diversity of intermediaries) and that the motives underlying such cooperation are diverse. The success of any government interventions will be highly dependent on the ecology within which they operate.

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“The course allowed me to explore new processes and technologies I would otherwise not have had available to me”

The Access to Masters Scholarship Programme provides students with access to skills, experience and contacts.

For many students, the ability to undertake postgraduate education can be hindered as a result of the high costs. The Access to Masters (ATM) programme aims to address this challenge.

The programme, which is backed by the European Social Fund (ESF) and the Welsh government, provides both financial support and access to business – a core element of the programme being that students are linked to an external partner company. This partner benefits from both the Masters student's time via a work placement and from the postgraduate research project, which is tailored to meet the company's interests and needs.

One student who has benefited from the ATM scholarship is Ben Mazur who completed an MSc Advanced Product Design at Cardiff Metropolitan University in 2010/11. At the heart of his Masters was a collaborative partnership with Dagge Design. Mazur says he has seen real and lasting benefits from the ATM, which helped him focus his talents and launch his own studio:

"After graduating from Cardiff Met in 2010 with a BA (Hons) in Product Design, I still didn't quite feel confident to enter industry and be able to stand out from the thousands of other graduates of that year. I felt that, although I had attained an excellent degree, my skills hadn't had enough time to fully develop and I hadn't found out what I really wanted to do.

A Masters in Advanced Product Design had always appealed to me, but without the help of another loan it would have been prohibitively expensive. Bethan Gordon, my lecturer at the time, told me about the Access to Masters (ATM) scheme and suggested I apply for it. After contacting potential collaborators I found a company, Dagge Design, which was willing to participate in my studies. This enabled me to receive the European Social Fund (ESF) grant, which paid for my tuition fees and gave me a monthly maintenance allowance. As a result of the funding I was able to spend more time studying and not have to worry so much about income from design work.

The course allowed me to study completely independently and explore new processes and technologies I would otherwise not have had available to me. It gave me the opportunity to hone my skills, focus on my goals and develop professionally. In addition to passing my Masters with Distinction, I am in the process of securing patents and taking the results of my major project, a lifesaving surgical device which has been praised by surgeons from The Welsh Institute of Minimal Access Therapies, to market in partnership with Cardiff Met.

The ATM scheme has allowed me to gain the confidence and expertise in business and manufacturing to set up my own product development studio and to work with many companies of all shapes and sizes from around the world."

Ben Mazur, Access to Masters scholarship recipient, Cardiff Metropolitan University

For more information, visit: www3.cardiffmet.ac.uk/english/bussinessservices/pages/accesstomasters.aspx
In August 2013, a £4.2m ($7m) research centre - the BP Centre for Petroleum and Surface Chemistry - was officially opened at the University of Surrey. The aim of the centre is to study recovery processes related to viscous oils, minimising the cost to the environment and enabling the development of these hydrocarbon energy supplies for the future.

The opening of the centre was the culmination of a long-term collaboration between the University of Surrey and BP, which began as a result of research undertaken in 2010 by Professor Spence Taylor, then a visiting researcher at the university and previously a BP employee. At this time, Professor Taylor had been conducting small-scale research projects within the University of Surrey's Department of Chemistry. BP's own in-house research facilities had been scaled down over previous years, and the combination of Professor Taylor's experience with the level of facilities available at the university made it ideally suited to support a new project in BP's Heavy Oil team.

For several months, Professor Taylor worked as an integral part of the BP team. In 2011, it became clear that the project would demand greater resources to support the project's growing remit. In May 2011, Professor Taylor proposed that the University of Surrey could provide facilities and expertise, for relatively modest investment.

The proposal was a departure from BP's usual way of conducting research. However, with ardent support from Chris West, Vice President of Heavy Oil at BP, it is now a model that may be repeated by BP in other research areas.

In negotiation, potential pitfalls around ownership of intellectual property and publication of results were avoided by sensible acceptance of both partners' positions. BP understood that academics need to publish, and the university respected BP's commercial position in maintaining confidentiality and technology ownership. This led to the signing of contracts in September 2012.

"In any process of collaboration it is important to get to know the partners, establish trust and set clear expectations and goals. In particular, it is imperative that the partners' wider teams are engaged in achieving these shared aims. From fellow researchers to lawyers and accountants, everyone in the process is instrumental, and needs to trust and be trusted," says Professor Taylor.

Under the agreement, the relationship between the university and BP has grown. Through the centre, BP has access to a wide pool of expertise and facilities across the faculty, aside from those within the centre itself, offering value for money and greater collaborative opportunities. For the University of Surrey the partnership marries industry and academia, and provides students with the opportunity to gain hands-on industry experience.


**Can university-business collaboration enhance private investment in the research base?**

The UK Research Partnership Investment Fund (UKRPIF) was established by HEFCE on behalf of the Department for Business Innovation and Skills, in response to the additional capital funding that was announced in the 2012 Budget, initially £100m.

The UKRPIF supports higher education research facilities and aims to attract investment in university research as a means of strengthening the contribution of the research base to economic growth. To date, the fund is supporting 22 projects across 19 universities, and the combination of grant funding and contributions from business and charities means that over £1bn is being invested in UK science and research.

It will help accelerate research and reduce new product discovery times relevant to a range of sectors including sustainable energy, home and personal care, pharmaceuticals, paint and coatings, thus helping to drive economic growth and UK competitiveness.

Another project supported by the UKRPIF is a £90m partnership between University College London (UCL) and Great Ormond Street Hospital. The Centre for Research into Rare Disease in Children will combine the specialist research expertise of the UCL Institute of Child Health with the unique patient cohort at Great Ormond Street to find treatments and cures for rare diseases, of which more than 6,000 have been identified.

The new Centre will provide around 13,000m² of dedicated laboratories, cutting edge technology and equipment and offices for up to 400 world-leading scientists and clinicians. Adjacent to Great Ormond Street Hospital and the UCL Institute of Child Health, the new facilities will offer a creative and dynamic environment for teams to focus on core research areas.

Professor Rosalind Smyth, Director for the Institute of Child Health, said “this new Research Centre will accelerate discoveries in Rare Diseases into improved patient care throughout the UK and beyond.”

In the 2013 Spending Round, the Chancellor of the Exchequer announced a further two years of funding, extending initiative to 2016-17 and making available at least £100m each year of match-funding to leverage private investment in science infrastructure.
Water security is an issue that has steadily gained prominence, especially as businesses are forced to react to new environmental realities. No resource is more precious than water, and waste through leaking pipes has long been at the top of the list of consumer complaints. A partnership led by Balfour Beatty and including Liverpool John Moores University, JD7 and Balfour Beatty Utility Solutions has the potential to completely revolutionise how companies find and work on water leaks.

Bringing a variety of different skills to the table, this collaboration is working on building the first complete in-pipe assessment vehicle which can perform optical and acoustic inspection of pipes without the need switch the mains supply of water off. This is likely to save time for road users especially and cut cost for companies needing to carry out essential maintenance. The project, known as the ‘Subaqua Assessment Vehicle for Water Infrastructure’ or the SAVE Water Project, has proved so innovative it has secured £200,000 from the Technology Strategy Board to enable further development.

The grant is part of more than £2.5m of funding going to several projects and studies aimed at addressing water security challenges in the UK and overseas. Building on existing technologies developed by JD7 and already being deployed by Balfour Beatty’s Network Intelligence unit, the project will develop the first complete in-pipe assessment vehicle which will work in live conditions.

“This project will certainly provide a vehicle for academics at Liverpool John Moores University to demonstrate the impact of their niche and unique sensor system in order to provide the water industry a step change in real time monitoring,” says Professor Ahmed Al-Shamma’a of Liverpool John Moores University.

The hope is that this project and similar ones will provide a working model which can be used throughout the water industry now and in the future. Larger organisations can take advantage of new technologies and drive this into their existing operations as well as looking at emerging opportunities which may previously have not been explored. Meanwhile smaller companies can benefit by moving quickly to develop and market new products while exploiting the gravitational pull big companies inevitably have.

Developing and exploiting technologies is a challenging process for any company, requiring innovative design coupled with a practical validation and trialling process. Collaboration between academia and the world of business will allow all phases to be addressed from as early as concept level and right through to implementation and marketing of the product.
The role of intermediaries
In today’s increasingly globalized innovation landscape a number of significant changes have emerged that reflect stronger international competition, increased technological complexity of goods and services, and the emergence of new opportunities to exchange knowledge between organisations, such as the use of multiple web-based platforms.

These changes have facilitated the rise of more ‘distributed’ or ‘open’ models of innovation¹. The need to coordinate decentralised processes of knowledge generation and diffusion has brought to the fore the role of institutional interfaces and specialist firms whose main objective is the transfer of scientific and technological knowledge². These organisations facilitate the diffusion of knowledge, and directly manage or support the translation of research into commercially-viable knowledge suited to the solution of specific industry needs³. They act as ‘knowledge brokers’ – or ‘intermediaries’ – in the process of innovation⁴.

Innovation intermediaries can bridge the gap between universities and industry, and connect the domains of basic and applied research with the market (Figure 1). They can be either internal or external to the university system⁵. University technology transfer offices are typical ‘internal’ intermediaries, while research and technology organisations that may work with, but are independent from, higher education institutions (HEI), can be defined as ‘external’ intermediaries. These can be private businesses, such as specialist service providers, or publicly-funded organisations, for example, national labs or intermediaries such as the Fraunhofer Society in Germany, VTT in Finland or TNO in the Netherlands.

The content and mode of knowledge exchange with or through any intermediary will vary with the nature of the knowledge base, the applicability of intellectual property rights, and the expected value, scope and objective of the transaction⁶. External intermediaries can be especially important in conducting activities at the exploratory – or experimental – technology development phases.

Bridging the gap: innovation intermediaries

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These may be hard to finance through alternative funding sources (including venture capital) and can only be managed with difficulty in a university environment, where the incentives of science predominate over commercial imperatives, and where the costly process of scaling up operations to meet market targets may be difficult to achieve (Figure 2).

External intermediaries operate in a mission-driven or market-driven environment designed to address specific societal or industry needs. They have to combine enough ‘absorptive capacity’ in basic science with strong applied skills. These pre-conditions are associated with investments in infrastructure and training for the development of emergent technologies and for solving technical problems that client firms may not be able to address on their own. In so doing, intermediaries often seek to attract in their local contexts of operation key and otherwise missing elements of industry value chains, and to create a focal space for the exchange of knowledge. Part of this knowledge will need to be retained locally if such institutions are to contribute directly (through the creation of skilled jobs) and indirectly (by boosting the innovative capacity of local clients) to regional economic growth.
Activities and performance

Over the last few years UK universities have intensified their engagement with business, even though great unevenness remains across industries and between large and small firms in the likelihood and volume of collaborative activities. When we consider the activities of internal intermediaries, the performance of UK universities is very strong on a comparative international basis for a range of metrics that include the number of licenses executed, licensing income and number of spin-offs. However, the returns from these market-facing activities are extremely skewed and are highly concentrated among a minority of institutions. In addition, formal technology transfer – despite its important supporting role – is neither the most frequent form of engagement between universities and business, nor the one that generates the highest income. The most important form of engagement by far are the personal interactions between individuals, while it is contract research activities and collaborative research that are most commercially valuable.

In the private sector, the UK has remarkable strengths in external intermediation in the professional business service sector, which includes areas as diverse as design services, architectural practices, R&D and engineering consulting, etc. Taken as a whole this sector is responsible for a growing share of turnover and employment, and is an important positive contributor to the UK balance of payments. Technology development consultancies in particular have been a fundamental driver of entrepreneurial growth in the high-tech economy by applying a research contract model, which essentially de-risks the process of innovation, these firms use their unique expertise to solve problem for clients. In so doing they operate very close to market needs, but over longer periods also accumulate new knowledge which they adapt, extend, protect and utilise to generate royalties and/or spin out new businesses. A good example of this is the high-technology cluster in Cambridge, where the high concentration of successful businesses has helped the city cement its reputation on the global high-technology stage.

By contrast, the UK has lagged behind international competitors in the development of publicly-funded intermediate research organisations. The UK science and technology infrastructure counts a number of research and technology organisations, including national labs, but concerns have been raised about their ability to work on a sufficiently large, coherent and sustainable scale, in particular for the development of emergent technologies. The erosion of the UK manufacturing capabilities and a perceived need to increase investments and improve the connection with the high-performing science base have led to growing interest in organisations such as the German Fraunhofer system. In these and other ‘open innovation’ intermediaries, publicly and privately funded researchers are co-located in substantial new facilities and can collaborate at a pre-competitive technology development stage, such as the Flemish Inter-University Micro Electronics Centre (IMEC). Recent estimates suggest that European research and technology organisations have an aggregate turnover between €18.5bn and €23bn. It is extremely difficult to identify precise returns on investments for these intermediaries, but it has been suggested that for every €1 in subsidy that is invested in these organisations as much as €25 of turnover is indirectly generated in beneficiary companies. This estimate excludes the long-term social benefits of R&D and is therefore a likely underestimation of full returns through upskilling and the renewal of applied technological capabilities.

It is also apparent that successful intermediaries are deeply engaged with universities and that even though some overlap, and therefore competition, is possible between the two, their role is broadly complementary. Engagement takes the form of joint projects, publications and appointments (most notably the Directors of Fraunhofer Institutes are professors at local universities), and PhD, personnel training and students’ placements, often prior to their move to industry. This guarantees an effective transfer of knowledge through project outputs and people, which can have pervasive positive effects on the problem-solving capacity of the innovation system.

In the course of 2010 and 2011, the UK government coordinated a process of consultation that led to the establishment of the Catapult Centres, a new set of innovation centres designed to operate close to the market interface while being strongly connected with the research base in the development of selected technology platforms. The programme, overseen by the Technology Strategy Board, was originally allocated a budget in the region of £200m to provide core-funding, which was to be integrated with contract research income from industry of between £5m to £10m per centre for five years (renewable upon evaluation). In March 2013, further funding was committed to expand the network of Catapults as part of the 2013 Spending Review for 2015-6. This complements the recent expansion of the new Small Business Research Initiative (SBRI) and strengthens the prospects of short and long-term social returns through a revitalised industrial strategy for the UK economy.
Boeing co-founded the Advanced Manufacturing Research Centre (AMRC) in partnership with the University of Sheffield in 2001. It is a proven, effective collaboration between business and academia which has become a model for research centres worldwide because of its industry-led focus.

At the close of the 20th century, University of Sheffield Professor Keith Ridgway and local businessman Adrian Allen began working with Boeing to apply Sheffield’s traditional industrial expertise in metallurgy and engineering to new materials, focusing on machining research. The AMRC was subsequently established as a £15m collaboration between the University of Sheffield and Boeing, with support from Yorkshire Forward and the European Regional Development Fund.

At present, Boeing works with the AMRC to develop advanced manufacturing technologies that will help reduce the time and cost of producing aerospace products while improving their quality and performance. The areas of research capabilities include machining, composites, assembly, structural testing, design and prototyping. The results of the research and development are applied to aerospace manufacturing in the UK and worldwide.

The AMRC partnership with Boeing has grown considerably since it was established, and now has over 70 industrial members – from global leaders such as Rolls-Royce, BAE Systems and Spirit AeroSystems, through to local specialist SMEs. These members help to spur the development of new manufacturing technologies that enhance the competitiveness of the UK’s industry across a broad spectrum of sectors, not only in aerospace but marine, automotive, nuclear and medical as well. The AMRC has worked with hundreds of other companies on specific projects to improve their capabilities and competitiveness.

The University of Sheffield AMRC campus is expansive, having grown from a single building into a world-leading cluster of industry-focused manufacturing R&D centres since its inception less than 15 years ago. Its two core research facilities – the original Advanced Manufacturing Research Centre with Boeing (launched in 2001), and the Nuclear Advanced Manufacturing Research Centre (launched in 2009) - are both part of the government-backed High Value Manufacturing Catapult. Other centres on the campus include the Castings Technology International (CTI), the National Metals Technology Centre (Namtec), the AMRC Knowledge Transfer Centre and the new AMRC Training Centre, which provides training in the practical and academic skills that manufacturing companies need to compete globally. Furthermore, the AMRC is currently preparing to expand further with a new state-of-the-art facility: Factory 2050.

Boeing is proud to work with a number of universities in the UK. The company values these relationships highly, as they develop innovative new technology partnerships and business concepts, as well as providing education and training for Boeing employees and potential new recruits.

Boeing’s investment also stimulates new capital investment in the UK industrial base, which support companies in their efforts to maintain a competitive edge.
Thinking big and being bold were the hallmarks of the UK’s most brilliant engineer - Isambard Kingdom Brunel. These are also qualities that underpin the work of the university that proudly shares his name.

One of Brunel’s current major collaborations between academia and industry is the £30m National Structural Integrity Research Centre (NSIRC), due to open its doors in January 2015.

The NSIRC mission is to extend the working life of products, plants and the essential building blocks of civilisation. In a world underpinned by ageing infrastructure this work will become increasingly critical and of great practical importance.

“From oil rigs to aeroplanes, railway lines to power stations, metal fatigue, corrosion and wear are engineering enemies, explains the university’s Vice Principal, Professor Geoff Rodgers. “Traditionally the UK has been in the forefront of research into the design, service life and safety of products and structures but five years ago we were beginning to pick up the early warning signs that our lead in the field was under threat.”

“In addition, the pace of development of new materials is increasing. To safely unlock the potential of nanotechnology and other novel materials we need to understand them deeply or risk product failure or wasteful overdesign,” he adds.

Brunel University has a long history of collaboration with other universities and with industry, which it uses to help strengthen its students’ team-working and problem-solving skills that are fundamental to an engineer’s mindset.

This collaboration places the university in a strong position to reach out at senior level and address the engineering challenges that are facing UK plc. today.

For example, the university hosts the Engineering and Physical Sciences Research Council (EPSRC) Centre for Innovative Manufacturing in Liquid Metal Engineering (LIME) in collaboration with Oxford University and Birmingham University. EPSRC-LIME enables Brunel to tap into other centres of structural integrity science excellence and present a ‘united universities’ front to industry.

Another pivotal relationship is the one that has grown up between structural integrity specialist TWI, a renowned research and technology organisation, and the Brunel Innovation Centre (BIC), which has a history of rapidly-moving research in areas such as ultrasound to real industrial applications with a strong emphasis on non-destructive testing. BIC operates with the aim of developing financially sustainable research that draws up the university’s existing strengths and complements the applied research and development activities of TWI.

The success of these aforementioned projects have supported the development of the NSIRC centre, says Professor Rodgers.

“Without those strong foundations and relationships, the NSIRC project would not have got off the ground as quickly as it did or attract very significant sums of on going financial support from industry.”

The lessons learned as a result of these experiences have been valuable. For example, potential industry partners move at different cycles and at different speeds, which means working with a pool of potential partners is crucial.

“They will come into the project over time so it’s important to be pragmatic and accept that ‘not right now’ does not mean never,” says Professor Rodgers. “We would certainly like to achieve further collaboration and are already working on a similarly large and ambitious industry and university project.”

For more information on the National Structural Integrity Research Centre, visit www.nsirc.co.uk
The Technology Strategy Board is the UK’s Innovation Agency. Our goal is to accelerate economic growth by stimulating and supporting business-led innovation. Fostering collaboration between business and universities is an integral part of fulfilling this ambition.

We help business on the innovation journey with a range of activities and programmes, each focused on helping to solve specific innovation challenges. Many of our programmes directly enable or rely on effective collaborations between business and universities, for example Catapults, Catalysts, Collaborative R&D, Innovation & Knowledge Centres, Innovation Vouchers, Feasibility Studies, the Knowledge Transfer Network (KTN), and Knowledge Transfer Partnerships (KTP). Around two thirds of the business-led projects we invest in involve academic partners.

We are keen to strengthen our programmes that support university-business collaboration, for example, in 2014/15:

- **We will continue to develop and expand the Innovation Vouchers programme**, to help smaller scale business gain access to the external knowledge they need to support or enable innovation activity.

- **We will maintain the pipeline of high quality KTP proposals and support at least 800 active partnerships.** KTPs build sustainable capacity and capability to innovate in businesses which do not already have the ability to engage in successful open innovation (with academia) and in particular, businesses that need a step-change in capability to maximise the potential for new growth opportunities.

The businesses we work with (large and small) tell us they value interaction with research institutions, and vice versa. However, while it is recognised that the UK’s universities are of extraordinary quality and are definitely open for business, there is a sense that we have only just started to unleash this potential. We work with partner organisations that share our objectives and goals to improve this position for the UK. In particular, we have strong and well-developed relationships with the Research Councils (RCs) and the UK Funding Bodies.

- **We will develop our relationships with partners to further improve the national co-ordination of our strategies and investments to increase business-university collaboration and broaden our engagement with research base stakeholders.**

- **We will continue to work with NCUB, Research Councils and Hefce to assess how to use intelligent brokerage to help more businesses collaborate with universities and enable easy access to relevant innovation assets.**

The House of Commons Science and Technology Select Committee inquiry *Bridging the Valley of Death: Improving the Commercialisation of Research* reported that there were difficulties encountered in the commercialisation of UK academic research and support for early stage businesses.

- **We will work with partners in the research base to seek better ways to align academic research with commercial potential and the appropriate routes to exploitation.**
YASA Motors is a company based on an Oxford invention – the Yokeless And Segmented Armature (YASA) electric motor. This highly advanced electric motor is smaller, lighter and cheaper than any competing technology, yet powerful enough that in 2013 Lord Drayson used it to set a new World Electric Land Speed Record of 204mph.

YASA, however, faced some challenges. The initial designs, developed by founder and CTO Tim Woolmer in his Oxford DPhil research, were complex and time-consuming to manufacture, while a lack of a suitable cooling system was holding back their potential.

YASA contacted Oxford Brookes University, hoping to tap into its expertise in advanced materials and joining technology. Engineer James Broughton and Knowledge Transfer Partnership (KTP) Manager John Corlett worked with Charles King, Director at YASA, to design and submit a successful proposal for a KTP, which was awarded £100,000 of funding from the Technology Strategy Board.

Broughton, himself a Brookes alumnus, further recruited Jonny Biddulph, another Brookes graduate in mechanical engineering, who brought his insight and commercial experience to the role of project leader and KTP Associate.

Broughton and Biddulph worked closely with the YASA team over two years designing, testing, redesigning and launching new components and processes. The university enabled access to labs and equipment that the fledgling company could only dream of, alongside knowledge of materials such as carbon fibre and joining technology such as sophisticated resins. The project was supported by Gill Rysiecki of the Technology Strategy Board (TSB), who contributed a wealth of experience in university-business partnerships.

By the end of the KTP in early 2013, motor production time had been reduced from seven days to two. Material use had been reduced, and defect rates were down ten-fold. The cost of a key component was reduced from £95 to under £10. On the commercial front, the company had won a large contract with a major vehicle manufacturer, and made significant inroads into industrial markets. The motors were adopted for the Jaguar C-X75 supercar, dubbed ‘the most technologically advanced roadcar ever conceived’, which resulted in the company being shortlisted for the SMMT Award for Automotive Innovation.

YASA’s latest focus has turned to a new engineering challenge – the question of motor cooling in high speed applications. YASA and Oxford Brookes believe it is possible to discover a new approach which can both increase power while keeping weight, cost, material usage and heat generation low.

Off the back of their success, the partners designed a second KTP to research this further. It was approved by the TSB in September 2013. Siew Yan Goh, recruited from her PhD at Liverpool John Moores University, is the new KTP Associate, while thermodynamics expert Stephen Samuel was appointed academic supervisor from Oxford Brookes. Biddulph, who now works for YASA as a materials engineer, supervises her on behalf of the company. The innovation cycle continues.
Innovations from the tech and biological sectors in the agriculture industry have often been fraught with tension, caught between farmers who fear price cuts and dying traditions and consumers weary of where their food comes from. However, one tool that has so far received little resistance is the Cool Farm Tool (CFT). Created by the University of Aberdeen in partnership with Unilever and the Sustainable Food Lab, it provides information about farmers’ greenhouse gas emissions and tips on how they might lessen their environmental impacts.

The computer-based tool - also aimed at processors and retailers with sustainability schemes - has already been successfully used by a number of market leaders including PepsiCo, Marks & Spencer, and Costco. PepsiCo has embedded the Cool Farm Tool in their 50-in-5 target - reducing carbon emissions and water use by 50 per cent in five years. It has also used the software throughout the group, including on more than 80 UK potato farms which supply Walkers crisps, something that has led to benchmarking and the development of carbon action plans, both for the organisation and for individual farmers. PepsiCo plan to expand to other crops within their Quaker Oats and Copella brands.

The CFT has spawned an institute of the same name, which has the mission of helping farmers and the businesses they supply make informed on-farm decisions to reduce their environmental impact. Although in the first phase it will primarily serve as a vehicle to distribute and support the use of the CFT, it will also collate data and case studies to provide advice on the best environmental practice for farmers.

CFT was developed by Dr Jon Hillier and Professor Pete Smith of the Environmental Modelling Group at the University of Aberdeen. The group has a global reputation and influence, with Professor Smith being the convening lead author for the mitigation chapter of several Intergovernmental Panel on Climate Change (IPCC) Assessment Reports and Science Director of Scotland’s ClimateXChange.

Emissions from agricultural production are difficult to quantify due to geographic variability and differences in practice between land users. Many retailers and processors have no means to calculate on-farm emissions which limits their ability to implement sustainability programmes.

The tool provides a tailored emissions profile and suggests likely beneficial mitigation options, such as the use of more efficient fertilisers, using different technologies, better soil carbon management, or looking again at the energy they are using for storage.

“Cool Farm Tool is a farmer-friendly greenhouse gas calculator which will allow estimation of a greenhouse gas footprint within minutes, and then provides the opportunity to test and compare other more sustainable options,” said Dr Hillier.

“Cool Farm Tool will be available via the Cool Farm Institute which has been founded with the initial support of PepsiCo, Unilever, Marks and Spencer, Tesco and Yara. The institute fundamentally believes that more can be achieved by collaboration with and across industry, working together to share methods, knowledge and findings,” he added.

For more information, visit: www.coolfarmtool.org

University of Aberdeen: pioneering an e-farming tool

With support from Unilever and the Sustainable Food Lab, the University of Aberdeen has developed a new open source website that aims to help farmers work more efficiently.

University of Aberdeen: pioneering an e-farming tool

CASE STUDY BY UNIVERSITY OF ABERDEEN
Rolls-Royce University Technology Centre in Heat Transfer and Aerodynamics

Designing high performance jet engines in partnership within state-of-the-art facilities brings about benefits for Rolls-Royce and a new generation of aerothermal experts.

Business Challenge

The UK Aerospace Sector is a successful, high value, high technology manufacturing industry that is second in size only to the USA. It generates over £20bn per annum in value added revenue and employs over 100,000 directly, and over 220,000 indirectly. The aerospace industry is one of the UK’s largest exporters, adding around £2.8bn annually to the UK trade balance. The industry is also one of the major industrial supporters of research within the UK. The conditions in the jet engine core, specifically the pressures and temperatures, present immense technical challenges to engine designers. These conditions are the context for designers who need to ensure optimum performance of the engine components. Optimum component performance is critical to the successful business case for new jet engines for commercial use. The challenge for Rolls-Royce is to remain globally competitive – especially in the technology used in aeroengines.

How Did the University of Oxford Help?

The UTC at Oxford has researched the highly complex flows inside the gas turbine for many years and has provided key insight into the flow physics of the engine. This research involves the construction of highly complex wind tunnels, turbine test facilities and instrumentation. The UTC is based at the Osney Thermofluids Laboratory which houses a world class set of experimental facilities. Recent investment in the building and its infrastructure exceeds £10m and has led to the establishment of one of the most impressive aircraft propulsion systems laboratories in the world. The total value of grants to the research group now exceeds £16m with the number of students and staff exceeding 50. The research capability at Oxford includes world class expertise in the numerical methods used to predict how gas flows behave.

Real Business Results

The UTC has provided research that has had a direct effect on the fuel burn of the Boeing 787 and other aircraft. Research outcomes formed the basis of two REF 2014 Impact Case Studies with very significant savings of aircraft CO2 emissions.

The UTC has provided highly trained aerothermal engineers for gas turbine companies (including Rolls-Royce) for many years. This benefit to Rolls-Royce was recently formalised by the introduction of a Centre for Doctoral Training (jointly with Cambridge and Loughborough) in Gas Turbine Aerodynamics.

What our Client Says

Rolls-Royce is very proud of its relationship with Oxford which spans over 4 decades. Rolls-Royce was delighted when, with considerable support from the University in 2010, the UTC was relocated to the world class facilities in the Southwell Building.

The work in the UTC has supported our turbine technology throughout this time. Developing and maintaining a critical mass in aerothermal research and training PhD students with the requisite skills remains a high priority for the Company. Rolls-Royce is pleased to note that the national importance of UK leadership in aerospace has been further evidenced by recent Government announcements such as the UK Aerodynamics Centre and the Aerospace Technologies Institute. We expect the UTC in Heat Transfer and Aerodynamics to play a key role in these new Government/Industry initiatives.
Building collaboration capacity in universities
The circulation of knowledge in and out of universities is a critical element in the chain of activities that turn research into wellbeing. However, formal recognition of – and a funding policy for – knowledge exchange (KE) as a core activity in universities is a relatively new idea that raises both challenges and opportunities.

One of these challenges is to ascertain how to compare performance of KE activity across universities or countries in a consistent manner that is representative of the many channels in which knowledge circulation makes a difference¹. In the last ten years, the UK has made significant progress in developing this paradigm to include activity beyond technology transfer and this progress that has been recognised by both the European Commission² and the National Academies in the US³.

One of the hindering elements in the application of these new paradigm across countries is the lack of common structures for assessing KE beyond specific outputs such as patents or licenses. Such countable outputs are partial and evolve up and down rather than continuously up or down. The UK is tackling this challenge by focussing on tracking the progress of its KE funding by using cost benefit evaluation to demonstrate the social returns on public investment in KE (around 6:1 on average⁴). While this evidence gives good reason for investing in these activities, by focusing on the absolute contribution to society, it will almost always lead to the conclusion that the larger higher education institutions (HEIs) which have been good performers, will continue to do well. This, in turn, renders the smaller institutions less visible because of their size, despite potentially being as effective or even more so compared to their larger counterparts.

Early rounds of funding followed – in part – resource allocated in generic indicators (such as staff numbers) so as to enable HEIs to develop their potential in KE. It was expected that, as KE matured within the sector, robust metrics would emerge to monitor progress, justify and allocate public investment in these activities. What maturity has shown is that forms of and benefits from KE activities are so diverse that a thorough evaluation would incur a disproportionate cost⁵.
Even within the well-rehearsed Higher Education Business and Community Interactions survey\(^6\) a clear distinction is drawn for indicators that are suitable for comparisons, such as income streams, and those that are less robust and require assumptions, for example, how much SME consultancy equals one new spin-off company.

Some of the above difficulties can be tackled using existing data by relaying performance as the relative growth in KE activities, instead of comparing the absolute contribution of each HEI to the total. Considering relative growth rates gives all HEIs the same chance of outperforming the average, irrespective of how large or small they are. Moreover, considering cumulative growth rates over a number of years offers the advantage of comparing HEIs using their own trend in KE activity and in doing so purging away short-lived events such as, for example, a bumper year in income from IP sale or the closing of a research unit.

Such trend analysis based on growth rates is common in international comparisons of economic performance, so as to treat smaller economies of countries such as Sweden in fair terms with the larger ones like the USA. The traditional analysis of trend growth in output across countries is to look at the relative importance of inputs such as capital or labour in explaining cumulative growth of Gross Domestic Product (GDP) over a number of years\(^7\). Smaller economies may be growing faster than the larger ones because they are investing more in efficient inputs such as education and disinvesting in less efficient inputs such as raw labour. Trend analysis of inputs not only compares units regardless of scale but also gives an indication of what inputs are more important in explaining growth.

Figure 1 illustrates how trend analysis of KE activity can be used to assess performance over time for a random selection of UK HEIs. The indicator of success is the growth of income from KE activity over the four years to 2011/12. This indicator of success depends on the behaviour of four components of KE activity: Consultancy, Contract Research, Continued Professional Development (CPD) and Facilities & Equipment. These four components were selected in principle because they are less volatile than others such as licensing but refinements of this initial analysis could feasibly include not only more components of KE income but should also consider other resources within the HEI. After all, the growth in KE income is intrinsically related to other activities in the HEI and considering these determinants may provide a fuller understanding of KE income growth.

Figure 1: Trend analysis of KE growth 2007-2012 (blue line); Trend growth of KE components at the average (bars) and difference between actual and average (stripped peaks). Positive peaks indicate higher performance in KE management than the average.
The solid line in Figure 1 shows actual KE income trend growth across HEIs. For illustration HEIs are sorted by size with the larger closest to and the smaller furthest from the vertical axis, and for a good scale spread, the larger have a total level of KE income in 2011/12 which is 25 times larger than the smaller. It is evident by the height of the blue bar that some of the smaller HEIs to the right hand side grow faster over four years than the larger HEIs to the left.

What makes some HEIs perform above others? Some degree of luck may be present but since this is trend growth over four years it is arguable that internal management of KE resource is more likely to be at work.

Each HEI arguably manages KE activity so as to balance opportunity and resource. Where an opportunity arises and the resource is not available, some HEIs may choose to reallocate resources to take up the new opportunity while others may let the opportunity pass and maintain course. HEIs that manage to allocate KE resources to their best uses will perform above the average. In the absence of information about KE management within HEI we use the relative importance of each of the four components of KE income to identify HEIs that are doing better than the average.

What is the average performance in KE trend growth?

We fix the weight of each of the four KE components (Contract Research, Consultancy, CPD and Facilities and Equipment) in the individual total to be equal to the average weight of that component across all HEIs. This gives a bespoke average for each HEI where the trend growth is the one they chose (or could afford given demand) but the importance of each component is the same for all HEIs. This transformation separates HEIs on the basis of the trend growth they chose (or could afford) as follows: HEIs that invest in those components that have higher individual weight than the average will experience higher KE growth than average. Equally, HEIs that are disinvesting in a component where they do not have a comparative advantage over others.

KE management in this context is about exploiting comparative advantage and rebalancing investment across KE activities when the resources are scarce. In as much as smaller HEIs face more constraints in KE income and in KE demand, they are more likely to have directed management of KE resources. Those which balance resources to match opportunity better appear as higher performing than the rest, regardless of scale.

It is plausible that some of the apparent under performers are in the middle of a rebalancing process and therefore this analysis is valid only in the period 2007 to 2012. High and low performers may change positions if they do not respond to incentives in policy and demand for KE, some of which are driven by scale. In England for example, Knowledge Exchange funding is currently allocated through the Higher Education Innovation Fund (HEIF) on a pro-rata basis with funds being allocated to HEIs on the basis of their proportion of total sector activity. Funding is only provided to HEIs which are above a certain – relative – activity threshold which is consistent with the evaluation data available at the time which found a positive correlation between total KE income and return on public investment. This formulaic allocation mechanism indirectly links KE resource availability (HEIF funding) and KE resource management therefore both elements should be borne in mind for a proportionate view of the whole HE sector.

Given that both of these dimensions are pertinent to the strategy and impact of KE activity, a hybrid approach of scale and management performance has the potential for providing better responsiveness of HEIs to autonomous changes in the supply of and demand for KE and incentives for policy. Such a hybrid approach may also help counterbalance inertia in the current system where the best predictor of future KE income is current income.

When Scott Rutherford, Director of Research and Enterprise at Queen’s University Belfast (QUB) joined the university in 2011, he discovered an interesting trend. “Our publication volume was growing faster than that of our peers,” he says, “but there was room for improvement in our global league table performance.”

The university turned to Elsevier, the world-leading health and science publisher, to help them to understand its situation. This led to a unique three-year partnership between the two organisations. QUB set the objective of increasing both citation impact and international reach through the development of institutional partnerships in focus countries. With Elsevier’s support, the university seeks to embed an understanding of citation indicators into its research strategy development.

“The objective was to improve the understanding of bibliometrics: what they mean, how they’re used, how they drive league table performance and, most importantly, how that information can be made useful for research decision-making,” says Rutherford.

With the support of Nick Fowler, Managing Director of Elsevier’s Academic and Government Institutions, the wider Elsevier team was engaged within the project and through the sharing of knowledge an informed strategy for resolving the challenge was developed.

Pilot programmes embracing this strategy are currently being rolled out across QUB, helping academics develop specific, evidence-based action plans which collectively contribute to the institution’s research strategy.

The result so far has been an innovative approach to informing an institution’s research strategy using publication and citation metrics. The programme has enabled university faculty to interrogate data, deepen their understanding of methodology and draw out key lessons for enhancing citation impact.

“It’s gone beyond analysing citation trends and a comparative assessment of Queen’s current position - we are now developing tailored and evidence-based action plans that are focused on effecting change at the research group level.”

Jonathan Greer, Research Information Manager, QUB

The university has supported researchers to take advantage of citation as an increasingly important tool. At the university’s School of Psychology for instance, which took part in the pilot programme, it was clear many of its researchers were not in the habit of careful and comparative monitoring of citation impact. “The school has now set up a lab visit exchange scheme to increase international linkages, which is a key driver of citation impact”, says Rutherford.

Key to the success of the partnership has been overcoming initial scepticism from academics. A series of workshops provided by Elsevier ensured that academics became comfortable with the approach and had the tools to use the data and analyses effectively within their schools.

The partnership has been so beneficial that Elsevier is using the same approach to initiate similar programmes at other institutions. The company aspires to take this concept further by facilitating a network of like-minded institutions, leveraging citation-based analyses across the entire institution to inform and drive the success of its corporate strategies.

“We worked with Scott’s team to share knowledge in such a way that it could be used to not only answer the initial question, but also help inform and determine strategy”, says Elsevier’s Fowler. “This was a fantastic learning experience for us and the first programme of its kind for Elsevier.”
AstraZeneca: driving scientific innovation through a collaborative post-doctoral programme

Connecting like-minded individuals from across industry and academia is helping to meet the needs of patients around the world.

In 2011, global pharmaceutical company AstraZeneca began an organisation-wide post-doctoral programme in the UK to help push the boundaries of novel science and support scientific discovery.

Previously, the company’s approach to post-doctoral study was ad hoc and fragmented, says its Vice President of Strategy - Respiratory Inflammation Autoimmunity iMed, Rose Maciewicz. “This new programme is designed to encourage greater interaction with academia, bringing more people into the lab to undertake cutting edge science and help develop and inspire the next generation of talented, scientific minds,” she says.

The programme funds post-doctoral projects originating from across the research areas and scientific disciplines within the company, addressing fundamental challenges that underpin drug discovery and development. This generates opportunities for academic researchers to innovate not only in the UK, but across the company’s other research sites in the USA and Sweden too.

Five calls for project proposals have been made since the programme began – with both the number and quality of ideas increasing each time. At the end of 2013, more than 1,000 proposals had been evaluated by a panel of its internal senior scientists, with a rigorous selection criteria focused on novelty and scientific quality.

There are currently about 80 post-doc projects underway, of which more than a third are based in the UK.

“When industry and academia come together, great ideas grow,” says Maciewicz. “Our programme is the perfect platform for this collaboration.”

Each project initially spans two years, and wherever possible an external academic supervisor maintains the connection by working closely with the student. The company’s first post-docs are now in the final stages of their projects. As they consider whether to return to academia or stay within industry to build their careers, AstraZeneca recognises the importance of maintaining closer working relationships between academia and business to stimulate innovative science.

One such example is Ilenia Giangreco. Working with the Cambridge Crystallographic Data Centre (CCDC), one of AstraZeneca’s established collaborators, Giangreco’s project developed new protein-ligand overlay algorithms that enables a better understanding of these complexes. The CCDC has now recruited Giangreco and, as AstraZeneca moves its UK research to a new Cambridge headquarters, her supervisor Dave Cosgrove, Principal Scientist at AstraZeneca, hopes the collaboration will continue to grow. “It is a definite plus having these sorts of relationships with academia. The post-doc programme creates exciting opportunities for further collaboration and idea generation”, he says.

The programme has made a positive impact elsewhere across the company too. Mene Pangalos, Executive Vice President - Innovative Medicines and Early Development, says:

“Not only has it raised the quality of our scientific research, it’s helped us to create an open, collaborative environment where great science and blue-sky thinking can really thrive.”

“The programme speaks to our core values of scientific leadership,” adds Maciewicz. “We are building relationships with the external world and as students leave us, hopefully they will be good ambassadors for AstraZeneca.”

As a result of its success, AstraZeneca plans a further expansion of the programme in 2014 and is working with colleagues in academia to identify more ways to connect like-minded individuals who share a passion for resolving the unmet needs of patients around the world.
Are emerging research nations capitalising on international knowledge exchange through talent mobility?

The circulation of people is a key driver for the exchange of knowledge between industry and academia. This exchange of knowledge is associated with inter-sectoral mobility and improves the efficiency of innovation systems (OECD 2013¹) through two channels. Directly, it spreads problem-solving capabilities in the research workforce that would otherwise remain in the same position and perhaps go unused. Indirectly, it supports what is known as ‘innovation absorptive capacity’, defined by Cohen and Levinthal (1990²) as the ability of firms to assimilate novel ideas developed elsewhere. People moving in and out of the academic sector, for example, enables faster and better absorption of academic knowledge outside academia.

Academic knowledge is also highly mobile internationally. Not only do academics move in response to research opportunities, they take ownership of their findings through publications that often have a global reach. In international settings, innovation absorptive capacity is a critical factor in a country’s ability to keep pace with advancements in the research and development of its competitors. By scrutinising the movement of academics across sectors and countries, it is possible to provide a good indication of the relative position of a nation with respect to its competitors.

To cover mobility fully we would need to follow people every time they move within and across countries. Even if we could identify ‘researchers’ equally across countries, there is no centralised global tag system to follow researchers moving in the globe. Still, it is possible to get a picture of mobility which, albeit incomplete, can be informative. The 2013 BIS report on the performance of the UK research base³ (Figure 7.11) captures mobility through the affiliation of publishing authors between 1996 and 2012. This method is partial because it excludes research personnel who did not publish and research personnel who did not change affiliation between sectors or across countries in all these years. However, it is meaningful because it includes exactly the same information for all countries and can therefore be used to look at relative positioning of nations.

The closeness of the dotted lines to one another in the chart shows that within country there are similar levels of movement in and out of academia into industry. High circulation of talent domestically is observed in USA, Japan, China and Brazil.

The international balance of exchanges between academia and industry shown in the bars tells an interesting story: the academic sectors in Canada, Italy and Russia import more industry talent from abroad than domestically (grey bars taller than grey dots), and export more academics to industry abroad than domestically (blue bars taller than blue dots). Similar patterns, though less pronounced, occur in China and India. Is this higher exchange of knowledge internationally than domestically the way to cover absorptive capacity that cannot be grown internally?

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² Absorptive Capacity: A New Perspective on Learning and Innovation. Administrative Science Quarterly 35(1).
Launched in 2010, the Plymouth Graduate Internship Programme (PGIP) is an example of how Plymouth University works in partnership with employers from across the South West region to enhance the employability of its graduates and stimulate economic growth. The PGIP creates short-term paid internships for graduates of any UK university or further education college. These internships are developed specifically to be graduate-level and to provide an opportunity for the intern to apply a range of skills, assume real responsibility, make an impact and aid their progress into becoming a successful professional. The PGIP is an opportunity for employers in the region to expand their workforce and tap into graduate learning, while also receiving financial assistance towards the intern's salary. The scheme also offers a soft entry point for employers to build confidence in working with the university.

Plymouth University has developed a simple process for employers to register their vacancy and scope out suitable job roles. Vacancies are advertised internally and through graduate agencies, sending employers relevant CVs from which to select and interview. Internships are contracted for a minimum of eight weeks with an expected salary of £300 (minimum) per week.

Through Plymouth’s combined internship service 84 graduates have been hosted in 60 businesses. The programme has already helped to boost employment in the South West, with a significant proportion of companies retaining their interns on permanent contracts. A sample survey was conducted in November 2013 to 20 intern-host companies with results showing that 70 per cent were retained, 14 of which were employed directly with the company and one who worked freelance.

One example is that of Bluestone360 Ltd, a Plymouth-based brand communications agency, which became involved with PGIP in 2010 at a time when they required additional resources to meet increased demand.

Working in partnership with the PGIP, they recruited graduate interns to roles such as copywriter, account executive and junior designer. The programme's success helped inspire the company's 2012 launch of the Bluestone360 Academy, the first and only long-term graduate development programme in the South West. It offers graduates six month internships, helping them gain full time employment and keeping creative talent in Plymouth.

“Our long term relationship with Plymouth University paid off when we needed to grow our multimedia design team,” says Mervyn Orchard, Director of Bluestone360.

“We have been able to recruit talented graduates, who have brought with them cutting-edge ideas and talents, which are driving up our capabilities resulting in an increased demand from existing and new clients.”

The internships provide graduates with the opportunity to enhance their practical skills, build relationships with prospective employers and enhance their overall employability. Having students work on live projects with clients on a commercial basis demonstrates how PGIP can evolve into a sustainable model that is self-financing. Bluestone360 and Plymouth University are now discussing how to take this collaboration to the next level, exploring possibilities such as expanding this model to undergraduates.

Further information on PGIP, and other Plymouth University Enterprise Solutions, can be found at enterprisessolutions@plymouth.ac.uk
Alta Innovations Ltd is the University of Birmingham’s 100 per cent owned subsidiary technology transfer company. It recently sought to commercialise a number of new intellectual property patent opportunities in the area of medical diagnostics.

Following an initial approach from the management team of Abingdon Health, a specialist medical diagnostics company operating in London and Oxford, Alta Innovations facilitated the establishment of Bioscience Ventures Limited (BSVL) - a joint venture between the university and Abingdon Health that aimed to develop new diagnostic tools for markets where there are currently unmet needs.

The management team at Abingdon Health has extensive experience of the healthcare diagnostics markets and a profound understanding of healthcare customer base, making them ideal partners to support the development and commercialisation of medical diagnostics intellectual property originating from the university.

The Alta Innovations team played a key role in establishing the BSVL joint venture, working externally with Abingdon Health to develop the market case for the various elements of the business, and internally within the university to gain joint venture buy-in from university management. The team also facilitated the necessary co-investment and the establishment of an appropriate governance structure.

One challenge to address was the high cost of experienced management. Another was that university intellectual property (IP) is often patented early in order to allow publication. This often makes it too immature to realise significant value, while the time needed for further development means the university’s commercial stake is diluted.

The BSVL joint venture approach has provided an efficient alternative to the normal models of commercialising university intellectual property. It has allowed high management costs to be shared across more than one medical diagnostics opportunity, and has ensured that individuals with sector-specific commercial experience could facilitate rapid product development. By developing a project which was managed by commercially experienced industry professionals and partnered with the world class IP and technology developed at the university, the collaboration creates maximum value for the inventors, the university and the joint company.

Since its formation in 2010, BSVL has received investment from both partners of £2m to accelerate development. Today, BSVL is a centre of excellence for the commercialisation of medical diagnostics and services. Its creation has enhanced and expanded the commercial applications of IP created by the university, focussing on diagnostic areas such as oncology, infectious diseases and genetic diseases.

In the two years following the launch of the venture, the chemical analysis and speciality chemicals manufacturing entity based on campus has become a profitable focal point, employing 16 staff. Two further subsidiary companies have been created too – Serascience, a specialist cancer diagnostic company, and Linear Diagnostics, which recently secured a £392,000 award from the Technology Strategy Board to fund a project diagnosing pathogens in harvested crops.

The skills and experience of Alta Innovations staff have been instrumental throughout, collaborating on and developing commercial opportunities with Abingdon Health, while managing the necessary relationships within and outside the university. The success of this venture was recognised with the prestigious Open Collaboration Award in 2012.
According to the World Intellectual Property Organization (WIPO), in 2012 around 50,500 patent applications were made by UK-based applicants to all patent offices in the world, ranking the UK seventh globally.

While on the face of it this ranking would appear to be a positive one, the gap between the UK and the countries above it was substantial. China, for example, made over 560,000 applications in that year, earning the country top position. Meanwhile, Japan and USA followed in second and third place with each over 480,000 and 460,000 applications respectively. The first European country in the league is Germany in fifth place with nearly 179,000 applications, 3.5 times the UK number. In addition, the proportion of applications that were filed outside their home patent office was 5% in China, 41% in Japan, 42% in USA and 59% in Germany, while in the UK 40% were filed domestically and 60% abroad.

These aggregate figures relate to economies which differ greatly in terms of their size, GDP, population and R&D efforts. When performance ranking is normalised to show total patent applications to all patent offices per billion R&D expenditure in real US dollars (2005 base year), a very different picture emerges. In particular, the relative position of the USA changes dramatically from top to bottom while the UK moves from seventh to 11th place behind countries like France, Sweden, Denmark, Finland, Germany, the Netherlands, China, Korea, Japan and Switzerland.

Arguably some patents are more valuable than others. One indirect way of addressing value differentials is to compare countries on the basis of patent applications lodged under the Patent Cooperation Treaty (PCT). Under the PCT an inventor can file a single international patent application with one patent office, which will simultaneously open up to it the option of seeking protection for an invention in the signatories to the treaty which cover more than 140 different countries. Such applications are likely to be considered of potentially more value than purely national applications. Scandinavian countries, Japan, Germany, Korea and France all scored higher than the UK when ranking countries by PCT applications per unit of R&D spend.
Patent applications draw on the knowledge of inventors who may not be domestically based or nationals of the country where the application is filed. This implies that a country’s inventive assets may not be fully reflected in domestic patent applications but the national inventors may well be informing innovative activity elsewhere. Figure 1 shows that UK inventors are cited in PCT patent applications more often than inventors in all other countries in the comparison group. This is evidence that UK inventive capacity is being exploited by business located overseas and increasingly so. The top users of UK inventive assets in their PCT patent applications are the United States followed by Germany and the Netherlands.

Figure 1: Foreign ownership of domestic inventions, 1999 and 2010.

Source: OECD.Stat. The share of a country’s inventors cited in PCT patent applications (EPO designations) where the applicant is located in a different country.

Patent applications draw on the knowledge of inventors who may not be domestically based or nationals of the country where the application is filed. This implies that a country’s inventive assets may not be fully reflected in domestic patent applications but the national inventors may well be informing innovative activity elsewhere. Figure 1 shows that UK inventors are cited in PCT patent applications more often than inventors in all other countries in the comparison group. This is evidence that UK inventive capacity is being exploited by business located overseas and increasingly so. The top users of UK inventive assets in their PCT patent applications are the United States followed by Germany and the Netherlands.

Figure 2: Distribution of PCT applications by type of applicant, 2012.

Source: (WIPO, 2013a).
Conversely, when looking at the proportion of domestic patent applications which draw on foreign inventors, Switzerland emerges as the country with the highest proportion of PCT patent applications citing foreign inventors (over 60 per cent), whereas the use of foreign inventive capacity is less prevalent in the UK which at 20 per cent ranks 8th among the comparators.

Collaboration with inventors from other countries is also quite prevalent in the UK, with a quarter of PCT applications which cite a UK inventor also citing an overseas inventor which ranks UK third among comparators after Switzerland and Canada.

Moving from usage of the overall national invention capacity to commercialisation activity by universities is difficult in a cross-country context. The limited data which exists suggests that the UK’s level of intellectual property (IP) income generated by universities per unit of national R&D spend is similar to that for Canada and Denmark, but less than half of the figure for USA. IP disclosures per unit of national R&D are, in contrast, relatively high by international standards and by 2011 were substantially higher than the ratio for the United States, Italy, Spain, Denmark and Canada³.

One way of assessing the importance of university patenting for national performance is to express it as a share of a country’s total patenting applications. Figure 2 shows the top 15 countries of origin of PCT patent applications in 2012. The top row shows the share of businesses applications in the total. The stacked bars show that the UK has a comparatively small share of business sector patent applications but the highest share for the university sector. University patenting is therefore a small, but relatively important feature of the UK patenting landscape.

Focussing on the UK performance only, Table 1 shows that there are three universities among the top ten PCT patent applicants with levels of activity comparable to large R&D intensive businesses. The dependence of these universities on inventors born abroad is higher than that of business. This is important evidence of universities’ role in attracting inventive talent to locate in the UK science base. The relatively low rates of inventors born abroad among businesses may well be a reflection of the multinational scope of these businesses which allows them to access overseas knowledge through their overseas subsidiaries rather than through immigration.

### Table 1: Top ten PCT applicants from the UK for the period 2006-2010.

<table>
<thead>
<tr>
<th>UK’s Top PCT Applicants (2006-10)</th>
<th>Number of Applications</th>
<th>Number of Inventors</th>
<th>Inventor Immigration Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilever Plc.</td>
<td>594</td>
<td>1,536</td>
<td>10.4%</td>
</tr>
<tr>
<td>Glaxo Group Limited</td>
<td>409</td>
<td>1,590</td>
<td>12.6%</td>
</tr>
<tr>
<td>British Telecommunications Plc</td>
<td>389</td>
<td>861</td>
<td>20.2%</td>
</tr>
<tr>
<td>BAE Systems Plc</td>
<td>305</td>
<td>644</td>
<td>3.2%</td>
</tr>
<tr>
<td>Imperial Innovations Ltd</td>
<td>246</td>
<td>648</td>
<td>29.8%</td>
</tr>
<tr>
<td>ISIS Innovations Ltd</td>
<td>242</td>
<td>618</td>
<td>29.8%</td>
</tr>
<tr>
<td>Dyson Technology Ltd</td>
<td>237</td>
<td>579</td>
<td>10.4%</td>
</tr>
<tr>
<td>AstraZeneca UK Ltd</td>
<td>210</td>
<td>640</td>
<td>8.2%</td>
</tr>
<tr>
<td>Cambridge University</td>
<td>205</td>
<td>572</td>
<td>36.6%</td>
</tr>
<tr>
<td>Qinetiq Limited</td>
<td>185</td>
<td>458</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

Source: (WIPO, 2013b).

Global analyses of patenting activity conceal complex internal relationships between the sources of invention and the usual indicators of success in inventive activities. The composition of the domestic inventor base and the usage of domestic invention abroad complement and explain the cruder rankings based on total counts of patent applications and demonstrate increasing interdependency of innovative capacity between universities and business and across countries.

King’s College London and GSK: a winning combination for the London 2012 Olympic and Paralympic Games

The advances made throughout this partnership will support the wider anti-doping community.

For the London 2012 Olympic and Paralympic Games, King’s College London worked in partnership with GlaxoSmithKline to provide world-class anti-doping laboratory services. This was the first time a pharmaceutical company and a university had partnered to provide this service for any Olympic Games since SmithKline Beecham supported the Atlanta Organising Committee in 1996 and worked with the Morehouse School of Medicine.

The Drug Control Centre at King’s College London, led by Professor David Cowan, is the only World Anti-Doping Agency (WADA) accredited laboratory in the UK. It is a world-leading centre with a strong track record in anti-doping control, analysing samples collected from athletes competing in major sporting events and training worldwide. However, there was insufficient space to be able to equip and staff the size of operation required for the 2012 Olympic and Paralympic Games.

Using GSK’s project management experience, the pharmaceutical company worked with King’s, LOCOG and UPS, the logistics company responsible for sample delivery to the laboratory, to understand the details of the project. A project management team was put in place and a detailed plan was developed and implemented. GSK’s experience of large-scale operations also provided King’s with a huge resource base that it would otherwise have had to find elsewhere.

Communication and knowledge-sharing was key: King’s brought scientific expertise in relation to anti-doping and GSK’s support allowed testing to be run on an industrial scale, bringing an understanding of how to run a facility 24 hours a day and manage effective and efficient shift changes.

Method development, a system by which tests are validated to provide reliable data for regulatory submissions, was an important feature for a research-focused institution such as King’s, and as such this was encouraged and supported by the partners. A number of new technologies were also introduced to test for banned substances.

During the London 2012 Games, a team of more than 150 anti-doping scientists analysed over 6,250 samples at the hi-tech WADA-accredited satellite laboratory in Harlow making it the largest project of its kind to date.

King’s and GSK shared their combined knowledge and lessons learnt with the International Olympic and Paralympic Committees and WADA, as well as the Rio 2016 team, which they hope will provide a blueprint for future Games.

GSK’s involvement with London 2012 brought the company closer to the world of anti-doping. It signed a groundbreaking agreement with WADA to provide information on medicines in development, in order that tests for the possible abuse of such substances can be identified in advance and ensure that anti-doping is ahead of the curve.

Science played a key role in assuring that the Games were as clean as possible and conducted to the highest ethical standards – the successful partnership between King’s College London and GSK enabled this to happen.
In 2004, China overtook the USA to become the world's largest beer market. While the competition in the UK is growing fierce amongst the main brewers, niche markets present a golden opportunity for microbrewers to thrive.

UK beer duty regulations mean that brewers making under a certain volume of beer are entitled to a lower tax rate. As a result, the number of craft brewers in the UK has increased by seven percent per annum. A significant proportion of these breweries are based in the Midlands.

The University of Nottingham has been supporting 20 such microbrewers across the East Midlands to find success through a project which helps them develop beers to be sold in China. A team from its brewing science department partnered with the regional Food and Drink iNet (Innovation Network) to help microbrewers develop stable, bottled conditioned beers suitable for export. This included helping them increase their quality control processes and enjoy greater consistency of product by measuring qualities such as alcohol by volume, CO2, microbial stability and shelf life.

After this developmental phase, the team had to find a way of exporting the beers to China in order to maximise the University's extensive experience in the country, where it has a campus in Ningbo.

Clements Marketing, a local East Midlands company, was contracted by iNet to work with the microbrewers on exports, guided by market intelligence provided by the University's Asia Business Centre (ABC) and the UKTI. Clements Marketing worked with businesses to develop market entry strategies and to link themselves with beer importers in China.

The Asia Business Centre further organised a beer tasting focus group on the Jubilee Campus, where Chinese students commented on the beers and the proposed pricing. ABC also linked Clements Marketing with the University's Ningbo Campus once a week, enabling students to provide ongoing feedback about the beers via video conferencing.

Speaking about the collaboration Alan Clements, Managing Director of Clements Marketing, says: “We are reaping the benefits of the pool of expertise located in Nottingham as well as at the University's Ningbo campus in China. In addition, we have also employed nine students who have helped us in a variety of areas ranging from market research to translation.”

As a result of the successful collaboration between the university, Food and Drink iNet, UKTI and Clements Marketing, a number of beers from the microbrewers are already being exported to merchants in Shanghai, Ningbo and in Chengdu, Sichuan province.

Alex Buchanan, Marketing Manager at the Thornbridge Brewery in Derbyshire, says the University and Clements Marketing provided his company with “excellent support” and “an understanding of the Chinese market.”

“This is a very good example of how we can help small and medium sized businesses,” say Mike Carr, Director of Business Engagement at the University of Nottingham. “Our technical expertise, unrivalled links and knowledge of China and South East Asia have helped to give Midlands microbrewers a significant competitive advantage.”

University of Nottingham and Clements Marketing: taking British beer to the Chinese market

Microbrewers in the Midlands are finding export success with the help of science and market research.
Every good employer cares deeply about recruiting, developing, retaining and promoting their workforce.

How could it be otherwise in a rapidly-changing economy where the internet is simultaneously opening up opportunity, allowing rapid entrance from global competition, and disintermediating whole parts of supply chains? And yet, many businesses still worry that the talent pathways from school into university or college and then out into business and the public sector are still far from delivering the right mix of skills, attributes and character.

Everyone – parents, schools, pupils, undergraduates, employers and government – has a vested interest in sharpening up the analysis of how young talent is developed and employed. But as well as understanding this problem, the challenge is to change it and deliver an educational pathway that fits with a knowledge-based economy.

In my first essay in this report, I wrote of the need for a systems-level understanding of innovation. And this is true also of ‘the talent pathways’. Take this example from the CIHE’s Great Expectations report where we advanced a possible journey of Josephine Fox, who was born in 2012 and became a graduate recruit in 2030.
By the time she has been recruited Josephine has benefited from a national mentoring scheme, problem-solving maths and physics teaching in schools, a placement programme, business sponsorship of her degree, and targeted development of her communicative and interpersonal expertise. And by the time she is in her second job, she is doing advanced manufacturing leadership programmes and developing the kinds of competitive maturity needed to drive the business forward.

High-quality talent pathways require world-class infrastructure support, systematic development programmes and open and collaborative engagements between interested parties. In an ideal world, market signals and information would flow from the career portfolios of those who had before gone back to parents, who are a child’s first advisor, and then through the talent supply chain. But we know that such pointers are imperfectly mediated in families and through teachers, and that we have some way to go to understand how universities and industry can communicate market information more effectively through, say, social media.

Crucially, we are still not clear about which parts of the tool kit work in the talent pathway. For example, research by the Institute of Physics on pupils studying physics and chemistry ranked the following factors as the most influential on the career choices:

### High-influence factors
- Enjoyment of physics and chemistry, future ambitions, perceptions of careers with a physics or chemistry degree, and the relevance of physics and chemistry study to life.

### Medium-influence factors
- The way physics and chemistry are taught, physics and chemistry teachers, images of scientists and the work that they do, and family influences.

### Low-influence factors
- The difficulty of physics and chemistry, role models, careers advisors and peers.

And yet, the CIHE’s research on girls who had studied STEM subjects and had not gone into physics and engineering at university showed clearly that the right role models (i.e. younger women, not older men), and lack of careers advice on the economic value of a degree were hugely influential².

So, what role can big companies play in this complex space? Many have good outreach programmes, and are deeply committed to their industries. However, the inability to bring high quality female talent into the engineering workforce shows that all of us involved in the talent pipeline can and must do more to coordinate programmes and methods.

One of the most powerful roles big companies can play is in the coordination of their supply and value chains to engage with schools, and offer placement schemes for as many undergraduates and postgraduates as are willing to take them up.

Let me illustrate with media – the industry I know best. In the 1980s, the Conservative government imposed a quota on the BBC and ITV that they take 25 per cent of their hours from independent producers. This became mandatory in 1993, and completely transformed the TV landscape and created a sector worth over £2.8bn a year by 2012³. As Deputy Director of Television, I was responsible for ensuring that we hit those targets working with the BBC’s commissioning teams and channel controllers.

I was conscious of significant cultural differences between in-house and the emerging independent companies. The former were still embedded in big battalions with strong top down command and control mechanisms where even the mavericks (and there were many) were surrounded by planning quotas and requirements to use BBC facilities.

The independents were either old media hands who had left the big two for whatever reason, or they were young guns who had been serving Channel 4 since its launch in 1982. Companies crewed up quickly, were forced to trust their young talent, and either delivered and went on to glory or floundered and died.

I bring up this ancient history because the BBC and ITV became absolutely reliant on smart, innovative supply chains in their programming. These days we would call it open innovation. The vertically integrated broadcasters had to open up to external ideas and create systems for collaborative working with production talent and R&D they no longer controlled. But even this value chain exploded as the internet transformed the whole industry.
The evolution of the value chain for the UK television sector.

### Traditional Value Chain

**Commissioner**
- Channel Director
- Head of genre

Broadcasters are responsible for: Financing production, setting specific prog. budgets, and making commissioning decisions

**Editorial**
- Writer & agent
- Script editor

Write script and raise funding
Proof read and edit scripts

**Logistics and planning**
- Location locators
- Talent scouts

Visit venues, liaise with owners
Identify acting talent

**Production**
- Schedulers
- Camera & sound

Establish the order of filming
Operating and maintain equipment

**Post-prod.**
- Editors
- Special FX

Cutting together the film and sound
Adding special FX to the footage

**Marketing**
- Promoter

Ads by broadcasters’ mkting dept

**Distribution**
- Broadcaster
- VHS / DVD prod.

Broadcast programming viewers
Production and distribution of video

**Retailer**
- Specialist retailer
- Generic retailer

Stock management systems, in store promotions, shelf-stackers and sales staff

### Internet Enabled Value Chain

**Commissioner**
- Crowd funding
- Online platforms
- Sponsor

Finance is more readily available through online channels end individuals - e.g. Kickstarter.
Digital content is commissioned by emerging platforms and advertisers, such as YouTube.

**Editorial**
- Software engineer

Generic software developers provide the tools to make efficiency gains.
Companies such as Cambridge Imaging Systems make existing content digital and searchable, which helps the ideas generation process.

**Logistics and planning**
- Location website
- Talent search site

This role is outsourced to generic location finding companies online.
Online services allow talent search to take place more easily - powered by the IT sector.

**Production**
- Generic software
- Freelancers

Software companies such as Setkick provide production management software for the film and TV sectors.
Digitalised has opened up production process to SMEs and freelancers.

**Post-prod.**
- Software engineer

Cloud storage, digital content management, and editing software companies have brought efficiencies to the production process from outside of the TV sector.

**Marketing**
- Online sources

Promoted via online platforms, such as YouTube and Twitter, which are supported by IT infrastructure.

**Distribution**
- ISPs
- Streaming sites

Telco’s increasingly deliver content to viewers’ main TV sets.
Digital content is marshalled by cloud storage companies for streaming services Netflik, YouTub and IPlyer.

**Retailer**
- Online retailers
- Streaming sites

Retailers such as Amazon and Netflix rely on IT infrastructure to reach consumers.
Distribution and retail are closely related and largely digital.

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**Key**

- Core creative industries
- Movement towards the enabling industries
- Movement towards unorganised content producers

Source: Stakeholder interviews, Oliver & Ohlbaum research and analysis.
The BBC needs young talent in-house in each of these boxes, but crucially it needs to foster high-quality people across its whole supply base. Despite all of the changes in the broadcasting industry, the Corporation remains the biggest trainer. For example, working with Channel 4 and Creative Skillset it won a bid for an Employer Ownership Skills Pilot aimed at breaking the cycle of ad-hoc entry or closed recruitment.

Anne Morrison, Head of the BBC Academy notes: “This project proposes to make the BBC’s training and associated resources available more widely across the broadcast supply chain - focusing on key industry skills gaps and making it more affordable for SMEs to invest in the diverse new talent needed to drive innovation and growth.”⁴

Morrison was a member of the CIHE Task Force on the Creative and Digital Industries and she very clearly outlined the problem for the media and tech sector: “The era where we can afford multidisciplinary groups is becoming unaffordable. We need universities to develop graduates with interdisciplinary skills, or who can lead interdisciplinary teams.”⁵ Production and media technology jobs exist today that no one had even heard of five years ago, and with the advent of big data that trend will only accelerate.

This brings us onto a crucial issue - namely, the reductive nature of much of the skills debate. Too often it sounds as if policy makers believe that employers want ‘skills in a skin’. But graduate are – or should be – the future innovators and leaders of businesses large and small, as well as in the public sector. Having a set of skills relevant to the immediate few years after you leave university may not – and probably does not – equip a graduate to have a successful career. All of the other attributes that mark out a rounded higher education are of vital importance in the development of the rounded employee or entrepreneur.

The talent wars that marked the period before the recession are returning as employers recruit for growth. They want the best and are prepared to drive hard at the recruitment and reward processes to ensure that they find top talent. However, in a world of open-innovation, on-shoring, high quality business networking, and closer supply chain coordination, surely it is not enough merely to worry about your own graduate recruitment programme? Everyone in the link matters. Like the BBC, all big corporations need high quality supply chains.

So, what forms might this take? Systematic joint outreach within an industrial sector? Pledges from smaller businesses to take on placements? Contractually obliging firms to take undergraduates on work experiencing? Rotating placement students between corporations and supply chain businesses? Pooled placement schemes? Leveraging strategic partnerships between big companies and their university partners to engage and support smart specialisation clusters? Geo-specific placement schemes that recognise the anchoring role of universities?

In the past, such an approach would have been almost administratively impossible, but technology, online and social networking has created low cost possible options.

Working together, businesses and industry should be able to create regional and local platforms and offer one-stop shop solutions for parents, teachers and students.

This will enable the kinds of strong market signals needed to create more informed choices, offer relevant role models, provide a means of creating and publicising placement schemes and offering better communication platforms.

The talent pathways for the UK’s young people lead to our future workforce. Big businesses can play a pivotal role in showing the way.

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⁴ www.bbc.co.uk/mediacentre/latestnews/2012/open-channels.html
We are very pleased with our collaboration with Santander Universities and the University of York and are delighted to have found a candidate as precise and intelligent as Francesca.”

David Pickering, director, Mare Nostrum

The Santander Universities SME internship programme: providing a vital link between students and enterprise

Around 1,500 students and businesses are expected to benefit from the scheme in 2013/14.

In May 2013 Mare Nostrum – a publishing company offering business consultancy and sales and marketing services to global print and digital publishers – approached the University of York student internship bureau to recruit a sales and marketing intern. They wanted someone with excellent Italian and French language skills who could absorb and understand business models, databases and systems.

To help find a suitable candidate, the University of York worked with its partner, Santander Universities, which supports higher education in the UK through the funding of scholarships, grants and internships with small and medium sized enterprises.

Santander uses its links with universities to help place student and graduate interns for a period of three months within small businesses. Santander funds half of the internship while the SME pays for the other half. This means the SME has access to resources that would otherwise not have been available.

The programme has been running for some time and as such processes are in place which enables Santander to easily match students with employers and vice versa. The minor challenges are basic logistics such as finding a suitable three-month period in the student's academic year and at a time that works for the employer.

It is a system that has been very successful: in the academic year 2012/13, 533 students completed internships, with more than 100 subsequently being taken on as permanent employees. It is anticipated that a further 1,500 students will benefit from placements during the 2013/14 academic year.

In the case of the University of York, it was able to place one of its students Francesca Pollard, a linguistics graduate, within the intern role on offer at Mare Nostrum. The internship has given Pollard “a deeper insight into the importance of solid communication skills, as well as giving me an opportunity to gain experience for my role in a ‘hands-on’ setting,” she says.

Meanwhile, Mare Nostrum director David Pickering was so pleased with Pollard and her contribution to the sales and marketing process at Mare Nostrum that he hired her as a field sales and marketing assistant.

“Through engaging in marketing campaigns and sales work Francesca has assimilated information quickly and now has a good understanding of complex business models and products,” he says. “We are very pleased with our collaboration with Santander Universities and the University of York and are delighted to have found a candidate as precise and intelligent as Francesca.”

Pollard is equally as impressed with the Santander Universities internship. “It taught me a set of essential skills such as confidence in approaching and solving problems and in communicating with colleagues and co-workers, which will be crucial both in the continuation of my job at Mare Nostrum and in my future career,” she says.
The Nestlé Academy Fast Start programme, which has been co-created by Sheffield Hallam University and Nestlé, sees school leavers combining part-time study for a work-based learning BA (Honours) Professional Business Practice Degree and full time employment in Nestlé’s commercial functions. Successful applicants to the programme divide their time between studying with Sheffield Business School (SBS), attending the University for on average six one-week blocks per academic year, and gaining full-time work experience across a broad range of commercial roles at the Nestlé offices at Gatwick and York. Students earn a market-based salary as well as having their course fees paid for by Nestlé and are guaranteed a job at the end of the three-year degree. This scheme is the first of its kind in the food industry.

The course has been developed using the SBS Flexible Framework which allows a full programme of learning to be created that meets the exact requirements of the client organisation. In order to develop the detailed content of modules, academic staff have worked closely with key stakeholders within the Nestlé business to understand key issues and challenges of the industry and the business and make sure these are addressed through the students’ learning experience. The course has also been aligned with Nestlé’s own Leadership Framework. Being work based, assessment is designed to get students to apply their learning to workplace issues and challenges. The course culminates in students undertaking a major consultancy project within the business.

One of the challenges of delivering the course was the timescale from the contract being awarded to the predetermined date of commencement of the course, which left the partners with just six months to put together the course structure, scope and develop modules and develop the learning materials. Having the flexible Professional Business Practice Framework meant the usual time delay of validating a new award was avoided. Coordinating scoping meetings between the University and Nestlé staff also presented a challenge but the use of video-conference facilities helped to overcome the dispersed geographical locations of some of the stakeholders.

Recruitment to the first intake of the course took place over a very short time period which again was quite challenging. The University worked closely with Nestlé on this activity, both promoting the opportunity and supporting the assessment centre process. For the next intake of students this process has started off much earlier on in the year.

Although only four modules into the first year of the course, feedback from everyone involved has been extremely positive and the University and Nestlé have already contracted for a further intake of students in September 2014.
A unique MSc offers IT graduates the chance to gain valuable industry experience at the same time as a recognised qualification.

FDM Group is an international IT services provider and a leading employer of IT graduates. Its graduate programme trains graduates to a professional level and prepares them for their careers as IT consultants. Once the training is complete, consultants are placed at one or more client sites for a minimum of two years.

In 2011, FDM developed an MSc in Applied Computer Science in partnership with the University of Brighton and welcomed its first group of students onto the new FDM Master Class Programme. This programme involves an extra year’s commitment beyond the company’s traditional graduate programme.

MSc Programme Co-ordinator at FDM, Alex Linssen, says the company has “learned a lot along the way,” while developing the new course: “When we designed the MSc we had roughly equal input with the university. We have continued to collaborate ever since. One such development is that students no longer have a fixed start date - they can join the course at any point in the year.”

FDM Consultants are selected for the qualification and offered the opportunity to undertake the MSc based on their skills and their drive to achieve. Participants could be based at one of the company’s training academies in the UK, Germany or America where they receive award-winning training and guidance. FDM covers all tuition costs and chosen candidates work full-time for the company while studying and working on a dissertation project relevant to their placement.

“As far as we know, our approach is unique,” says Linssen. “And we believe it improves our chances of attracting high-calibre graduates as they can further their careers as well as gaining practical skills. We are getting a high level of enquiries from new graduates as a result of this offer.”

Both partners are enthusiastic about the programme’s capacity to successfully launch the careers of aspiring IT consultants, and to help eliminate the catch-22 scenario experienced by many of today’s graduates, where finding a first job is difficult unless they have the relevant industry experience in addition to their qualification.

The initiative has been well-received across the entire company. “This partnership is hugely exciting for both the university and FDM. We are passionate about training graduates to kick-start their careers as emerging IT Consultants,” says Sheila Flavell, Chief Operating Officer at FDM and University of Brighton graduate.

The success of the MSc has demonstrated the potential of the partnership, and as such a second programme is now in development.

For more information, visit www.brighton.ac.uk/business
How can partnerships grow talent?

There is strong evidence to suggest that placements and work experience are extremely valuable to students and employers, both in terms of their academic performance and their employability skills.

From a business perspective, placements offer employers a route to recruitment and access to skilled individuals who can bring new ideas to the company. An inherent strength of a fixed-term placement is that the employers can draw upon a temporary, and thus flexible, source of talent. NCUB’s discussions with businesses often cover how certain project requirements lend themselves perfectly to a temporary appointment, particularly for an articulate individual with higher level skills.

From a student perspective, undertaking a placement improves their chances of obtaining secure employment by enabling them to improve workplace skills, knowledge and competencies. Furthermore, work placements increase a student’s understanding of the world of work – accelerating personal maturity, self-awareness and the ability to articulate achievement. In contrast to the often individual-centred world of academic study, work placements provide a welcome space for team-based approaches.

The Real Prospects 2011, a survey involving 22,000 graduates, provides some evidence to support the value of placements:

<table>
<thead>
<tr>
<th>Percentage of respondents</th>
<th>Indicated that they had worked for their employer whilst a student.</th>
<th>22%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of these respondents had</td>
<td>been on a work experience placement or internship.</td>
<td>45%</td>
</tr>
<tr>
<td>Had been on a placement as part of their degree programme.</td>
<td>27%</td>
<td></td>
</tr>
</tbody>
</table>

To advance our knowledge of undergraduate student perceptions on their employability and the role of their university in enhancing it, NCUB surveyed 4,000 university students from across a range of 20 English universities.

The NCUB Student Employability Index is an instrument for gauging student perceptions in four areas:

- Careers and employability support.
- Part-time work, work experience and internships.
- Extent to which employability shaped subject and institutional choice.
- Sectors for future employment.

While difficult to generalise, the preliminary findings reflect well on other studies in similar areas of interest¹. For example, more than 90 per cent of respondents agree with the statement that placements, work experience and internships would be helpful, but more than half of senior (non-first year) students had not undertaken any of them since starting university.

Institutions benefit directly from more satisfied students and graduates, but the link established through this survey can also enhance university-business partnerships. If a placement experience is high quality, employers are more likely to return to that university for additional placement vacancies, as well as look for other opportunities to link up.

For some universities, placements fit within a broader, institution-wide emphasis on business engagement, forming an important part of building constructive relationships with local and regional organisations. Placements sit alongside other activities, such as knowledge transfer partnerships, continued professional development, consultancy and work-based learning, playing an integral role in developing the future health of UK businesses and students alike.

1 Wilson, Review of university-business collaboration, p.37.
2 BIS 2013. Learning from Futuretrack: The Impact of Work Experiences on Higher Education Student Outcomes. UK Department for Business Innovation and Skills.
Newcastle University’s Flying Start Degree programme, delivered in partnership by the university’s business school, PwC and ICAEW (Institute of Chartered Accountants in England and Wales) is now in its twelfth year. The programme was the first to see a top university, a leading employer, and a globally recognised accountancy body come together to offer advanced career opportunities while providing students with a full university experience.

The programme is unique in the way it prepares students for professional accountancy careers. Students graduate with a degree from a top UK university, 12 of the 15 professional exams of ICAEW’s ACA qualification, and paid work experience in years two to four with one of the world’s top professional services organisations. After completing the four year degree, successful students may be offered a full-time graduate job with PwC and complete their ICAEW Chartered Accountancy qualification.

“The strength of this course is the mix of academic study, practical work experience and professional exams; Knowledge, Skills and Experience have always been the cornerstones of training as an ICAEW Chartered Accountant.”

Shaun Robertson, Head of Qualifications, ICAEW

Since its launch, the programme has been a popular route for training business, accounting and finance students, with more than 300 applications for around 50 places available each year, and close to 85 per cent going on to graduate roles at PwC. The programme has developed consistently high academic performance. In 2013, for example, the programme saw 100 per cent of its students obtaining a first class or 2:1 degree, compared with a national average of 63 per cent.

Richard Irwin, Head of Student Recruitment at PwC, says the company took a conscious decision to keep students in university education. “It’s important that employers find a balance between academic learning and offering work experience, so that students can get the skills, the knowledge and the learning discipline to become well rounded employees,” he says.

Sponsoring a degree programme is a critical component of the PwC’s strategy to cost effectively attract the best talent. The Flying Start programme trains students to qualification level at 40 per cent less cost than the company’s mainstream graduate programme.

Classroom learning with practical work experience is an important factor too. Students find a truly integrated learning experience through the unique structure of work placements, rather than sector-standard industry sandwich degrees. “At a time when school leavers are much more actively balancing the benefits of university with those of starting their career, this programme offers the best of both worlds,” says Irwin.

Debbie Jones and Chris Soan, Degree Programme Directors for the BA (Hons) Business, Accounting and Finance programme at Newcastle University Business School, call the programme a “great success” for all three partners and a “blueprint for others to follow”. The collaboration has enabled the university to produce graduates who offer great value to employers. “Our students are ‘work ready’ and fully equipped to face corporate challenges,” they add.

Simon, a 2011 Newcastle University graduate, says participation in the programme gave him: “...lots of experience compared to my peers, and a network of contacts not only spanning the country but also globally.”

Building upon the success of the Newcastle University degree programme, PwC have subsequently launched a partnership with the Henley Business School at the University of Reading and a third programme with the University of Nottingham.
Building career portfolios in partnership
Higher level skills are a critical factor for international competitiveness and a key input in the process of innovation that generates growth and drives prosperity. It is therefore unsurprising that the market for graduates and postgraduates is under continuous scrutiny to ensure it is meeting the needs of a knowledge-based economy.

Despite recent sustained growth in the numbers of graduates and postgraduates, and in the job opportunities for the higher skilled in the UK, there remain perceived shortages of skilled recruits among employers of graduates and postgraduates. This apparent conflict of evidence is partly caused by an inadequacy of the evidence rather than fundamental flaws in the supply and demand of high level skills. Let us consider each in turn.

According to official statistics, 788,000 graduates and postgraduates qualified with a higher education degree in the UK on 2012 and around two thirds of them went into employment in the UK or overseas. The knowledge they carry to work is of value for all employers, who pay higher wages to degree holders and particularly for innovators, who employ proportionally more graduates and postgraduates than non-innovators.

More specifically, the supply of higher level skills is approximated by numbers of degree qualifiers across different subjects, with science, technology, engineering and maths (STEM) subjects often reported as leading indicators for innovation capacity. The supply of graduates and postgraduates of all disciplines increased 5 per cent year-on-year between 2007/8 and 2012/11 in the UK, so despite fluctuations within year in some disciplines, there has been sustained net growth in all of them in recent times. Sustained growth in supply has been slowest in Subjects Allied to Medicine (0.4 per cent yearly) and Computer Science (1 per cent yearly) and fastest for Business and Administrative Studies (10 per cent yearly) and Engineering and Technology, Mathematical Sciences and Mass Communication and Documentation, all with yearly growth rates of 8 per cent in the last four academic years.

³ BIS 2013 (May) First findings from the UK Innovation Survey (Revised) Science and Innovation Analysis. London: Department for Business Innovation and Skills.
Traditionally, the demand for graduates and postgraduates is approximated by employment levels, which move with the economic cycle rather than with education policy and can swing greatly within a year. For example, employment in the year to June 2013 increased by 16 per cent in real estate and fell by 1.5 per cent in the water sector, however over the five years to June 2013 employment grew the equivalent of 4 per cent year-on-year in both sectors. The demand for higher level skills goes far beyond accounting for employment opportunities however, and concerns the quality of recruits, as much as the quantity.

Multiple direct surveys of employers point towards skills shortages that are removed from specific subject knowledge, and relate to more general attributes that enable workers to use their specific knowledge in a practical and efficient way⁴.

Conversations with NCUB employer members suggest that practical skills, flexibility and adaptability to change are attributes now sought to distinguish the best recruits among the increasing number of candidates with adequate subject specific knowledge. The consulted employers do not anticipate fundamental changes in Higher Education delivery at the expense of poorer subject knowledge, but would welcome a way forward based on joint responsibility between universities and business, supported by better feedback, a shared infrastructure, staff and student mobility and co-development of provision.

Recognising how staff and student mobility contribute to growing those generic skills that are perceived in short supply is a key part of the way forward. In the shorter run, job mobility can also help bridge the gap between a supply of skills based on disciplines and subject knowledge and a demand for skills seeking agility and delivery beyond subject knowledge. Job mobility is the wheel that moves external labour markets, where employers seek the talent to fill positions that cannot be filled through promotion within the organisation⁵.

Employers offer job openings alongside an occupational ladder with varying levels of seniority and responsibility along the ladder. For higher level positions, skills that go beyond specific subject knowledge become more important. These skills include people and project management, leadership skills and sector or firm specific knowledge. Figure 1 illustrates how to progress alongside the occupational hierarchy, workers need to grow these skills either by moving across jobs and occupations within the organisation (internal market) or by moving outside the organisation (external market).

At the same time, graduate and post-graduate employees often start employment as recent qualifiers and progress their career by advancing along their own individual occupational ladder, growing experience and seniority as they advance. Employees can also opt for progressing within the same organisation or for developing a portfolio of positions that demonstrates experience and seniority.

Occupational ladders and career portfolios demonstrate the value of skills grown through job mobility for employers and employees respectively. Combining job and sectoral mobility demonstrates and enables personal investment in generic work skills thought external labour markets. Sectoral mobility, in addition, can be used to link the subject of degree on graduation with the likely progression in early career, thereby bridging the traditional view of the supply of graduates, based on disciplines, with the more complex needs of demand in terms of agility and readiness. Sectoral mobility by subject can be illustrated by looking at employment destinations of graduates and postgraduates three and a half years after graduation.

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FOR EXAMPLE:

Graduates who graduated in **Creative Arts and Design** in 2008/9 were spread across 13 different sectors on employment in 2013.

- VERSUS -

Per cent of Graduates who graduated in **Medicine and Dentistry** in 2008/9 were employed exclusively in the Health & Care sector in 2013.

Degree subjects whose graduates find employment in multiple different sectors enable better progression alongside an external labour market. Degree subjects whose graduates find employment in a single sector enable better progression alongside an internal labour market.

We have no evidence that one type of career progression is superior to the other, but the distinction between the two demonstrates that holding a degree does not imply identical careers for all who hold the same qualifications. The dispersion of careers shows that degree subjects are not uniquely identified with certain occupations or sectors. This can help move the debate on graduate and post-graduate skills away from the simple counting of degrees and jobs towards a more holistic approach to graduate skills, and towards a more fluid view of the labour market for higher skills, based on the opportunities and rewards in career progression within and across sectors.

The wheels show diversity of employment destinations in 2013 for those who graduated in two disciplines in 2008/9. For each discipline the wheel shows percentage of graduates employed in each sector: 23 per cent of Creative Arts and Design are employed in Education, 18 per cent in Estates and Research and so on. Creative Arts and Design is the discipline with the most diverse destinations. Medicine and Dentistry is the discipline with the least diverse destinations. Totals may not add up to 100 per cent because only destination sectors of size 0.1 per cent or larger are shown.
C2 Consultancy and The British Medical Association: professional development for doctors across the country

Through a programme of one-to-one consulting, workshops and webinars, the University of London-affiliated C2 Consultancy has provided BMA members with a range of support from career management to strategic leadership development.

C2 Consultancy is a not-for-profit career and professional development consultancy service that sits as part of The Careers Group at the University of London. The organisation draws on the knowledge of more than 40 careers staff based in the university’s colleges. C2 began working with the British Medical Association (BMA) by providing discounted one-to-one career coaching service for their members ranging from students to retirees. By identifying themes in coaching sessions and through facilitating focus groups with junior doctors, C2 was able to advise the BMA on developing new services to help their members address career important career issues.

Following the focus groups, design briefs were drafted for BMJ Learning, a continuing education service for healthcare professionals, to develop a number of Career Essentials e-courses on topics such as E-portfolios and Managing Working Relationships. These courses proved extremely popular with their target audience.

In response to a lack of preparedness for strategic management issues exhibited by doctors moving to consultant-level positions, C2 developed a one-day Management Essentials workshop to raise awareness of up-to-date management thinking, tools and techniques. It has proved very popular with doctors already in consultant and GP partner roles as well as those aspiring to such roles. Through continuing to identify the development needs of doctors, further workshops were developed on presenting, influencing and negotiating.

The face-to-face workshops were a success, but many members found it difficult to take a whole day off for training. As a result, the consultancy worked with the BMA to develop and pilot a programme of hour-long evening webinars on topics such as Strategic Thinking, Developing Leadership, Mastering Workplace Communication and Networking for Professional Development. These webinars have proved increasingly popular, especially with junior doctors. C2 therefore worked with the BMA to identify more topics relevant to this group, such as Time Management, Switching Specialties, Assertiveness, and Wellbeing at Work.

When the Member Benefits Marketing Manager sat in on a networking webinar, she recognised that the subject would be useful for her own team, which comprised mostly young graduates. Following discussions, C2 agreed to run a complementary workshop for them on essential elements of career success. The possibility of delivering a programme of professional development courses for BMA staff is now being explored.

Throughout the collaboration, C2 Consultancy has sought to build a relationship with the BMA in which they are not just a supplier but a trusted adviser. On a number of occasions the BMA has consulted the organisation on new ideas for projects or new member services. C2 have always striven to provide creative ideas and honest opinions, even if this means not undertaking particular activities together.

This relationship has also been beneficial to The Careers Group’s core work within the colleges of the university. The insight gained into the challenges faced by doctors throughout their careers informs the work that our career consultants do with undergraduate students in the university’s medical schools.
Aston University has an outstanding record of fostering and promoting enterprise and entrepreneurship among its staff, students and graduates. One way in which it achieves this is by organising a range of initiatives to support the development of ideas; inspiring the individuals behind them to create the businesses of the future. The flagship project is BSEEN (Birmingham Skills for Enterprise and Employability Network).

BSEEN is an innovative business start-up programme led by Aston University in collaboration with the University of Birmingham and Birmingham City University, and part-funded by the European Regional Development Fund.

CASE STUDY BY ASTON UNIVERSITY

The Birmingham Skills for Enterprise and Employability Network is helping to create a new generation of entrepreneurs.

The project offers a diverse package of support to students and recent graduates at a time when many will see business start-up and self-employment as an attractive career option. BSEEN participants receive free incubator space, a business grant, extensive business training, mentoring and networking opportunities.

Since the second phase of BSEEN began in October 2012, more than 200 entrepreneurs have engaged with the programme, resulting in the launch of more than 75 new businesses.

“The advice and support that we received from the programme team has been crucial.”

Eleanor Watson, founder of Poikos Limited

Entrepreneurs who have participated in the BSEEN programme are quick to recognise the contribution that the scheme has made to the success of their business and to their own development.

Eleanor Watson is the founder of Poikos Limited, a company that uses innovative intelligent software that accurately records body measurements to deliver custom-fit clothing at affordable prices. She has recently secured £100,000 in seed investment from the Regional Growth Fund and believes BSEEN has been fundamental to Poikos’ success.

“The advice and support that we received from the programme team has been crucial,” she says. “I continue to enjoy the lasting relationships developed with my brilliant fellows in our cohort, and I will always be extremely grateful to BSEEN for providing me with the confidence and skills necessary to go and pursue my dreams.”

The current project will run until 2015, by which time 400 entrepreneurs will have attended one of the BSEEN two-day start-up workshops and more than 90 new businesses are expected to have been registered.

Recent BSEEN success stories include:

James Fedden
Founder of the Cake Doctor, who produces high quality cakes, puddings and hot beverages, which are baked in house and sold from a converted vintage ambulance at festivals, markets and street food events.

Ben Smith
An Aston graduate, who has recently founded the company Frumtious, a health-conscious natural food company producing fruit-based snacks suitable for all diets and ages.

David Bennett and Sam Jones
Two First Class Computer Science graduates from Aston who founded Codevate, a software development company. They specialise in mobile and web application development and bespoke software, and engage with start-ups and small businesses to help them bring their ideas to life.

Christos Orthodoxou & Anisa Haghdadi
Both Aston graduates, who set up Class Careers, an innovative organisation connecting young people aged between 16 and 19 with employers via webinars streamed into the classroom and through a focused recruitment website.
How can we maximise the pool of high quality talent in manufacturing, technology, engineering and computing (MTEC) to ensure the UK remains globally competitive?

Businesses are crying out for high-quality engineers, technicians and manufacturing business leaders, and yet firms are missing out on one of the most important sources of talent in the country – smart, numerate, university-qualified women.

Britain is among the poor performers in the European league table of qualified female professional engineers. Fewer than one in ten science and engineering professionals in the UK labour force are female (9.5 per cent), and women are disproportionately underrepresented in the manufacturing sector.

To address this deficit, the UK needs a concentrated, long-term campaign and development programme to increase the number of girls taking physics and allied academic disciplines, rather than just focusing generically on science, technology, engineering and mathematics (STEM) subjects. NCUB’s forthcoming MTEC Green Paper sets out such a challenge: increase the number of women in the talent pipeline into MTEC companies. When looking to the future, it is evident that there are not enough young women studying the subjects that would enable them to enter the MTEC sectors. In 2013, physics was the fourth most popular A-level subject for boys, but the 19th most popular for girls. Furthermore, the gender gap is widening - a problem compounded by half of our state schools failing to put girls forward for physics A-level², despite young women being highly qualified for the subject. At BTEC Level Two, where the proportion of females studying engineering was merely five percent, they outperformed their male peers, with 37 per cent achieving the highest grade (D*), more than in any other subject³.

At degree level, gender imbalances at take up are stark: just 14.3 per cent of engineering and technology undergraduates are women⁴.

To address this challenge we must first understand it, before focusing on a coordinated solution.

The gender balance in biological and life sciences has already shifted: women made up 62 per cent of those taking biology degrees and 75 per cent of those studying veterinary science in 2012. This has come from concerted action among stakeholders and shifts in how young women perceive careers in these industries.

The problem is not one of volume, so simply growing the number of girls and young women studying STEM subjects does not address the core challenge of growing the MTEC talent pool. Physics A-level in particular is a major issue for MTEC businesses, as many universities require physics to study engineering and technology. MTEC companies need to join with universities and schools in a joined-up campaign to emphasise the social and personal benefits of working in such companies.

Furthermore, it is critical to use language that pupils and parents understand. MTEC companies should engage with consumer-focused companies and social media to drive key messages to students, teachers and their parents, not just those who teach formal and physical sciences.

Ultimately, a strategic campaign led by successful women and aimed at mobilising the current university population will help to unlock the next generation of female talent.

⁴ From HESA data www.ncub.co.uk/our-initiatives/talent-2030.html
From 2013 to 2014, University College London (UCL) Careers (part of The Careers Group, University of London) partnered with The Royal Bank of Scotland (RBS) to deliver a bespoke programme targeting female undergraduates and graduates, which aimed at improving their confidence when starting their careers. RBS acted on research from the University of Oxford, which found that women are commonly put off applying to certain industries and earn considerably less on average than their male counterparts. Spurred on by the question of how to address this imbalance, build confidence and open the gate for women who wanted to enter careers in the city, the bank sponsored the Sprint programme. The Springboard Consultancy developed the programme which also gave RBS early access and engagement with students they hoped to recruit.

The bank approached some of their top target universities to see if they would like to bring this programme onto their campus. This approach chimed well with UCL Careers, which had noted similar concerns, and had been involved in setting up a Women in Management Society in the college's Management Science & Innovation (MS&I) Department in response to these issues.

UCL Careers took part in a pilot Sprint programme, hosted at City University in July 2013, which encouraged female undergraduates and graduates from the MS&I department to attend and monitored feedback. This feedback was extremely encouraging, broadly themed around an improved confidence when job hunting, expanded professional and personal networks and the identification of appropriate industry mentors.

Buoyed by these positive outcomes, UCL Careers committed to running a Sprint Programme at UCL in January 2014, opening participation to any female undergraduate or graduate from UCL and City University. The university took responsibility for engaging relevant students and encouraging them to apply. It also undertook the selection of which candidates would attend, looking for applicants who demonstrated career drive, understood how the programme would help with their professional development and possessed strong communication skills.

RBS took responsibility for liaising with the Springboard Consultancy regarding the programme's content. Participants spend three days on the course, but also commit to a follow-up date when they present back to employers to ensure their learning is embedded. RBS was also responsible for engaging other employers to act as sponsors for the programme.

Although the programme has not yet concluded, anecdotal feedback indicates that students and graduates found the programme highly beneficial. The university is keen to run the programme on campus again, and plans to meet with RBS to discuss the experiences of joint working, alongside student feedback and outcomes. There is also a keen possibility that discussions of the programme could be extended to other universities which have also hosted Sprint, in an effort to transfer learnings and share best practice. In particular, this would be particularly valuable when considering marketing and engagement strategies so as to ensure the maximum number of female undergraduates and graduates have the opportunity to participate.

Over the past year UCL has played host to the RBS sponsored Sprint programme with overwhelmingly positive feedback so far.
Can a culture change be effectively encouraged without direct funding?

Talent 2030 is a business-led national campaign that is changing the attitudes of young women towards careers in engineering and manufacturing through targeted actions.

An ambitious project run by NCUB, its goal is to encourage more talented young people, particularly girls, to pursue careers in the manufacturing and engineering sectors. The campaign was launched following the Council for Industry and Higher Education’s (CIHE) Engineering and Manufacturing Task Force, which identified that failing to attract young women in these sectors was putting the UK’s economic growth at risk.

The campaign’s ultimate aim is anchored in the targets that shaped its name: to increase the proportion of women engineers at university from 16 per cent to 30 per cent by 2030. By engaging with girls through targeted activities, the campaign aims to make subtle culture changes from an early age that will have a cumulative effect as they progress through education and professional development.

The campaign is supported by UK engineering businesses1 which recognised the need to take immediate action in order to increase the future available talent pool in the UK.

Jill Shedden, Group HR Director at Centrica PLC, a supporter of the campaign, says there is more to be done to encourage female students to consider engineering as a career. “This is essential for our industry’s future, which is why we are supporting NCUB’s Talent 2030 campaign,” she adds.

The Talent 2030 website, outreach events and national engineering competition for girls are all promoted through schools channels and social media. These activities aim to inform and inspire girls about engineering and manufacturing careers.

Three key areas worthy of more focus if NCUB and its partners are to encourage more young women into engineering are:

1. Better knowledge of future earnings
2. More emphasis on the green and sustainable side of engineering
3. More women role models

Talent 2030 extends its outreach efforts through trips offered to young women interested in exploring the benefits of studying and working as a professional engineer.

The picture below was taken on a recent Talent 2030 outreach trips to Oxford, where girls were taken to visit Eurocopter and Balliol College. Exposure to the female role models that they met throughout the day demonstrated that qualifying as a professional engineer is an exciting and achievable career choice for them.

¹ Talent 2030 is supported by Airbus Group, Anglo American, Centrica and Rolls-Royce.
Knowledge Transfer Partnerships (KTP) is a UK-wide programme headed by the Technology Strategy Board, the UK’s innovation agency, and supported by 12 other funding organisations. Running for more than 35 years, the programme is a national success and now boasts over 800 partnerships across the country. The KTPs leverage the knowledge and skills available within universities, colleges and research organisations to help UK businesses improve competitiveness, productivity and performance.

One such partnership is between the University of Glasgow and micro-chip laser manufacturer Compound Technology Global (CSTG).

Continued expansion of the business relied on CSTG’s ability to offer ‘high-value add’ device technology and chip fabrication processes. CSTG understood the commercial potential of Quantum Cascade Lasers as an emerging technology, but had very limited knowledge of their design and optical characterisation. Nor were there any commercially available modelling packages or turn-key equipment to address this gap in the firm’s capability.

The company became aware of the expertise available within the School of Engineering and established the KTP partnership with the Professor of Quantum Electronics, Charlie Ironside.

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Their work together resulted in world-leading advances in semiconductor laser engineering, including the production of a radically new mid-infrared laser called a Quantum Cascade Laser (QCL). The technology is in its commercial infancy and has the potential to displace traditional sensing technology with high resolution optical techniques.

The project was named Scotland’s best KTP project in 2012 and shortlisted for the UK’s overall KTP award. It has also seen huge benefits for both bodies.

For example, turnover at CSTG has grown by 40 per cent.

“The collaboration has opened up a new spectrum for us as a business, taking us into radically new applications and markets. We have increased our order pipeline – especially in the defence and industrial markets – and rapidly established a thought leadership position in the area of mid-infrared laser technology.”

Dr Wyn Meredith, Commercial Director, CSTG

It has also yielded top-tier research publications and expert recognition for both the company and the university – in particular Dr Thomas Slight, the KTP associate on the project, whose reputation has been significantly strengthened as a result of his work. Dr Slight now gives conference talks to both technical and customer audiences in the UK, US and Europe. He has co-authored a review article on Quantum Cascade Lasers for the Institute of Physics journal Semiconductor Science, and is now employed as a Senior Engineer at CSTG.

“The project has enabled me to achieve my goal of working within a world-leading laser manufacturer and I’m delighted that I can continue to develop the skills I learned from the University of Glasgow by retaining the close partnership between CSTG and the University in ongoing and future projects,” says Dr Slight.

To find out more about KTPs, visit: www.ktponline.org.uk
Anchoring universities to local need
A video games development studio in Brighton faced a challenge with introducing radical dynamics to human figures racing on motorbikes in a major new game.

While the studio had dealt with restricted movements of motorcycling figures before, this game’s concept involved acrobatics, as bikers could effectively drive off mountain roads and do flips and somersaults. The more implausible the moves, the more realistic they needed to look. The Art Director felt that the motion capture technology they had hitherto been using did not provide enough fundamental understanding of the weight and mass that the human body occupies. She deemed they needed a refresher course in a much older technique of figurative representation: sculpture.

What better provider should there be for this need than the University of Brighton’s renowned Arts Faculty, active in the city since being established in 1859? But facing a complex university structure from an industry viewpoint can be confusing, so typically firms rely on personal contacts. This studio had links with the computer science department, which already provided the firm with maths training, but who had no natural links with sculpture experts. It took some weeks before an appropriate sculptor was identified and engaged.

While the disciplines of art, technology and business work together everyday in a business project like the one described, the logics of academic organisation are not so seamlessly fused.

Similar stories can be found everywhere but we draw on Brighton as a result of the Brighton Fuse project, a collaboration of the University of Brighton, University of Sussex, the National Council for Universities and Business, and Wired Sussex, the local intermediary agency. Funded by the Arts and Humanities Research Council, the project conducted a survey of 500 firms and 77 interviews in the Creative Digital IT cluster. The results, showing impressive growth figures and the higher performance of superfused firms - those that combine creative design and technology intensively – have attracted great attention in government, media and business.
Among other organisational behaviours the study examined university - firm interactions in the cluster. Here we highlight the importance of interactions, show the barriers against increasing these, and we speculate on the nature of fusion and what it means for university - industry relationships.

All studies of university-industry links point to the most important role of universities as being developers and providers of graduate talent¹. The creative industries are large employers of graduates and this was confirmed in the Brighton Fuse study. What is perhaps more interesting is that we found with each level of higher education qualification, the better the business performance from the entrepreneurs.

**Figure 1: Mean growth by level of qualification of entrepreneurs in the Brighton Fuse study.**

Those with an undergraduate degree perform better than those with no degree, those with MBAs do better than graduates, and PhDs do better than MBAs. This result would surprise many who would not predict that educational attainment prepares graduates for the business world. Equally it may just show that competent, intelligent people perform well in both domains. But it certainly does refute the urban myth that pursuing a degree is detrimental to would-be entrepreneurs.

**Channels and level of engagement:** Figure 2 shows that 56 per cent of firms in the sample engaged with universities in at least one activity in 2011: Arts organisations engage with universities most (74 per cent) and web portals least (just over a third did so). Design services engage less than the average, and marketing services engage more than the average.

The dominant channel for engagement is informal networking with staff (carried out by a third of firms in our sample), followed by use of facilities, and placements. 10 per cent of our sample collaborates in research with universities, and 6 per cent train their staff there. There is no IP licensing to speak of.

In keeping with economy-wide studies, levels of university engagement in the Creative Digital IT (CDIT) cluster are at least partly conditioned by business capacity. Larger firms (over ten employees) engage more than smaller ones. Capacity also mediates the type and number of interactions; larger firms were more likely to offer placements and engaged using more channels that the average and the self-employed firms.

Also in keeping with general evidence, younger firms engage with universities less than more established ones. Just over 40 per cent of those firms that started operating in 2010 have a relationship, compared with almost 60 per cent for those created in the 1990s. This may indicate that firms first take time to become established, and then turn their attention to what interaction with the universities may offer. Many creative-digital sectors are volatile with high mortality rates of start-up firms, so it may be that in the early years they see university interaction as less critical to survival. Later on they see the benefits, many of which are ‘slow-burn’ type benefits, although there is also the opportunity to sell services to universities.

The study also found variance by ‘growth status’: on average, high growth firms engage more with universities, although the differences are not statistically significant except for their higher propensity to offer placements and to use university facilities for events. In addition for the ten plus (employees) threshold, high growth firms are significantly more likely to provide briefs for students and also use more channels for interaction than the smaller firms.

Barriers to engagement: Around two thirds of respondents perceive barriers to engagement with universities, and at 75 per cent frequency, larger firms are the most likely to report perceived barriers. The most commonly reported barrier is lack of information about what universities can offer – identified by 59 per cent of all respondents. This is followed by lack of time to explore opportunities for collaboration (identified by 54 per cent), not knowing who to talk to (identified by 51 per cent). Lack of relevance or interest from universities are rarely mentioned as barriers to collaboration in this sample, which is in interesting contrast to findings from the Hughes and Kitson ‘Hidden Connections’ study for AHRC in 2011, but the surveyed samples in the two studies have different disciplines and sector coverage.

Lessons learned: The Brighton Fuse project showed that universities are an important provider of talent to the CDIT sector, and that there are unusually high levels of interaction in the cluster. Yet this interaction is not in the form of the fabled intellectual property monetisation and spin-off companies that fascinate policy attention. Similarly to science, technology and engineering disciplines⁴ we observe instead a broader range of linkages between CDIT firms and universities. The most important of the channels are informal networking with academics, use of facilities, and placements.

These results are broadly consistent with the findings of previous studies⁵, which show that interactions are about softer motivations, such as updating knowledge on both sides, reviewing the field of talent, searching and scanning in a passive sense for opportunities and ideas. Barriers to interaction are what may be expected from the predominantly small and micro-sized firms of the creative-digital economy, with little resources and time to research opportunities to collaborate.

The fusion effects may be best paraphrased by the multi-media artist Bob Dylan: “Something is happening, but we don’t know what it is.” We find that fused and superfused firms have difficulty in recruiting appropriately skilled people. Does this result suggest that there is a lack of training services suited to the needs of superfused firms? Perhaps T-shaped training is something that universities have not yet adapted to the current needs of industry. Perhaps our disciplinary silos hamper the development of cross-disciplinary training services, for all the same reasons as the computer science-sculpture divide in our opening anecdote above.

Figure 2: Channels of engagement of businesses with universities by sector of business activity.
10 years of DigitalCity: Teesside University’s vibrant hub is a model for powerful partnerships

Skills transfer, access to investment and extensive networks are among the key benefits for students, entrepreneurs and local communities.

DigitalCity is a multi-partner initiative to create a high-growth digital cluster in Tees Valley, North East England. Led by Teesside University, it capitalises on academic expertise in digital media and technology and a strong enterprise agenda, providing a unique environment for the development of digital start-ups.

Since it began, DigitalCity has seen purpose-built facilities spring up on the campus and in the town centre, with a network of new buildings in development further afield. It is a cornerstone of the Local Enterprise Partnership’s economic development strategy.

The initiative is defined by a joint investment by the university, local authorities and LEP. This partnership helps facilitate a number of key features. For example, an innovative fellowship programme aims to capture the best graduate talent and encourage the start-up of new businesses. Meanwhile, the national and international virtual and physical networks provide benefits such as the transfer of digital skills and knowledge to businesses, a creative environment for entrepreneurs, postgraduates and established companies, and access to inward investment, innovation and trade partnerships. Local schools and communities also benefit from initiatives promoting social inclusion, raised aspirations and the sharing of digital skills.

This year sees DigitalCity’s tenth anniversary. This milestone is a testament to the partnership that has created and grown it. Over the years it has had the active support of regional and local development bodies, private sector organisations, local authorities, the European Commission, government departments, and a wealth of community groups. Against a backdrop of political and economic change partnership commitment has only increased, to the extent that six councils have adopted DigitalCity as a key economic driver, generating revenue and capital investments for innovation, jobs and businesses.

Strategic leadership and collective ownership have played a part, too. DigitalCity has not been without challenges and risks, but the continued, explicit commitment of strategic partners and effective governance by a private sector-led strategic board have given continued confidence in its future. In addition, strong project management and successful delivery have meant that partner support has been there when needed to exploit opportunities or address problems.

For example, the abolition of Regional Development Agencies and subsequent loss of income had the potential to be damaging had it not been for the ideas and support from DigitalCity partners. Indeed, the changing financial and political environment has been the biggest threat to sustainability and to continuity of project staff.

The sheer complexity of DigitalCity, the partnership and the organisations involved can make it challenging to keep activity on track and exploit opportunities. The only answer is high maintenance and clear, consistent communication at all levels.

While there has rightly been a strong focus on delivering, greater marketing and strategic liaison would have helped increase the visibility and influence of DigitalCity at an earlier stage. However, even those things that have not gone to plan have left valuable lessons for the partnership that can be applied elsewhere.

For more information, visit www.thedigitalcity.com
Experts from the University of South Wales are working in partnership with a consortium of four of Wales’s biggest financial services companies - Atradius, Admiral, GMAC and Composite Legal - to deliver credits towards an MSc in Financial Services based in workplace learning. The project arose directly from the University’s ambition to deliver financial services courses at undergraduate, postgraduate and professional level, both to produce industry-ready graduates and to up-skill the existing industry workforce. This strategy was developed in response to the Welsh Government’s aim of increasing employment in the Welsh financial services industry, retaining talented graduates to the Welsh sector, and to attract new financial services firms to Wales.

Each of the 20 graduates on the two-year pilot programme, which is part-funded by the Welsh Government’s Sector Priorities Fund, will undertake a six-month training seat with each organisation while completing the MSc on a part-time basis. The programme sees employers taking a more cohesive approach to training and recruiting potential employees, and is an excellent example of collaboration between the private, public and higher education sector.

The project faced two main challenges: focusing the University’s timescales to meet the required start date and addressing the tender’s specification that a substantial part of the degree be awarded by the Accreditation of Prior Experiential Learning (APEL). This requirement was met by designing four work-based learning modules, which students would complete during their four six-month periods of work experience. The project is the first of its kind for the financial services sector in Wales. Donna Whitehead, Head of the School of Law, Accounting and Finance says the University of South Wales was chosen to deliver the project because of its “strong track record in providing flexible, tailor made learning in the workplace”.

Anne Middleton, HR Manager at Atradius, adds: “As the financial services industry in Wales grows, demand has increased for better qualified and experienced employees. This new programme offers a unique opportunity for graduates to work for leading Welsh companies and gain high level skills in the sector.”

With the benefit of hindsight, the University feels the allocation of more staff resource up front would address the obstacles of tight timescales, demands of a high-profile project and the increase in workload. Moving forward, the Faculty is already in discussion with the consortium about collaborating on a project to determine what a future scheme might look like. The School is also keen to deliver a variant of the MSc which would be available to existing employees and trainees of other local financial services companies.

This successful University-business partnership is not the first for the University of South Wales. Its partnership with British Airways, for instance, saw the Company move key heavy engineering training from Heathrow to the University. The landmark agreement combines technical training for one of the world’s leading airlines with the enhanced career prospects of a university degree, with students graduating with both an engineering degree and industry-standard EASA training through BA’s licence.

"As the financial services industry in Wales grows, demand has increased for better qualified and experienced employees. This new programme offers a unique opportunity for graduates to work for leading Welsh companies and gain high level skills in the sector.”

Anne Middleton, HR Manager, Atradius

University of South Wales: strengthening the Welsh financial services industry through a workplace MSc partnership

The University has partnered with a consortium of four large financial services companies to deliver a unique MSc that combines work experience with part-time study.
Can placements of academics in business positions facilitate long-term partnerships?

The HEFCW-funded Strategic Insight Programme (SIP) supports engagement between university staff in all nine Welsh universities with organisations in the public, private and third sectors in Wales, the UK and internationally.

Placements are designed to foster knowledge exchange and the development of long-term, mutually-beneficial relationships.

Since the start of the pan-Wales phase in 2011, the programme has approved almost 500 applications, engaging almost 400 separate organisations. There have been 37 international placements to date, working with organisations in countries such as the USA, China, India, Germany and Australia.

The total follow on income to date secured by participating universities is more than £2m, giving a healthy programme multiplier of expenditure versus income of £2.98m.

Participants carry out a wide range of activities, achieving a vast scope of outcomes.

In Swansea a SIP between Dr Pavel Loskot, Senior Lecturer at the University’s College of Engineering and Zafire Ltd has resulted in a commercially and technologically superb opportunity. Zafire Ltd, a developer of complex solutions for the service management and aviation industries, worked with Dr Loskot under the strategic aim of fundamentally improving airline baggage delivery systems. The placement resulted in a successful joint bid to the Technology Strategy Board. This project, which is worth £59,000, aims to assess the feasibility of a ground-breaking new vision of the processes and infrastructure for the transport aviation industry.

Good practice has also been learned through the collaborations of the University of South Wales and Airbus; and Bangor University and Siemens Healthcare Diagnostic Products Ltd.

In South Wales a SIP placement between Professor Andrew Thomas, Head of the University’s Business School and Airbus (formerly Cassidian UK) resulting in a long-term partnership and the establishment of a sustainable supply chain system. The SIP placement enabled the strategic scoping of the project, and an enhanced three-year Knowledge Transfer Partnership (KTP) with a project value of £200,000. This in turn led to the design and implementation of an innovative sustainable and trusted supply system capable of achieving state-of-the-art operating performance.

In Bangor a collaboration between Professor Konstantinos Nikolopoulos of the Business School and Welsh Government anchor company Siemens Healthcare Diagnostics Ltd was established with the aim of identifying the needs of the company’s Operations Management team and introducing tangible improvements for various functions. As a result of the partnership, Siemens have embedded a series of long-term operational changes, reducing inventory costs through improvement of capacity and inventory management capabilities.

An in-house evaluation of the programme experiences of 2012/13 academic year placement participants has shown that 87% of participating partner organisations felt that SIP had increased their understanding of the services and support available from the higher education sector in Wales and 87% said that as a result of the placement, they see the HE sector as a resource that is available to help their organisation.

For more information, visit: www.siprogramme.org.uk
Innovation Scotland is a new strategy to improve support for business innovation arising from companies working with Scotland’s world-leading universities. The strategy aims to increase the effectiveness, simplicity and sustainability of the translation of research into business products and processes provided by universities and their public sector partners.

Developed jointly by the Scottish Funding Council, Universities Scotland, Highlands and Islands and Enterprise and Scottish Enterprise, the implementation of the strategy will lead to increased competitiveness of businesses and economic benefit for Scotland.

Innovation Scotland originated just over two years ago when Michael Russell (MSP), Cabinet Secretary for Education and Lifelong Learning asked the Scottish Funding Council (SFC) to work with universities to establish a single knowledge exchange organisation which would help simplify and improve the academic landscape for business. In line with the Scottish Government’s economic strategy, the focus was also firmly on creating jobs and sustainable economic growth.

Since then, great strides have been made to build on Scotland’s excellent research base and improve the effectiveness of knowledge exchange. In addition to the Scottish Funding Council’s on-going £100m investment in Innovation Centres, Innovation Scotland will further transform collaborations between businesses and universities and support Scotland’s future economic growth. Key to this has been the role played by Universities Scotland, especially in consulting with the sector and jointly establishing a working group.

By addressing the challenge of making university-business partnerships happen more frequently and more naturally, Innovation Scotland will make it easier for growing businesses to create and exploit collaborations with top researchers at Scotland’s universities. A key focus for its work will be to remove more of the barriers that stop businesses adopting and marketing ideas developed in universities.
The Scottish Funding Council has invested £4m to establish and implement Innovation Scotland which has the potential to transform universities’ contribution to the Scottish economy. The reward for getting it right will be an increase in the amount and the quality of collaborations between business and universities leading to new products, services, jobs and greater prosperity for Scotland.

Scottish universities already have a reputation for excellence around the world. This was reiterated by Michael Russell (MSP) at the launch of Innovation Scotland on 1st October 2013. He went on to add that recent years have seen “an increase in academic research being used to help our businesses to grow and compete.”

“Innovation Scotland brings people and resources together in a new way to help build on this progress,” added the Cabinet Secretary. “The strategy will further improve the links between universities and businesses, boosting our universities, helping Scottish companies and delivering a brighter future for our economy.”

A key component of Innovation Scotland has been the creation of the Innovation Scotland Forum¹ - a national policy forum to advise SFC, the enterprise agencies, Scottish Government, universities and others on increasing the quality of support for university-business innovation in Scotland and the future implementation of the new arrangements.

The Innovation Scotland Forum is made up of senior business, university and public sector representatives and meets three or four times a year. It is chaired jointly by Michael Russell (MSP), Cabinet Secretary for Education and Lifelong Learning, and senior business figure Melfort Campbell OBE.

To date, the forum has met twice and looked at the oil and gas and creative industry sectors as well as considering issues around skills for business.

Notes and advice from these meetings will be widely publicised and fed back to the boards of the founding partners – Scottish Funding Council, Universities Scotland and the two enterprise agencies. The forum’s advice to the Scottish government is also channeled through the Scottish Government’s Strategic Forum.

The Scottish Funding Council has committed over £100m to support the creation of Innovation Centres in key sectors over the next five years. So far, four have been launched: Industrial Biotechnology², Digital Health Institute³, Stratified Medicine Scotland (SMS-IC)⁴ and the sensors and imaging systems centre CENSIS⁵, and 2014 will see the launch of another four centres.

Another key component of Innovation Scotland is the additional work of Interface. Established in 2005, Interface facilitates business and academic partnerships, encouraging research and development, resource sharing and knowledge exchange with the ultimate goal of driving business development and growth. Through developing long-lasting relationships with Scottish universities and research institutions, Interface is well placed to connect businesses to Scotland’s world-class research expertise and facilities.

Interface⁶ has enabled Scottish businesses to increase their competitiveness, develop new products, services and processes as well as exploiting new international market opportunities by collaborating with academia.

The impartial Interface brokerage service has supported more than 1,600 businesses across Scotland and the UK, the majority of which are SMEs, increasing business turnover, productivity and profits. According to BiGGAR Economics 2013⁷, a recent independent study on the economic impact of the service, the academic and business collaborations facilitated by Interface will annually contribute £79.9m to the Scottish economy, within the next three to five years.

Interface also manages funding opportunities through Scottish Funding Council’s Innovation Voucher Scheme which supports businesses with their first academic collaboration. Since the launch of the Innovation Voucher Scheme in 2009, more than 600 vouchers valued at £2.9m have been awarded to Scottish higher education institutions and businesses.
As well as continuing the demand stimulation and business engagement activities, the Scottish Funding Council has made additional funds available for Interface to support the Innovation Scotland strategy. These new activities include:

- Enhanced promotion of collaborative opportunities including technologies and facilities available to support R&D to SMEs.
- The implementation of Horizon 2020 SME engagement innovation vouchers to support the leverage of EU Funds by Scottish SMEs and universities.
- Promoting the repository of nationally-approved standard contracts, processes and best practice.
- Supporting follow-on Interface engagement through the new opportunities offered by the Innovation Centres.

As part of the delivery of the Innovation Scotland strategy, it should also be noted that the Scottish Funding Council is supporting a new Enterprise Campus which will provide a collaborative model for optimising fresh support from high-growth companies to Scotland’s universities. This will simplify company-university interactions and provide stable national knowledge exchanges.

While Scottish universities are among the most successful in the UK at creating valuable knowledge-based companies, there is a great deal of variation across Scottish universities in terms of quality and number of companies formed. It is here that scope for improvement can be found by generating more activity across the sector.

The research postgraduate sector is an area where support for entrepreneurs has been limited. This group contains entrepreneurs with the genuine potential to create successful companies. However, for reasons of complexity and scale, postgraduate entrepreneurship might sometimes be overlooked by universities.

The Universities of Aberdeen, Edinburgh and Strathclyde developed the Enterprise Campus model to link high-growth companies with postgraduate support. The campus will augment existing support at universities with services delivered from three regional hubs. It will also allow smaller universities to access previously unavailable products.

The key offering of the Enterprise Campus will be one-to-one support to entrepreneurs, delivered either by the local university or by the local hub. This approach will allow for the draw-down of technology and commercial mentoring, management placements, IP diligence, and pre-incubation hosting.

Over a three-year pilot funded by the Scottish Funding Council, the Enterprise Campus is projected to assist 130 projects, delivering more than 200 interventions and resulting in 90 new companies. The pilot may also facilitate a re-structuring within the sector as participating universities achieve greater performance and consider adopting the model for spin-out companies as well.

The future looks bright for Scottish university-business partnerships. The Horizon 2020 SME Engagement Scheme, recently launched by the SFC, will invest £400,000 in helping up to 80 small and medium-sized businesses apply for H2020 funding by working with Scotland’s universities.

In consultation with Universities Scotland, the SFC is also amending national structures, such as the Knowledge Transfer Grant, so they can better encourage collaboration and support businesses working within the Innovation Scotland strategy.

Innovation Scotland aims to improve and simplify the experience of businesses who work with universities to develop and exploit innovative ideas. If it is successful we will see more companies innovating, our universities more engaged with industry and Scotland’s reputation as a place to ‘do business’ further enhanced.

Ultimately, Innovation Scotland will address long-standing business concerns around the challenges of working with universities to create jobs and growth which, through the advice of the forum, will lead to a mutual exchange of people and ideas between companies and universities, bringing greater financial rewards to the Scottish economy.
Digital Health is an upcoming discipline that involves the use of information and communication technologies to address health problems and challenges. Digital Health spans mobile technology, social media and sensor technology, and is already being used to reduce inefficiencies in healthcare delivery and make medicine more personalised. Increasingly, these digital capabilities are changing how people use and interact with technology and empowering them to be equal partners in the design and delivery of their own healthcare services.

The Digital Health Institute (DHI) based at the University of Edinburgh (UoE), is an innovation centre supported by the Scottish Funding Council, and was launched in October 2013 as a collaboration between UoE, Glasgow School of Art and NHS 24. The DHI aims to co-create sustainable economic growth through new products, services and systems developed in partnership with policymakers, businesses, academics, health and care specialists and citizens. Its aim is to generate high-value health and social care solutions that are deployable in Scotland and other markets around the world.

Over the past nine months, the DHI has been piloting its innovative product development process – which takes an idea through three elemental phases: Exploratory, Laboratory and Factory.

A recent example of this process in action was a collaboration to develop an idea called BabyCam, a system for alleviating stress when a newborn baby is separated from its family due to illness, by allowing parents to view their baby live through a tablet connected via Wi-Fi to a camera in the neonatal cot, allowing greater bonding and attachment.

Initial exploratory meetings pulled together relevant expertise from government, the NHS, social care, academics and partner companies to explore a range of potential innovations, their impact, and eventual market potential. Alignment between key stakeholders is necessary to clear the way for the implementation of this sort of niche product in highly regulated healthcare environments. DHI’s exploratory meeting was hence an essential linking point between product innovators and delivery organisations.

Once through the exploratory phase, the next step was the experience lab, working with companies, designers and other stakeholders to identify issues – such as how the product would fit into the process of a busy neo-natal unit, and what parents needed to keep the bond with their new baby. After several iterations, the lab achieved a product which was deployable.

The final element of the process was the DHI Factory, which moved ideas closer to final products. Since entering this phase, DHI and other stakeholders, including NHS Fife and Glasgow Caledonian University, have begun evaluations to identify and evidence further issues and successes with this approach. This will ensure that any future product has the necessary tactical insight to build informed decision making into the development process. The combination of key knowledge and skills shared by the DHI and partner organisations allows for the creation of innovative trial healthcare products that are fit for purpose.

The Digital Health Institute: generating digital healthcare solutions for Scotland and the wider world

Scotland’s new Digital Health Institute recently collaborated with government, business and academia to realise a product that alleviated the stress of newborn babies separated from their parents in neo-natal wards.

CASE STUDY BY DIGITAL HEALTH INSTITUTE
University of Southampton and Lloyd’s Register: a four decade partnership in service of today and tomorrow’s maritime challenges

The new Southampton Marine and Maritime Institute (SMMI), the largest university-business partnership in the UK, has been the result of trust and understanding.

The University of Southampton and marine specialists Lloyd’s Register have a close working relationship that dates back over four decades. In that time, engineers from the two institutions have collaborated on a wide range of technical developments directly related to maritime safety. Summer 2014 will see this relationship cemented even further, when Lloyd’s Register moves its Global Technology Centre to an impressive new headquarters on Southampton’s redeveloped Boldrewood campus.

The £140m campus will be home to the Southampton Marine and Maritime Institute (SMMI), the largest university-business partnership in the UK. At its launch in 2012, the SMMI was described by the Universities and Science Minister David Willetts as exemplary of the relationships required between industry and higher education to drive future economic growth in the UK and around the world.

University of Southampton Vice-Chancellor, Professor Don Nutbeam, says this unique project is the product of understanding and trust built over decades of cooperation. “It really has no parallel in the UK in terms of its scale and ambition. This element of trust has been an essential ingredient in making the unprecedented financial commitment required to bring this about.”

The university hopes that the SMMI and the development of the new campus will be a hub for collaborations that run internationally, acting as a magnet to attract other partners to draw upon the university’s research and development capabilities and the future resource represented by its students.

With around 1,000 academic staff and researchers, the SMMI integrates all marine and maritime disciplines across the university. Specialists in ship design and naval architecture, fluid dynamics, acoustics and oceanography, through to arts, humanities and social sciences, are working together to better understand current and future maritime challenges.

The co-location of Lloyd’s Register with the university and its collaboration in the SMMI will help to ensure research support for the marine and maritime sectors, which will catalyse future developments at regional, national and international level. This in turn will enable wealth creation, strategy and policy formulations, new research and enterprise initiatives, as well as graduate employment opportunities for the region’s highly skilled work force.

Tom Boardley, Marine Director for Lloyd’s Register believes that collaborative initiatives such as the SMMI are the way forward for British industry. He says: “When you combine the strengths of business and academia for research purposes, you stimulate the kind of practical innovation that supports sustainable industry. It is strategic technical alliances like these that will ensure our shipping and energy sectors have the solutions they need to remain safe, environmentally responsible and globally competitive.”

The close links with Lloyd’s Register will be supplemented by collaborative frameworks with other UK industrial and societal organisations and government establishments.

“The SMMI at Southampton brings together a research, innovation and education community from universities, research institutes, industry and governments,” says SMMI director, Professor Ajit Shenoi. “We envisage it will be a catalyst for ground-breaking interdisciplinary research and development of great significance to industry and society related to the maritime sector. Its future is very exciting.”
Northumbria University: the multidisciplinary approach

Northumbria is building a reputation for finding multidisciplinary solutions to problems.

One question is constantly at the forefront of everything that Northumbria University does: how can it maximise potential using a multidisciplinary approach?

Northumbria University is a business-focused professional university that uses a multidisciplinary approach to deliver the best possible solutions to issues faced by businesses. This desire to make sure projects work on more than one level is why it has worked with major companies over the years from Diageo to Unilever and even in the public sector with the Department of Transport.

One of its most successful collaborations came with working with the BBC. The broadcaster came to Northumbria with two problems: how to increase static listening figures on their radio outlets especially among younger people, and whether it is possible to find opportunities for commercial radio partnerships.

Armed with background information on the position of BBC Radio, students conducted in-depth research on the BBC brand, current and future technological capabilities, licence fees, human machine interface and commercial radio. Posters and imagery were produced for each of the research areas, arming students with a collective knowledge.

The students produced an illustrated document that discussed each territory in terms of discovery, unanswered questions, insights and futures concluding with a series of ‘What If’ concepts.

Adam Powers, Head of User Experience and Design at BBC Audio and Music Interactive and Mobile, said: “It has genuinely been a rewarding experience engaging with Northumbria University, their enthusiasm, thoughtfulness and creative insight has been inspiring and I look forward to continuing the relationship.”

Other collaborations that have worked particularly well were with Fendor and Sonoco.

Fendor is a specialist in commercial and specialist glazing. It came to the university wanting to know what its future product range could and should contain – in particular in relation to anti-terrorist strategies such as blast-proof glazing.

A multidisciplinary team from Northumbria University, with experts from law, business and engineering, researched multiple territories, including: standards and legislation, building conservation, new builds, foreign know-how, competitors, and influential bodies and organisations. Smaller teams then conducted more detailed research to gain a better understanding of the potential opportunities and threats, which was used to create new ideas.

The work produced for Fendor not only provided the company with pathways to innovation, but it also helped them to forge relationships with influential bodies, something that is crucial to the development of innovative product lines.

With Sonoco, the university team was tasked with finding new market applications for their existing cardboard tubing product.

Using insights from Sonoco’s catalogue of current applications and a guided tour of the factory, the students set out to discover new areas of potential with an emphasis on large volume applications. Under the headings of transportation, environmental, structural, indoor/outdoor and inconceivable, they generated a high volume of commercially viable, technically feasible and exciting product ideas.
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