CIHE
LEADERSHIP FOR BUSINESS AND HIGHER EDUCATION

Enhancing Value Task Force

uk-irc
UK-INNOVATION
RESEARCH CENTRE

Enhancing Collaboration Creating Value

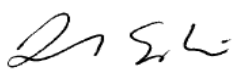
Business interaction with the UK research base in four sectors

Summary Report

By Andrea Mina and Jocelyn Probert, edited by David Docherty

Foreword

This is the third in a series of linked reports on gaining the most value from UK research, and in particular its publicly-funded research. The first report set the UK's spend on R&D in an international context and the second assessed the impact of that expenditure. In this third review, the research team interviewed seventy-one top-level sources from both large and small firms, universities, government/regulators and charities to explore the challenges and opportunities concerning the creation of value through collaboration. Focusing on four different sectors – construction, energy, pharmaceuticals and the converged creative, digital and IT industry – the review reveals the different innovation needs within and across these industries and highlights the main challenges to collaborative innovation that the UK faces to be competitive in the modern global knowledge economy.



David Eyton, Steering Group Co-Chair

Prof. Shirley Pearce, Steering Group Co-Chair

Steering Group Chairs:

- David Eyton, Group Head of Technology, BP
- Prof. Shirley Pearce, Recent Vice Chancellor, Loughborough University

Working Group Chairs:

- Dr. Robert Sorrell, VP Public Partnerships, BP
- Prof. Michael Caine, Associate Dean (Enterprise), Loughborough University

Steering Group Members

James Baker	Managing Director – Advanced Technology Centre	BAE Systems
Prof. Genevieve Berger	Chief R&D Officer	Unilever
Prof. Sir Leszek Borysiewicz	Vice Chancellor	University of Cambridge
Prof. David Delpy	CEO Champion for Impact	RCUK
Prof. Peter Downes	Vice Chancellor	University of Dundee
Prof. Malcolm Grant	President & Provost	UCL
Iain Gray	CEO	Technology Strategy Board
Dr. Hermann Hauser	Partner	Amadeus Capital Partners
Prof. Julia King	Vice Chancellor	Aston University
Patrick Loughrey	Warden	Goldsmiths, University of London
Dr. Menelas N Pangalos	EVP Innovative Medicines	AstraZeneca
Prof. Ric Parker	Director of Research & Technology	Rolls-Royce
Lord Sainsbury of Turville	Peer	House of Lords
Phil Smith	Chief Executive	Cisco UK and Ireland
David Sweeney	Director of Research, Innovation & Skills	HEFCE
Mark Thompson	Director General	BBC
Prof. Patrick Vallance	President, Pharmaceuticals R&D	GSK
Prof. Sir Tim Wilson	Non-Executive Director	The Unite Group

Strategic Partners:

Dr. David Docherty, Chief Executive, CIHE and Prof. Alan Hughes, Director, CBR and UK IRC, University of Cambridge

"We often punch above our weight when it comes to academic excellence. And we punch below our weight when it comes to exploitation."

Business leader

"Everyone knows that science in the UK is absolutely exceptional. But a lot of the discoveries from UK academic groups were commercialised into very valuable products by, for example, US firms."

Business leader, Pharmaceuticals Executive

The Enhancing Value Task Force was established to *"Identify and prioritise a small set of key actions for change that will enhance the value of publicly-funded research and collaboration with business."*

This final investigation before we distil those conclusions and recommendations focuses on lessons about business interactions with universities drawn from four industrial sectors:

- Construction,
- Energy,
- Pharmaceuticals, and
- Creative, Digital and IT (we treat these as one converged sector under the acronym CDIT)[1]

These will deepen the understanding of collaborative innovation and value creation developed in the previous two reports.[2]

In the first report, we explored the sources and nature of £26.4bn invested in UK R&D - £8.4bn of which is government funded - and noted that despite increases in investment in higher education research, **there is an R&D Funding Gap** between the UK and its major industrial competitors. Furthermore that **R&D is concentrated in the UK's biggest firms** (only 3.5% of R&D in 2011 was conducted by independent SMEs). And finally that **the UK innovation system is simultaneously open and vulnerable.** Overseas investment in UK R&D is very high by international standards; but this openness also means that the country is relatively vulnerable to strategic investment decisions made outside the UK.

The second report reviewed the extensive literature on the impact of publicly-funded R&D on the UK's economy, firms and society and established firstly, that **quantification of impact is exceptionally difficult** and attempts to reduce multiple inputs to a single rate of return often require heroic assumptions. Secondly, that successful public-sector impact most often **relies on complementary private and charitable sector investment.** And finally it concluded that **policy must be shaped by a systems view of impact, rather than by a simple linear model.** Rate of return calculations provide little policy guidance and the report recommended that intermediate and trajectory-based measures must be developed which focus on the interactions within the innovation system.

Following on from these systems-level insights, the Task Force commissioned reviews of four sectors and their particular innovation value chains to explore broad similarities and distinct differences in the ways in which they generate wealth from knowledge, and in particular how business-university collaboration is and should be organised in order to facilitate this.

1 A previous CIHE Task Force coined the acronym CDIT to encompass the Creative, Digital and IT industries in order to focus policy-thinking and universities on the increasing convergence of businesses in this sector and the radical realignments of value and innovation chains. Put simply: no fibre, no Facebook.

2 This document is a summary; for the complete 'Enhancing Collaboration, Creating Value' report visit www.cihe.co.uk/eccv-main. The first and second Task Force reports, 'The UK R&D Landscape' and 'Enhancing Impact' are also available via www.cihe.co.uk/EnhancingValueTaskForce.

The sectors were chosen because they have different industrial structures (concentrated to diffuse), varied reliance on innovation (moderate to intense), a range of technology solution clock-speeds (long-run to rapid-fire), and approaches to collaborative behaviour (strategic versus sporadic). To deepen our understanding of these characteristics and their impact on generating value, the UK Innovation Research Centre conducted a programme of in-depth interviews with a sample of seventy-one top-level sources from large and small firms, universities, government/regulators and charities. Even with such a rich cross-section of business and academic leaders, we do not claim statistical significance for our findings, but there were clear and relatively consistent themes which, taken together, give a clear picture of the issues and challenges.

The top level messages are that collaboration has strengthened considerably over the past decade or so, and that even sectors like construction, which have not been traditional partners with universities, are beginning to develop collaborative models of innovation with higher education institutions. On a global level, UK universities make excellent collaborators for businesses and many of them have sufficient breadth to generate effective multi-disciplinary responses to business challenges. Businesses based in the UK are especially well-positioned to exploit the advantages of proximity and the development of long-term partnerships. However, the pressures of new technologies, globalisation and financial rationalisation are driving businesses to be more selective and focused in their partnerships, while universities develop new avenues for collaboration to step up to the emergent challenges.

Bio-Pharmaceuticals

Size: £30bn+ turnover

Employees: 75, 000

Structure: Concentrated (approx 350 companies, with fewer than 20% of firms employing nearly 90% of total workforce and top 37 companies accounting for approximately 83% of total turnover).

Collaborative approach: Consistent

Technology Solution clock-speed: long run

Construction

Size: £122bn

Employees: 2.1m

Structure: Overall diffuse, but varying with market segment in a fragmented value chain. Overall 256,441 construction companies, but the total turnover of the top 100 biggest builders in the UK was around £64bn in 2011.

Collaborative approach: Sporadic

Technology solution clock-speed: Medium run

Energy

Size: £49bn+

Employees: 173,000 (the UK oil and gas supply chain (support services) supports employment of 407,000 people in the UK, around half in Scotland.

Structure: Concentrated. Six vertically integrated companies in electricity dominate both generation (67%) and supply (99%), and four oil companies account for the bulk of oil production. Renewables:diffuse.

Collaborative approach: Consistent

Technology solution clock speed: Long and medium run

CDIT

Size: £102bn gross value add

Employees: 2.5 million (including freelancers)

Structure: Diffuse. Some major players, but tens of thousands of small businesses (e.g. 485 games companies, 11,000 film and TV companies employing c. 154,000 people, 330,000 "software professionals" and 64% of software businesses employ fewer than 50 people).

Collaborative approach: Sporadic

Technology Solution clock-speed: long run (fibre, servers, platforms), rapid-fire (user-interfaces, software, design).

Sources:

- HM Government (2011) 'Strengths and Opportunity 2011: the landscape of medical technology, medical biotechnology, industrial biotechnology and pharmaceutical sectors in the UK.' December.
- CIHE (2010) 'The Fuse: Igniting High Growth for Creative, Digital and Information Technology Industries in the UK'. September.
- DECC (2010) Energy Market Assessment. Constructing Excellence (2011) UK Industry Performance Report 2011. The Construction Index Top 100 2011

Scale, Speed and Synergies: Specific Innovation Challenges By Sector

Bio-Pharmaceuticals

Each of the sectors has specific innovation and collaboration challenges that flow from the nature of their value chain, their structure and average firm size, and the speed of taking products and services to market.

A key challenge for pharmaceutical companies is the renewal of the industry's research and business model. The sector is increasingly externalising R&D that was previously done in-house. A higher level of outsourcing and collaboration brings greater opportunities for independent R&D providers, smaller firms and universities. The complementary challenge is the growth of a dynamic and well-supported biotech community in the UK, with potential for strong contributions from entrepreneurial academic teams.

> *"A big trend is the location of basic research units into areas of high academic concentration, the sort of biotech cluster areas. One has got better access to academics, better access to talent, and the ability to potentially tap into small companies for partnerships. It has been very positive."*
>
> *Pharmaceuticals Executive*
>
> *"The last new investment we made was in the US because there were the academics, there were the entrepreneurs, there is a very mobile work force of highly-trained people who work in industry and academia, and we also thought there was potential for co-funding."*
>
> *Pharmaceuticals Executive*

Creative Digital and Information Technology

In CDIT, there is a growing recognition of the need to engage with universities and many now realise that they do not have access to all the science they require if they are to develop an outward-facing approach to the digital economy.

> *"Things have changed in recent years, in the last decade, with universities and research. I think awareness has grown within universities that there is interest in using knowledge that might be available to be developed specifically for industry."*
>
> *CDIT Executive*

> *"Most companies have to be outwardly focused in the digital world. We are certainly outwardly focused in terms of our customers, and our customers routinely ask us, "Can you do this? Can you do that?" In some cases we can do it with internal resources, in some cases we need some external resource to help, and the universities are often a valuable source in that area."*
>
> *CDIT Executive*

But one of the challenges in creating value in the CDIT sector is the business model of the many small and disconnected firms which do not generate IP or create sustainable value.

> *"One of the things that characterises the UK creative industries is agency model businesses where work is done on a work-for-hire basis and production is generally at the mercy of large organisations or companies who dictate terms, and generally those are buy-out terms."*
>
> *CDIT Executive*

This means that they operate very close to the market.

> *"We do not do much work with universities because for the type of work we are doing university research tends to be rather a long way out there compared to what we are interested in."*
>
> *CDIT Executive*

A key requirement is an improvement in the level and nature of graduate skills to reflect the converged CDIT business world.

> *"We need to teach people better in schools, especially computer sciences and maths, and balance that with teaching art. We need people who are learning arts and sciences together. The university faculty system we have is outmoded; separating arts and sciences is a 19th century construct."*
>
> *CDIT Executive*

Energy

Up-skilling and an increase in the supply of human capital are also required in the energy sector. So is the need for a stable policy framework and strong signals from government which would release investments in innovation.

> *"We have a big programme to form closer links to universities to get good connectivity, good expertise that we don't have in-house."*
>
> *Energy Executive*

> *"There's got to be an opportunity for Government to incentivise home-grown technologies. I think we should encourage and support home-grown green jobs and home-grown technologies. I don't believe we are seriously supporting those technologies and those advancements in the UK as much as I think other countries are doing."*
>
> *Energy Executive*

Construction

In construction, where we register the least amount of collaborative work with the research base, innovation and engagement is hindered by excess fragmentation of the value chain, risk aversion, and severe limits to the demand for innovation.

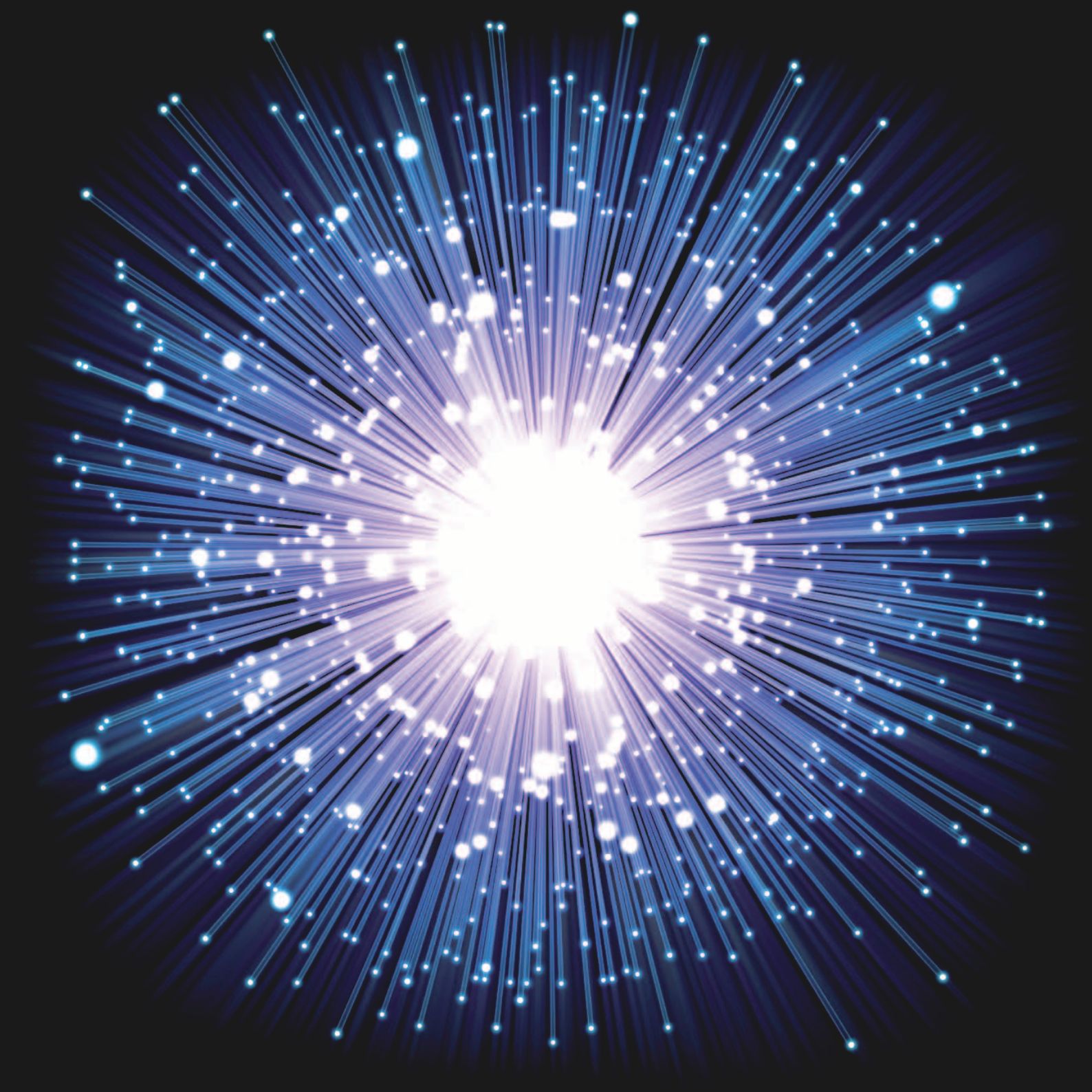
> *"One of the systematic issues we tend to confront in construction is that the different parts of the system at the end of the day are supplied by different groups of people who aren't necessarily into coordinating particularly well."*
>
> *Construction Executive*

> *"There is a general lack of connectivity with university or research organisations. There is this belief that the education system is one thing and business is another."*
>
> *Construction Executive*

However, some executives in construction now recognise that this must change and they must engage more systematically with universities and the innovation system to upgrade the value-chain.

> *"If you had asked me five years ago, I would have said 'I don't care what [a leading UK university] does, we are doing this and the client thinks we're the bee's knees'. And then all of a sudden the client says 'we want it done for 20% less'. And we think, 'Oh right ok actually now what is [the university] doing? What are they doing with traffic management? How do you get technology into cars?' I think universities will see more coming out of drive for efficiency in terms of research, because people are going to want an innovative R&D-stimulated step-change in what they are doing."*
>
> *Construction Executive*

As well as these sectoral specific issues, our research has identified ten key challenges that, if overcome (and government, business and policy-makers are working on each of them), would power collaboration across all the sectors and increase value creation for the UK economy.



Partnership, Competition and Risk: Ten Shared Innovation Challenges Across the Sectors

Ten core themes emerged from the interviews that highlighted the vital importance and changing nature of partnerships in a modern knowledge economy, and the absolute need for the UK to be globally competitive in the provision of science and technology. Meeting the partnership challenge is critical if the UK is to continue to attract, retain and grow innovative companies and their extended supply and value chains.

1. R&D location decisions are increasingly global, with the availability of talent and quality of research acting as clear drivers of location decisions for science-based businesses. Proximity to markets is especially important for later stages of R&D processes, for less R&D intensive investments and for services. Location of R&D in the proximity of universities is not essential but is seen as increasingly important in R&D intensive businesses.

> *"Globalisation of science and R&D is one of the challenges that any country is going to face now. I can go anywhere in the world to get the right science, I have no allegiance to any country, to any university, to anybody. So we collaborate in China, Russia, Japan, United Kingdom, Europe, America, Canada, wherever the best science is, really."*
>
> *Pharmaceuticals Executive*

> *"The advantage of being close to the university is the ability for people from both sides just to walk across the road, so from a hands-on collaboration point of view it is very quick and it is very easy. Basically our time-to-solution has been much quicker working in that way, rather than working by correspondence all the time with remote partners."*
>
> *Energy Executive*

2. Strategic Partnering on innovation activities are on the increase because of growing uncertainty, cost and complexity of technology. Choices of collaborators are flexible, may involve single individuals, teams or whole organisations, and depend on contingent 'fit for purpose' decisions.

> *"The big thing that has changed is the number of consortia we are in with our competitors. Even 5-10 years ago we would never have joined up with competitors in the things that we are currently in with them. But we can' t possibly fund all the science that we need to access on our own. We used to think we could, but we can' t."*
>
> *Pharmaceuticals Executive*

> *"In the past we had outsourced to a lot of different companies, but we decided to form some large strategic partnerships where you could really begin to build a very close relationship with the companies that you were sourcing your work with, rather than outsourcing and just sort of passing it over. It's almost like an extension of your internal organisation; it is not an outsourced group that doesn' t interact closely. It's a changing partnership model. It's also taking a very strategic look at an area where companies externally have a core business and can do some of your work more effectively, more cheaply than you can internally, while maintaining quality, because quality is really critical in the work that we do."*
>
> *Pharmaceuticals Executive*

> *"I think that there is a trend towards more collaboration because of the increased complexity of problems that we are trying to solve. You can' t solve internet problems on your own because the internet is a complex system with many interfaces and I would say that there is a trend over time to do more collaborative research."*
>
> *CDIT Executive*

3. Collaborative arrangements with universities and the research base differ by firm size, and the challenge remains to improve the level of engagement with small and medium-sized businesses.

Major companies from the pharmaceutical and energy sectors have a high level of collaborative engagements with universities and the ability to exploit those relationships.

> *"If you look at where our deals are, where our connections are, the UK is incredibly well represented. In early translational work and academic collaborations the UK is very strong."*
>
> *Pharmaceuticals Executive*

> *"Our purpose is to build science capability. We have a big programme to form closer links to universities to get good connectivity, good expertise that we don' t have in-house."*
>
> *Energy Executive*

> *"Historically we used universities with a known history of working on [these] issues, so it's a bit like going to shop where you know you can buy what you want. But the changing nature of technology has opened the scope with who we work with more broadly."*
>
> *Energy Executive*

Even larger CDIT companies historically had a relatively low level of collaborative intensity, particularly when it came to rapid-fire innovation, but this is changing.

> *"I think the situation has changed. Universities are more industry focused and industry has also woken up to the ideas around open innovation, but more importantly to the kind of complexity that it's trying to deal with and recognises the value of academics. There has been huge progress but I do think that it was started from quite a long way back. I think that for many years previously the connection between industry and academia had been quite broken actually."*
>
> *CDIT Executive*

The issue of how to improve connectivity cost-effectively for both universities and a greater range of SMEs remains a challenge, and this is of course a vital issue for construction and CDIT, which are marked by hundreds of thousands of small businesses and freelancers in their diffuse industrial structures.

> *"We're Venus and Mars."*
>
> *Construction Executive*

Generally, smaller firms across all sectors are at a considerable disadvantage in engaging with universities relative to large companies (unless they are connected with the research base from the start) because they often lack the time to absorb university inventiveness. Their 'absorptive capacity' is limited by their size and lack of boundary spanners who have the time and capacity to engage with academics.

> *"One of the difficulties is encouraging SMEs themselves to be more innovative. The idea of university support is a bit alien to a lot of them."*
>
> *Energy Executive*

However, there are formal and informal ways of working around these challenges of receptiveness and absorption that are bringing benefits to SMEs in each of the sectors.

> *"There are a number of ways to connect SMEs, including partnerships, small grants, vouchers and informal contacts. I think the way in which people who work for universities engage with small businesses is underestimated. It often happens by ignoring the formal processes, because they're just too difficult and bureaucratic. And it is just engaging on an informal basis."*
>
> *CDIT Executive*

4. Collaboration is a resource-intensive activity, and financial resources represent only part of the exchange between industry and the research base. Importantly, successful collaborations rely on investments in the time spent on joint work and the exchange of ideas, materials or tools. Of the essence are: the development of an understanding of the institutional framework in which partner organisations operate; shared vision of the objectives of the collaboration; and trust, clarity of motives and transparency in its conduct. As well as changes in universities and academics, partnership improvements have been driven by increased understanding in industry of how to manage the relationship and how to gain value from it. Progress is inevitably uneven – both on the university side, with different institutions, disciplines or research groups making more or less progress (and some younger academics showing more willingness to engage than the established) and from industry.

> *"Some of the best academic/industrial collaborations actually do not involve money at all. They are exchanges of intellect or ideas or materials or tools. They do not have to be financially based."*
>
> *Senior Academic*
>
> *"When I talk about partnership, we are not just handing over money; we are putting intellectual input into the collaboration. We are intellectually invested."*
>
> *Pharmaceuticals Executive*
>
> *"I think being very clear on what we expect of each other is probably the most important thing."*
>
> *Energy Executive*

5. Businesses and academia have different institutional objectives and timeframes, and collaborative success flows from understanding and reconciling the two cultures.

> *"The challenge has always been about how one manages to marry the academic sector's objectives with corporate objectives. Academic research can be an end in itself, whereas for corporate organisations research investment has to lead to a tangible outcome and has to be driven by a business objective. You have to be very careful when you agree to collaborate around a project to make sure that those two things are aligned."*
>
> *CDIT Executive*

A clear alignment of goals can allow both business and universities to play to their own strengths.

> *"We stress the importance of academic freedom in attracting the best Principal Investigators to work on industry challenges. We have set up our various open institutes that way and it has been a critical learning for us."*
>
> *Energy Executive*

Academic incentives, e.g. promotion criteria, are still substantially built around publications and grant proposals rather than industry collaborations or industry experience. This hinders labour mobility between industry and academia even where industry expertise would be needed in research, education or commercialisation activities.

> *"When somebody is coming up for a promotion, it is important that there is due value given to commercial partnerships, to consultancies, to industrial income as much as to some of the other forms of academic scholarship."*
>
> *Senior Academic*

> *"The movement of people between industry and academia is improving, but in the UK people are not nearly as flexible as they are in the US. Many of the academics I know still have quite a purist approach to science. And I think the system does conspire against you in terms of enabling that free movement. It's so difficult to be in the scientific environment getting grants, writing papers, then taking a period out and then coming back and trying to write grants and start writing papers again. Experience outside of the science isn' t really recognised that much in the university system. It's not recognised and it's not valued. It's almost seen as something that you shouldn' t really do. There ought to be much more movement."*
>
> *Pharmaceuticals Executive*

The culture of university-industry collaboration in the UK is improving considerably, if unevenly across different organisations or divisions. Emerging trends include the rationalisation of relationships (the selection of a smaller number of high-quality interactions), and increased formalisation in the interest of limiting the time and effort required to establish agreements.

> *"Over the last few years we have been trying to close that gap between academia and industry and to rationalise the types of relationships so as to focus on very high-value ones."*
>
> *CDIT Executive*

> *"The UK needs to be the best in key areas of science in which we are strong. Being mediocre across the board will not any more drive the kinds of collaborations that will be productive, so it probably is a few select places that we go to for the areas where there is a common objective or need."*
>
> *Pharmaceuticals Executive*

"Historically, we hooked up with whoever we liked the look of. You couldn't accuse it of being a focused strategy. Now we have picked about ten universities we want to have a long-term collaboration with, because we believe they are either extremely strong over a broad field or in a very, very specific niche in a particular area that's important to us."

Energy Executive

"First of all you need to work out what you want, where you think you can find it, and then have time to go and look for it. We are aligning with two or three universities who are specifically working or have opened up and are prepared to work on areas that we think will deliver sustainable improvements to what we think our customer needs."

Construction Executive

The rationale for stricter selection of appropriate partners might, however, be multi-dimensional and not limited to excellence in research:

"We have selected in the UK ones we want to work with already. Firstly, they tend to be closer to where we have large points of employment in the UK and secondly they are better known for training specialists in our areas of subject matter. Thirdly, we would take people that were more keen on working with us on certain selected project areas that we are interested in. And fourthly, we are increasingly working with the universities that are more internationally facing, ones that might have better students and researchers that may study over here and then go back to another country in which we operate."

CDIT Executive

"We tend to work with individual technologists, so it could be professors, it could be straight researchers. But it will be the best person to work with, not just because they are very good but also because we can do business with them."

Energy Executive

6. Critical barriers to commercialisation of academic research involve management of intellectual property rights, financial constraints and lack of business know-how.

The exploitation of innovative ideas is difficult and the risk of failure is very high. But access to knowledge generated by the research base is still a source of significant advantage for firms.

Although many companies (typically the larger and more experienced firms) report that they have no particular problem finding agreement on IP, many business leaders still cite problems with IP negotiation, financial barriers, and lack of business 'know-how' among academics (although many note signs of higher degrees of entrepreneurialism among younger staff) as specific barriers to successful commercial exploitation of university research.

"We are in the process of identifying a group of tier one universities where we will have solid frameworks in place. We can't spend a year negotiating an IP contract for a product that we want to bring to market in a year."

Energy Executive

"One of the problems is over-inflating the value of scientific innovation at an early stage. If you don't know what you don't know it is quite a dangerous thing. And I think sometimes we undervalue what industry brings as a partner."

Senior Academic

And this combination of over-valuing IP, looking for quick returns and undervaluing industrial input can lead to frustration in some companies.

"Some universities are strangling innovation. They think they're being business-like at IP but they're actually making it very hard to do any work with them. The net result is that nothing happens, so nobody benefits."

CDIT Executive

From a business perspective, universities often are seen as lacking strategic focus in their patenting activities and as privileging quantity (as an output metric) over quality in technology transfer. Negotiations over IP can be unduly lengthy, not least owing to fundamental disagreements over value.

"Tech transfer office must get a return on X, Y or Z quickly. That is not conducive to interactions with large firms. It may be ok for a quick turnaround exit from a spinout, but even there I would argue it is not a very sensible thing to do. There is often naivety in terms of what constitutes value and as a consequence over-protection of IP at the wrong stage, which then leads actually to more difficult discussions where universities are being more protective of early IP than industry."

Pharmaceuticals Executive

7. A barrier to innovation and creating value that emerged with some regularity was the conservative attitude to risk among both investors and academics. There is a shortage of early-stage funding, attributed at least in part to the current macroeconomic framework but mainly to the poor appetite among investors for first and second stage funding in some sectors.

"The reason we haven't got our technology running today is purely down to the availability of finance. In the US, seed equity is available for new technologies like this with similar or higher levels of technology risk. In Europe, and in the UK in particular, it is not."

Energy Executive

"The number one problem in the biotech sector in the UK is the total lack of appetite from the City of London, their shareholder base, for investing in this type of company or in this sector."

Pharmaceuticals Executive

"On the whole, the European and certainly the UK investment community is much more conservative than the US. It is much more risk-averse and tends to want to enter at a later stage, and there are very few and far between investors at the early stage. As a result of that, and since the economic crisis of 2008, the VC community has moved further to a later stage, which has left a gap which in the last couple of years has begun to be filled by some angels. But angels are disorganised, fragmented, are not systematically accessible. Overall they've left a big gap; a gap, which I don't think public funding in the UK has really been able to respond to particularly well."

CDIT Executive

"There's a lot of research that sits on the shelf for various reasons and I think there's a lack of entrepreneurs who would put up the investment, or investors who would come and take it forward into a real enterprise. Or to get it taken up by other manufacturers. It doesn't have to be a start-up company. The exploitation part of it is the bit where it tends to fall down."

CDIT Executive

This lack of early-stage funding was matched by a perceived lack of risk-taking and business 'know-how' among many university researchers.

"Why is the biotech community in the UK not as strong, or not as proportionally strong, as our academic science? It's to do with the lack of availability of people who are prepared to leave academia to go to a biotech and actually do it. Or people who are prepared to do it again and again and again as serial entrepreneurs. In Boston, you can find people there who have done eight biotechs, five of which have been successful."

Pharmaceuticals Executive

8. Cross-disciplinary R&D is vital to addressing the 'grand challenges' of the future (e.g. smart cities, climate change).

In universities, a 'silo' mentality may discourage inter-disciplinarity and hinder the ability to address the 'grand challenges' of the future (e.g. smart cities, climate change), as has been recognized by cross-disciplinary initiatives supported, for example, by the Research Councils, the Higher Education Funding Councils and the Technology Strategy Board.

"We still have to break the university department silo mentality of problem-solving and functional excellence within a multi-disciplinary environment. It's clear to us that to solve some problems we have to work across boundaries. Some universities have really woken up to that and have integrated themselves. Those are the universities that we get a very positive reaction to when we say: "This is our problem', because we come with a problem, not with a department in mind. Not all funding bodies, however, get it."

Pharmaceuticals Executive

"There's a lag in tracking what industry needs. Very few university courses teach the kind of skills we need and courses are not joined between disciplines. In the UK it is partly because of the way universities are measured. There's a tendency to stick to old disciplines. To be a good computing department it's much better if you do traditional computing. The same goes for a good engineering department and a good maths department and so on. If you want to do well and just be a five-star computing department, you don't waste your time trying to collaborate with sociology or maths or something else."

Energy Executive

Overall, views on the prospects for university-industry interactions are positive. However, there are some concerns that perceived pressures on universities to demonstrate the value of their work to the commercial world can have unintended consequences, for example on the patient, long-term accumulation of fundamental knowledge.

"You have to measure us on mission, and you have to give me ten to fifteen years, because I do not want to produce a better coating on a peanut. I want to produce a cure for TB. And if you don't have a time horizon of fifteen to twenty years, I can give you the peanut coating."

Senior Academic

9. Willingness to invest in UK-based research is sensitive to the government policy agenda and a business-friendly operating environment. The respondents perceive a number of missed opportunities by and for UK plc, particularly in risk aversion among public sector officials and the perceived weakness of government in formulating coherent long-term strategies that would enable businesses to implement long-term investment plans.

> *"What doesn' t work for industry is government policy saying ' I' m doing this today' but tomorrow it has changed. That doesn' t work; particularly when you' re talking about energy technologies developed over twenty years."*
>
> *Energy Executive*

> *"There is a need to think strategically and of course that's what all governments are very bad at doing. No policy, no minister is particularly interested in anything beyond the next election, and with infrastructure that really matters because these decisions we are talking about are decisions of decades, not just three or four years ahead."*
>
> *Construction Executive*

> *"The line that the Scottish government crossed was to recognise that this technology is a huge industrial opportunity – this is innovation with prodigious economic development potential. The bit that excited the politicians was the jobs and the economic potential."*
>
> *Energy Executive*

10. There is a clear need for an incentive strategy that joins up the innovation system within a healthy business environment and enables firms to commit more to innovation.

Many respondents felt that what is required to pull through commercialised research based on university inventiveness into firms and the economy are industrial strategies in key areas, such as advanced manufacturing and smart cities, underpinned by long-term policies which ensure the participation of UK-based companies. This means supporting home grown technologies and solutions, but also improving the capacity of UK-based firms to exploit technologies developed elsewhere.

> *"Suddenly like London buses we get computer science being announced for schools, we get high-speed, super-fast broadband being announced, we get a production tax credit announced in the Budget. The Government has certainly got to be congratulated for finally seeing the value of [this] industry in the UK."*
>
> *CDIT Ececutive*

> *"There is a lot government could do: I think one of the things that still is apparent when you work in the US versus the UK, is getting facilities that really are right for you and the way that landlords work for those sites. And the patent box extension and the R&D tax credit looked like it was going to disappear at one point, but it stayed, because that's very important. And I think maintaining the funding in medical research, at the level it's at least, is incredibly important. And incentives to help translate things out of academic into the early phase companies, any incentive that can help that is useful."*
>
> *Pharmaceuticals Executive*

The UK is also seen to use European regulation less flexibly than its Continental (or US) counterparts in supporting the funding of UK commercialisation efforts:

> *"We are doing some great science. We want a research project to be sponsored with half a million dollars to potentially create a new product for UK PLC, and make the company successful. This cannot be done. Treasury would say that it was very naughty and it was against EU rules. But all I can tell you is [on the Continent] you can walk into places where they are getting massive subsidies for what they are doing. I cannot see why you can' t do it here. It also happens in the US with the SBIR."*
>
> *Business Leader*

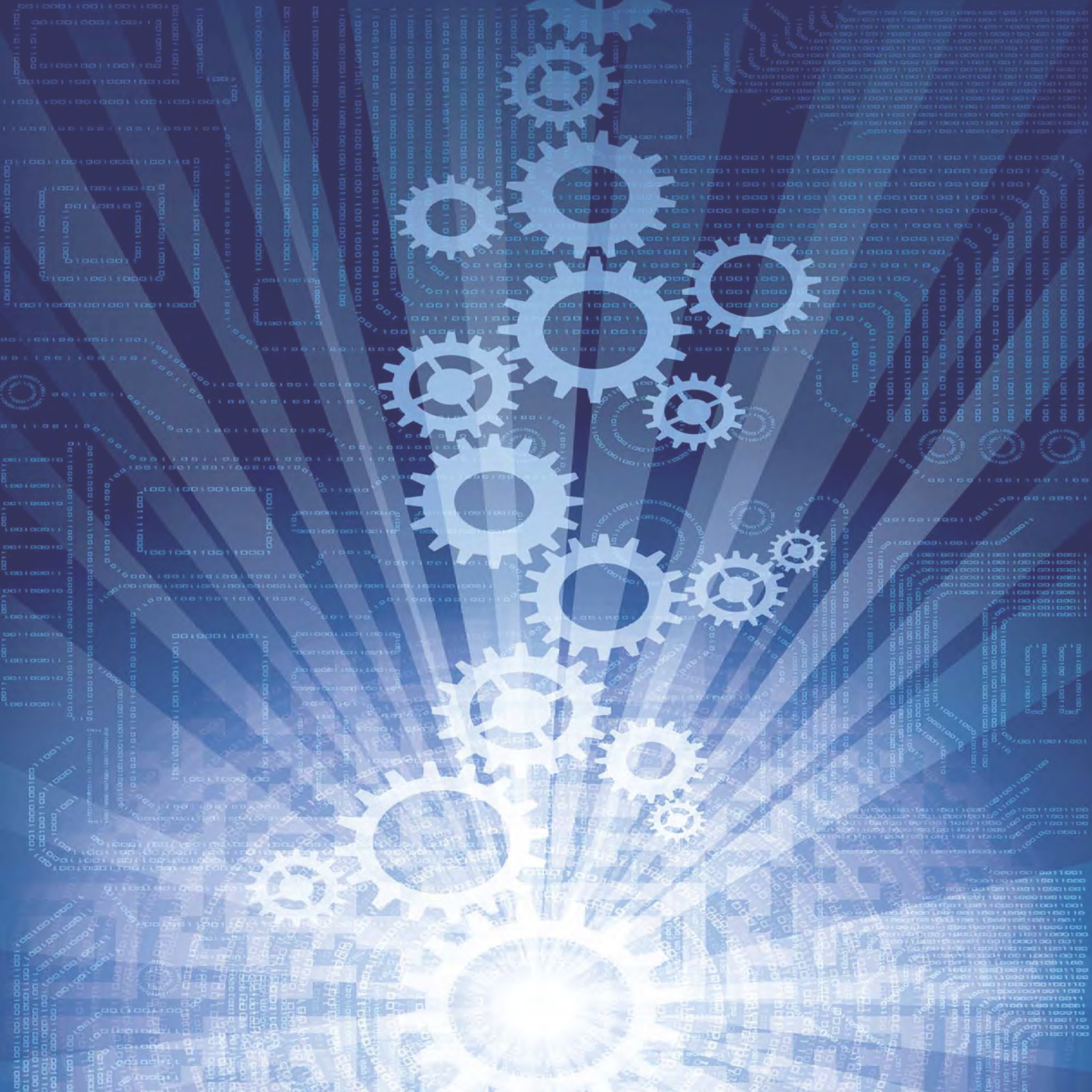
Finally, and crucially, despite the significant effort put in by government agencies, funding and research councils, and the Technology Strategy Board, the channels that could facilitate collaboration between innovative SMEs, the research base and government are still seen as not sufficiently effective and our respondents felt that this had to remain a significant area of focus.

> *"The UK in my view has generally been pretty poor at helping SMEs that are going through big structural changes. It doesn' t look after its little companies, in an industrial sense, as well as other European nations or the US do. We should be having jobs here, not producing another smart invention that ends up being commercialised in China or Japan."*
>
> *Energy Executive*

Skills, skills, skills

As well as these ten key challenges to enhancing collaboration and creating value almost every respondent was concerned about skills. While the higher education sector is in many disciplines regarded as second to-none by international standards, the inadequate supply and pipeline of talented young people with strong STEM backgrounds and/or appropriate technical training was seen by many of our respondents as a significant potential challenge across sectors and firms. Investments in skills by governments in emerging economies are a potential game-changer and leave no room for complacency.

> *"In the space of a few months I gave talks at Yale, Harvard, Cambridge England and Beijing University. In Beijing I met with some of the brightest young scientists you could have imagined. So the UK should be concerned."*
>
> *Pharmaceuticals Executive*



Conclusion

Knowledge is key in creating the new wealth of nations. It is vital therefore that the generation and diffusion of innovation within and across many of the industrial sectors that will substantially power the economy is mapped, understood and supported. It is clear from this analysis and these interviews that there are general challenges across the sectors and that the spill-over benefits of resolving one challenge in one sector may benefit the rest But, it is equally obvious that a 'one-size-fits-all' approach would be far too simplistic. Innovation value and supply chains, and efforts to promote, develop, incentivise and support these chains through knowledge collaboration and industrial strategy must be true to the deep, underlying needs of the different industries and their future competitive challenges. In the final report of the Task Force we will reach conclusions about, and make recommendations on how these challenges should be met.

Working Group Members

Dr. Aileen Allsop	Consultant	
Richard Biers	Programme Leader, Futures and Innovation	DSTL
Sally Devine	Task Force Coordinator	CIHE
Pete Digger	Leader - UK Science Relations	AstraZeneca
Alice Frost	Head of Knowledge Exchange and Skills	HEFCE
Chris Ganje	Policy Advisor	BP
Dr. Andy Leonard	Vice President	BP Cambridge
Prof. Ben Martin	Editor - Research Policy	SPRU
Dr. Andrea Mina	Senior Research Fellow	CBR and UK~IRC
Dr. Declan Mulkeen	Director Research Programmes	MRC
Prof. Douglas Paul	Director of the James Watt Nanofabrication Centre	University of Glasgow
Dr Jocelyn Probert	Senior Researcher	CBR and UK~IRC
Dr. Allyson Reed	Director of Enterprise & Communications	TSB
Dr. Douglas Robertson	Director of Research and Enterprise Services and Chair of PraxisUnico	Newcastle University
Stephanie Scott-Davies	External Affairs Manager	CIHE
Dr. Malcolm Skingle	Director Academic Liaison	GSK R&D
Philip Ternouth	Associate Director	CIHE
Nigel Townley	Engineering Director, Enhanced Customer Aligned Test Services (ECATS)	Cisco
Dr. Alison Wall	Associate Director, Impact	EPSRC
Andy Wilson	Head, Centre of Technology	BBC

CIHE
LEADERSHIP FOR BUSINESS AND HIGHER EDUCATION

Council for Industry and Higher Education (CIHE)
Studio 11, Tiger House, Burton Street,
London, WC1H 9BY
w. www.cihe.co.uk
e. cihe@cihe.co.uk
t. +44 (0)207 383 7667
f. +44 (0)207 383 3433

uk-irc
UK-INNOVATION
RESEARCH CENTRE

UK Innovation Research Centre
Top Floor, Judge Business School Building
University of Cambridge
Trumpington Street
Cambridge, CB2 1AG
e. enquiries@ukirc.ac.uk
t. +44 (0)1223 746575
f. +44 (0)1223 765338

 ISBN 978-1-909071-01-8
Photo Credits: istockphoto.com