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BIG INNOVATION CENTRE

Collaborate to innovate

How business can work with universities to generate knowledge and drive innovation

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The Big Innovation Centre is an initiative of The Work Foundation and Lancaster University. Launched in September 2011, it brings together a range of companies, trusts, universities and public bodies to research and propose practical reforms with the ambition of making the UK a global knowledge co-creation hub as part of the urgent task of rebalancing and growing the UK economy, and with the vision of building a world-class innovation and investment ecosystem by 2025. For further details, please visit www.biginnovationcentre.com.

Collaborate to innovate

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Executive summary

Universities play a major role in supporting innovation and competitiveness in the UK. In addition to delivering outstanding research and teaching, universities widely interact with all stakeholders in the economy. There is a growing pool of evidence which demonstrates the positive contribution they make to the UK's economic and social development. However, it seems that we still do not fully understand how to make the most out of successful university–business interactions. This was emphasised in a recent statement by David Willetts, the Minister for Science and Universities, and Vince Cable, the Secretary of State for Business, Innovation and Skills:

"Universities must be open to and accessible to local businesses, particularly SMEs that may not realise the mutual benefits that are on offer, or are otherwise tentative about engaging with their local Higher Education Institution ... While many businesses do engage with universities … there are still too many businesses that are not reaping the rewards of collaboration"[1].

In response to this gap in the economy, this report discusses how to unlock and stimulate different forms of collaborations between universities and businesses, by drawing on a survey of 200 businesses, and in-depth interviews with 14 companies. The main findings from the report are:

Businesses and universities collaborate successfully – Universities are not 'ivory towers' isolated from the economy

Businesses were in general very positive about their experiences with universities. More than half of our respondents stated that they were able to successfully achieve their strategic objectives when interacting with universities. Businesses are motivated to work with universities in order to engage in innovation and strategic networking and to increase their competitiveness, rather than for short-term financial gains. In particular, businesses and universities in the UK have become proficient at managing relationships which allow business to access academic knowledge.

There is room to improve how some universities and businesses collaborate to generate new knowledge

While most businesses were generally able to successfully access university knowledge, addressing complex business challenges through knowledge co-creation proved to be difficult for a significant proportion of companies that had this objective.

To some extent this result is understandable, since addressing complex business problems in such a way that meets the needs of both the company and the university is a difficult

[1] Cable, V. and Willetts, D. (2012) Foreword to "Following up the Wilson Review of Business–University Collaboration", Department for Business, Innovation and Skills.

process. And many of the objectives of businesses and universities may not be compatible. But, the scale of the challenge here is matched by the opportunity; and it is encouraging to find that firms that are successful at addressing business-related challenges with the support of universities are also successful at accessing university knowledge, whether in the form of basic research, university talent, or academic networks. This supports the view that there is no opposition between collaborating with universities in order to address business challenges and collaborating with universities around the more traditional research and teaching missions of universities: rather, a group of sophisticated users of academic knowledge are able to successfully pursue all these objectives when interacting with universities.

We are not advocating that universities become 'like business' and give up their role of developers of basic research to suit the needs of business, but rather that universities and businesses can collaboratively tackle market challenges and capitalise on opportunities, each with their own distinctive roles to play, since there are synergies between businesses accessing university knowledge and co-creating knowledge with universities.

This paper focuses on discussing how to achieve successful university–business collaborations in four areas: Which practices and institutional support structures ensure successful collaborations? Which interaction channels work well and which need support? What is the role of different intellectual property protection strategies in creating value for the partners in the interaction? How can the initiation of university–business interactions be promoted?

OUR FINDINGS: HOW TO UNLOCK SUCCESSFUL UNIVERSITY–BUSINESS INTERACTIONS?

- **Adopting communication, collaboration and negotiation-related management practices is a key to successful collaborations**

Management practices that unlock successful university–business interactions identified in our study are:
- Reaching a shared understanding with academics
- Increasing transparency, and an openness to collaborate with academics
- Implementing a strong programme structure with clear milestones
- Reducing top-down approaches with more team-level communications
- Enforcing contracts (e.g. avoid opportunistic behaviour or other trust issues)
- Capitalising on differences rather than trying to match the practices of academics or universities to business routines
- Ability to negotiate (the price or other terms of the contract) with university technology support or business relations staff

The majority of respondents have successfully adopted two practices: 'openness to collaboration with academics' and 'reaching a shared understanding with academics'. SMEs face difficulties when adopting these practices, when compared with large firms. However,

most successful collaborators have successfully adopted all the above-mentioned practices. Hence, there is scope for businesses to learn how to implement these practices to support their interactions with universities.

- **University–business interactions should be supported by institutional infrastructure**

Our research offered insights on a number of institutional approaches to support interaction:

Revise Lambert Toolkit by incorporating knowledge co-creation interactions and the needs of specific target groups

The Lambert toolkit is a set of decision tools and standard agreements designed to improve the process of negotiating collaborations between research establishments and business, which has been in place since 2005. Our report revealed that the Lambert toolkit has been used by only 10 per cent of the respondents, but 60 per cent of those who have used found it to work very well. Major issues highlighted by companies were a lack of focus on new co-creation mechanisms, low awareness of the toolkit and failure to address the heterogeneous needs of user groups.

Support university–business interactions by using specific Open Innovation networks

Networks are forums that facilitate universities, businesses, local authorities and other stakeholders to network and work together. A few examples of these are University of Glasgow Innovation Network, Eindhoven Open Innovation network, and Local Enterprise Partnerships. Even though only 36 per cent of surveyed firms have used these networks, a significantly higher proportion of successful collaborators have mentioned that these are working very well.

Learn from past experience of innovation voucher schemes

Innovation voucher schemes are used by only 13 per cent of firms. Of these, 58 per cent did not find them successful. It was evident that it is important to provide additional support to SMEs besides financial incentives. On the basis of this evidence we would recommend that those managing these schemes should find ways to couple financial incentives with additional support that would enable successful university–SME interactions.

- **Businesses should aim for a portfolio of interactions with universities, built around research, education, placements, and other services**

The most successful relationships are built by businesses that carry out a portfolio of different interactions with universities involving research, education and training, staff placements, and technology services. This is perhaps due to portfolio engagements generating additional benefits through synergies between different types of activities. This is a more relevant message for larger companies.

- **New models should be adopted to share resources between universities and businesses**

The least performing university–business relationships involve the formation of joint research labs and the sharing of resources between universities and businesses. Concerns over lack of 'secrecy / confidentiality' and conflicts of interest between universities and businesses were highlighted as reasons. However, successful collaborators have successfully engaged in the formation of joint research labs by adopting new business models that enable them to overcome these issues.

In these successful arrangements, rather than creating alignment on common research outputs, businesses and universities independently conduct their own research, but align on capabilities that both parties can access. Company staff is permanently seconded at labs located at universities. As a result, university and company researchers share common resources and equipment, collaboratively organise seminars, develop new advanced methods of conducting research and share knowledge on an ongoing basis. Whenever possible they conduct collaborative research too. This has enabled knowledge spillovers and the exploration of new collaborative opportunities by university and company staff. This model of joint research labs has been found to be very successful in order to simultaneously meet the commercial needs of companies and the academic needs of universities.

- **Encourage university–business placements**

University staff and student placements in industry should be encouraged since these are mutually beneficial and work well. The uptake of industry placements in universities should be improved by universities and businesses collaboratively designing research-based placements with clearly defined objectives and outcomes.

- **Intellectual property protection strategies should be open and flexible**

Most firms in our sample have not used either formal or informal IP protection strategies in their working with universities. These firms are mainly in sectors like business services, creative and cultural, and information and communication services, and they interact with fewer – mainly UK – universities. Firms that use IP protection strategies generally rely upon bundles of both formal and informal mechanisms, at the same time with different partners, and over time with the same partner where the nature of the interaction changes. Firms in science-based sectors, collaborating with a large number of universities and with more international universities tend to use larger IP bundles.

While holding a large bundle of different types of IP (e.g. more than 8 types) is associated with higher engagement in interactions with universities, this is not necessarily linked to greater success in these collaborations: the share of collaborations that 'work well' is the same across both heavy and low users of IP protection methods. 'Soft' IP such as cultivating commitment and trust and secrecy/non disclosure agreements are working very well. Firms should be prepared to be open to the use of many different IP protection strategies and

flexible in adopting different strategies according to what is appropriate in each specific interaction or even in each stage in the interaction process.

- **Academics and users are catalysts for university–business interactions, but Technology Transfer Offices (TTOs) strengthen institutional links**

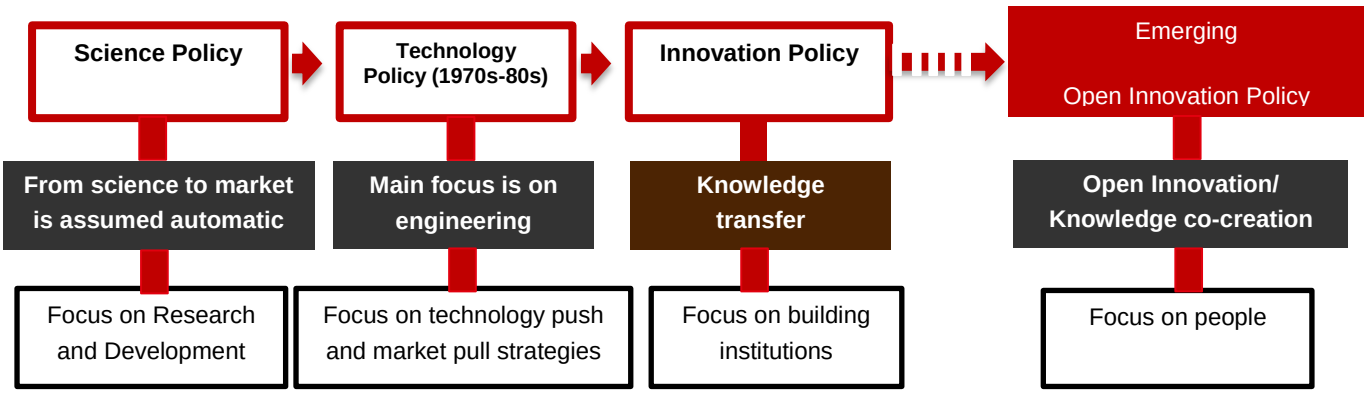
Individual academics are key to starting most interactions between universities and businesses. Hence, important mechanisms to encourage interactions could be: universities doing more to empower and encourage academics to work with business (including providing better support); universities and/or businesses developing new platforms that could help build links between them. Alumni connections also play a key role as a source of university–business links.

TTOs and research support staff are hugely important to support academics' interaction with businesses (particularly as providers of administrative, legal and coordination services) once the relationship is formed. They were also found to play an important role in order to initiate certain types of inter-institutional interactions.

MESSAGES FOR UNIVERSITIES, BUSINESSES AND POLICY MAKERS

Our findings suggest that there are ways to improve how businesses and universities work together in an Open Innovation paradigm. Government policy has moved from the linear model of science policy in the 1950s-60s (i.e. a research-driven approach), which primarily focused on supporting the basic research base, to technology policy in the 1970s and 1980s with clear utilitarian – often engineering – perspectives (i.e. technology push and market pull approaches). More recently, innovation policy in the 1990s–2000s incorporated a knowledge transfer mission through building institutions, e.g. technology transfer offices in universities and tighter intellectual property (IP) enforcement. It looks as though a new open innovation landscape is emerging with a major focus on people and open innovation infrastructure.

Paradigm shift from 'knowledge transfer' to 'knowledge co-creation'



While public policy and actions introduced under the leadership of Rt Hon David Willetts, Minister for Science and Universities, made a great contribution to this emerging open innovation policy, our findings indicated that more needs to be done to support co-creation by universities and businesses.

Reflective recommendations for universities and business together – how to pursue good practices

- Invest in relationships to reach a shared understanding and to build trust between partners
- Place greater focus on agreeing clear delivery plans, objectives and identifying milestones, especially important when establishing placements from business into universities
- Commit to finding ways to move from top-down management approaches towards team-level communication between university and business staff
- Increase university–business placements through co-funding and knowledge co-creation challenges and projects
- Increase engagement in a portfolio of interaction channels rather than focusing on a few
- Be open and flexible in relation to the use of IP protection mechanisms depending on the type and stage of interaction, the sector of operation and the type of output
- Increase awareness of and develop skills in the effective and flexible use of a bundle of formal and informal IP protection strategies
- Adopt new business models when forming joint research labs in order to enable academics and businesses to carry out independent research whilst also engaging in collaborative work whenever possible, which allow both academic and commercial objectives to be achieved
- Invest on the skill development (e.g. relationship development and management, communication and understanding business and academic 'language' etc) of academics, support staff and business personal essential to unlock successful co-creation and co-innovation.

Specific messages for universities

- Build stronger administrative support arrangements for academics to engage with business. The arrangements in many institutions have been reported to be too bureaucratic, and too focused on managing relationships rather than supporting the work of academics.
- Facilitate collaboration between centralised support services (e.g. Technology Transfer Offices, Business Development Offices and Research Support Offices) and individual academics. The role of centralised services as providers of support services to academics (e.g. legal, administrative and coordination services) is more important than being initiators of university–business links
- Develop an entrepreneurial culture within universities
- Empower individual academics to collaborate with businesses and reward their business engagements

- Continue to improve the user experience for SMEs that try to work with universities
- Invest in opportunities to better exploit alumni connections to build relationships with companies

Massages for policy makers and funders

- Revise Lambert Toolkit by incorporating knowledge co-creation interactions and the needs of different user groups
- Knowledge co-creation/open innovation networks appear to work well and should be a priority for continuing support
- Support the adoption of new business models when forming joint research labs in order to enable academics and businesses to carry out independent research whilst also engaging in collaborative work, which allow both academic and commercial objectives to be achieved
- Secure expanded funding for university–industry placements
- Support the skill development (e.g. relationship development and management, communication and understanding business and academic 'language' etc) of academics, support staff and business personal essential to unlock successful co-creation and co-innovation.
- Support the adoption of open and flexible IP rights/strategies
- Research how to support the bundling of different forms of formal and informal IP protection strategies in university–business relationships
- Support the development of new platforms to link businesses and academics
- Demonstrate how current schemes have learnt from past experience of innovation vouchers – e.g. coupling financial incentives with other support schemes for SMEs
- Support SMEs to adopt good practice and provide them with additional support to engage with universities
- Continue funding support for schemes that work well for SME–university interactions – e.g. Mini knowledge transfer partnerships
- Support and encourage the adoption of new models that encourage collaborations between universities and SMEs – e.g. accelerator model, in which large firms act as intermediaries between universities and SMEs

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1. Introduction

Our ability to innovate will spur the UK's recovery from recession, as growth in the knowledge economy can only come from innovation. Yet, major structural issues need to be overcome if the UK is to be able to exploit current economic opportunities[2]. As well as businesses and the public sector, our universities are key assets for our innovation ecosystem. Our recovery will depend on the performance of these organisations and how well they are able to work together in order to exploit the economic and social opportunities and the new business models arising from new technologies.[3] The mutually beneficial relationships between universities and businesses are a key part of this story.

Universities are widely considered important players in the economic processes that support national competitiveness[4] and innovation[5]. In particular, the UK performs increasingly well in terms of universities' engagement in the economy and their interaction with businesses. For instance, the Higher Education–Business and Community Interaction (HE-BCI) Survey for the academic year 2010–11 shows a continuing increase in income from knowledge exchange between UK HEIs and the public, private and third sectors: income has grown to £3,302 million in 2010–11, a nominal 7 per cent increase since 2009–10 and a nominal 41 per cent rise since 2003–04. This is notwithstanding the important fact that working with businesses represents, for most universities, a secondary mission to their core focus on teaching and research.

David Willetts, Minister for Science and Universities, and Vince Cable, Secretary of State for Business, Innovation and Skills, also recently emphasised the importance of university business collaborations, while also highlighting that there is a room to improve these interactions:

> "Universities are complex institutions that play a variety of important roles in our society … Universities must be open to and accessible to local businesses, particularly SMEs that may not realise the mutual benefits that are on offer, or are otherwise tentative about engaging with their local HEI … While many businesses do engage with universities … there are still too many businesses that are not

[2] Levy, C. and Brinkley, I. (2013) "A manifesto for innovation and growth", Big Innovation Centre report.
[3] Andersen, B., Brinkley, I and Hutton, W. (2011), "Making the UK a Global Innovation Hub. How business, finance and an enterprising state can transform the UK", Big Innovation Centre report.
[4] Mowery, D., Sampat, B. and Ziedonis, A. (2002) "Learning to patent: Institutional experience, learning, and the characteristics of U.S. university patents after the Bayh–Dole Act", Management Science, 48, 73–89.
[5] Lam, A. (2005) "Work roles and careers of R&D scientists in network organizations", Industrial Relations, 44, 42–75.

reaping the rewards of collaboration."[6]

In response to this gap in the economy, this report discusses how to unlock and stimulate different forms of collaborations between universities and businesses, which comprise a key element of open innovation.

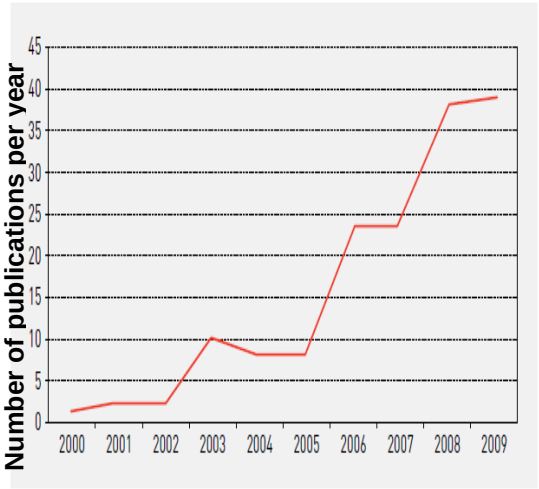
1.1 Open Innovation and our higher education institutions

Open Innovation represents a key area of opportunity for the UK economy. By working collaboratively with other organisations on innovation, companies can achieve far more than in isolation.

Much evidence suggests that companies are increasingly looking beyond their organisational boundaries to source knowledge. This phenomenon has been linked to the broadening skills base of our workforce, the increasing sophistication of consumers, technological convergence, the increasing modularity of knowledge, the rise of more specialist and sophisticated intermediation services and consultancies, the increasing trade in knowledge services, and shifts in policy approaches to focus on unlocking collaboration. Collectively these factors appear to have increased the benefits associated with innovating beyond a firm's organisational boundaries.[7] As illustrated in Figure 1.1 the term Open Innovation has increasingly entered academic literature. The search volume indicators suggest that it is also more widely used in general.

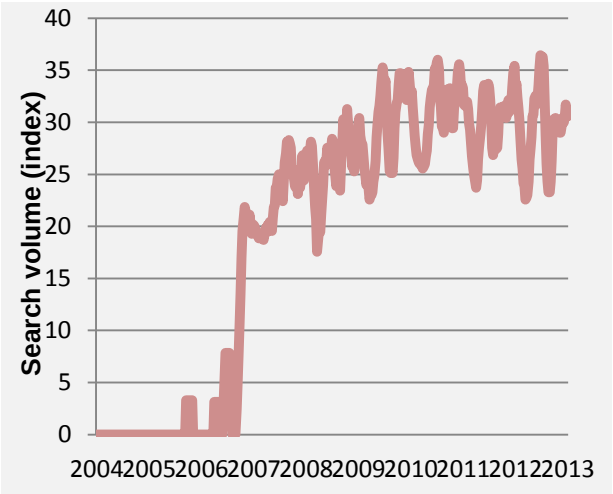
Figure 1.1: The rise of 'Open Innovation' as a term

Academic papers on Open Innovation



Source: Dahlander and Gann, 2010[8]

Google search volume on Open Innovation



Source: Google trends analysis

[6] Cable, V. and Willetts, D. (2012) Foreword to "Following up the Wilson Review of Business–University Collaboration", Department for Business, Innovation and Skills.
[7] For a discussion of this trend see Levy, C. and Reid, B. (2011) "Missing an Open Goal", Big Innovation Centre report.
[8] Source: Dahlander, L. and Gann, D.M. (2010) " How open is innovation?", Research Policy 39(6): 699–709.

The concept of Open Innovation is much broader than just the sharing of ideas. Open Innovation also involves close collaboration between multiple stakeholders in addressing a business or social opportunity and challenge. Using collaboration to harness the creative abilities of stakeholders – such as technologists, scientists, businesses, entrepreneurs, intermediate and consumer demand, universities, skilled workers, public agencies, government and other institutions – is a key element of Open Innovation.[9]

The transition towards Open Innovation in our innovation ecosystem underscores the importance of closer interactions between universities and businesses. Indeed, the economic importance of collaboration with research organisations such as universities will increase as large companies switch away from in-house operations towards more collaborative models of delivering research. Some risks with this transition must also be acknowledged – for example, the risk of falling expenditure on research in our economy.[10]

The notion that public policy should respond to Open Innovation is evident in several government reports, which aim to promote knowledge-driven economic growth through close collaborations between universities and businesses. For instance, the UK Government's 2011 "Research and Innovation Strategy for Growth" highlighted the ecosystem perspective and promoted the view that UK businesses and universities need to work together to close the gap from concept to market. Similarly, a range of reports highlighted the commitment of various government bodies towards promoting and supporting close interactions between universities and businesses as a strategy for economic growth: the "Higher Education Innovation Funding 2011–15" report of the Department for Business, Innovation and Skills (2012); the PACEC report on "Knowledge Exchange and HEIF Funding" (2013); HEFCE's proposal on open access publications for the Research Excellence Framework, as well as the Skills and Research Councils' Knowledge Exchange Principles.

Traditionally, debates over business engagement with higher education institutions have been highly polarised. They have witnessed a divide between those who think that universities should 'do more' to help the economy and those who want to preserve the academic integrity of higher education institutions. However, this polarised debate is unhelpful and misleading. At their best, university–business collaborations have been shown to benefit the core teaching and research missions of universities as well as the objectives of the private sector[11]. Existing evidence confirms that the UK's performance on university–business collaboration is strong, and has been improving in recent years, as suggested by the increasing income that universities are able to attract from businesses.

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[9] Andersen, B., Brinkley, I and Hutton, W. (2011), "Making the UK a Global Innovation Hub. How business, finance and an enterprising state can transform the UK", Big Innovation Centre report.
[10] This is an idea discussed in detail in Levy, C. and Reid, B. (2011) "Missing an Open Goal", Big Innovation Centre report.
[11] For example the Wilson Review identified a number of strategic partnerships between universities and businesses (including the business supervision of PhD students) that had yielded both direct business benefits and research outcomes for the university. These cases were Siemens–University of Lincoln; Procter and Gamble–Durham University; and BAE Systems–University of Bristol. Wilson, T. (2012) "A Review of Business–University Collaboration", Department for Business, Innovation and Skills.

But Open Innovation is a complex activity and businesses and universities need to overcome many challenges when working together.[12] Handling the cultural change required to embrace external ideas, tracking the performance of Open Innovation activities and overcoming confusion over strategy have all been highlighted as issues in the literature.[13] However, successful open innovators have found ways to truly extract value from their environment. They have found that engaging in new risk-sharing projects, ventures and activities requires a subtle appreciation, which can prove difficult to develop, of the specificities of the different organisations. This project looks to complement existing evidence with a stronger understanding of the approaches and practices that support Open Innovation between universities and businesses.

1.2. Aims of this study

This paper aims to support better understanding of one aspect of our national capacity for Open Innovation – collaboration between universities and businesses.

As noted above, the past ten years have seen a transformation in terms of how we think of university–business relationships. Much of the discourse so far has highlighted the importance of supporting business access to university knowledge in order to engage in successful Open Innovation[14]. While the ability to access university knowledge plays a crucial role in promoting Open Innovation, universities and businesses should make a further step that leads to knowledge co-creation, without which they will not be able to reap the full benefits of Open Innovation[15]. By knowledge co-creation we mean close collaboration by all stakeholders in addressing a business and social opportunity or challenge. These opportunities range from the development of a new product through to larger socio-economic issues such as green energy, health or crime (See Boxes 1 and 2 of Chapter 2 for the definitions of 'knowledge access' and 'knowledge co-creation').

Drawing on existing work on the 'supply side' of university–industry knowledge transfer (including the report to the Strategic Advisory Board for Intellectual Property Policy on 'The flow of knowledge from the academic research base into the economy', Andersen and Rossi, 2010) this study aims to extend the 'state of the art' within this research field. The SABIP study provided evidence on how technology transfer offices use various forms of formal and informal intellectual property rights to enable the transfer of knowledge from their institutions to industry. Our project aims to take these ideas forward by looking in detail at the users of academic knowledge and intellectual property.

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[12] Golightly, J., Ford, C., Sureka, P. and Reid, B. (2012) "Realising the value of open innovation", Big Innovation Centre report.
[13] Annex 1 presents a more detailed discussion of this literature .
[14] Ternouth, P. Garner, C., Wood, L. and P. Forbes (2012) "Key Attributes for Successful Knowledge Transfer Partnerships", CIHE report.
[15] Hughes, A. and Kitson, M. (2012) "Pathways to Impact and the Strategic Role of Universities: New Evidence on the Breadth and Depth of University Knowledge Exchange in the UK and the Factors constraining its Development", Cambridge Journal of Economics, 36(3): 723–750.

A number of projects have sought to establish the scale and characteristics of the 'user' pool[16] and some have focused on the challenges and barriers experienced by businesses when working with universities[17]. However, only a small number of studies have focused on what unlocks university–business links from a user perspective[18], and, to the knowledge of the authors, no research has differentiated between business objectives to co-create with universities and to access existing knowledge.

Hence, this project was designed to respond to this knowledge gap by helping us to better understand the experience of businesses that engage with academic institutions. We focus on how businesses pursue a variety of strategic objectives when interacting with universities, aiming not only at embedding university knowledge in their innovation processes, but also at engaging in knowledge co-creation. We look at:

- To what extent were businesses able to achieve their strategic objectives when interacting with universities – both their general objectives and those specifically related to knowledge access and knowledge co-creation?
- Which channels of university–business interactions, which practices, which institutional infrastructures and which intellectual property mechanisms work well? To what extent do these promote successful interactions allowing knowledge access and co-creation? and
- How to promote the initiation of university–business interactions?

This project explores how to strengthen innovation and growth policies affecting university–business links, improve services offered by universities to businesses, and help businesses learn how to best collaborate with academic partners. This section discusses the evidence base including data collection methods and the characteristics of the sample. Sections two to six investigate the perspective of businesses on university interactions, focusing on the companies' strategic objectives (Section 2), the role of practices and institutional structures (Section 3), the interaction channels (Section 4) the intellectual property protection strategies for value creation (Section 5) and the origin of relationships (Section 6). We conclude with a discussion of the findings together with the implications for universities, businesses and policy makers. We remark that achieving successful university–business interactions requires an enterprising state building a durable framework for such interactions, requiring an ongoing mapping and evaluation of capabilities and shortcomings but also of successes and opportunities.

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[16] Universities UK and Institute of Directors (2011) "New research shows universities and small firms are working together to drive innovation and growth"
[17] Hughes, A. and Kitson, M. (2012) "Pathways to impact and the strategic role of universities" and Ankrah, Burgess and Shaw (2007), 'Do Partners in University–Industry Technology/Knowledge Transfer Relationships Understand Each Other's Motivations?', Leeds University Business School Working Paper 2:1
[18] Bruneel, J. D'este, P. and Salter, A (2010), "Investigating the factors that diminish the barriers to university–industry collaboration". Research policy. 39 (7). pp 858–868

1.3 Evidence base

We have adopted a mixed methods approach to deliver this project. Initially qualitative evidence was gathered through case studies to scope the project. Subsequently, quantitative evidence was collected via an online survey. Finally, we conducted in-depth follow-up interviews with a sample of respondents to the online survey. The findings were triangulated through the pre-launch of the report at the Triple Helix Conference 2013 and a public consultation, which ran for one and half months.

Case studies:

Seven case studies were conducted with companies in four different sectors, namely, life sciences (medical and pharmaceutical), information and communications technology and digital technologies, creative industries and the third sector (e.g. charities). The seven case study interviews were:

- Dr Pauline Williams, Head of Academic Discovery Performance Unit, GSK
- Dr Malcolm Skingle, Director Academic Liaison, GSK
- Dr Alan Watt, Chief Science Officer, Cellzome Inc
- Irving D'Mello, Head of Product and CTO, JustGiving
- Dr. Joanne McCudden, Head of Business Development, Domainex Ltd
- Calum Lee, Senior Consultant, BOP Consulting
- Dr Anthony Ledford, Chief Scientist, AHL, part of Man Investments Limited
- Russell Craig, Manager, IBSG Public Sector
- Dr Jon Hague, Vice President Open Innovation, Unilever

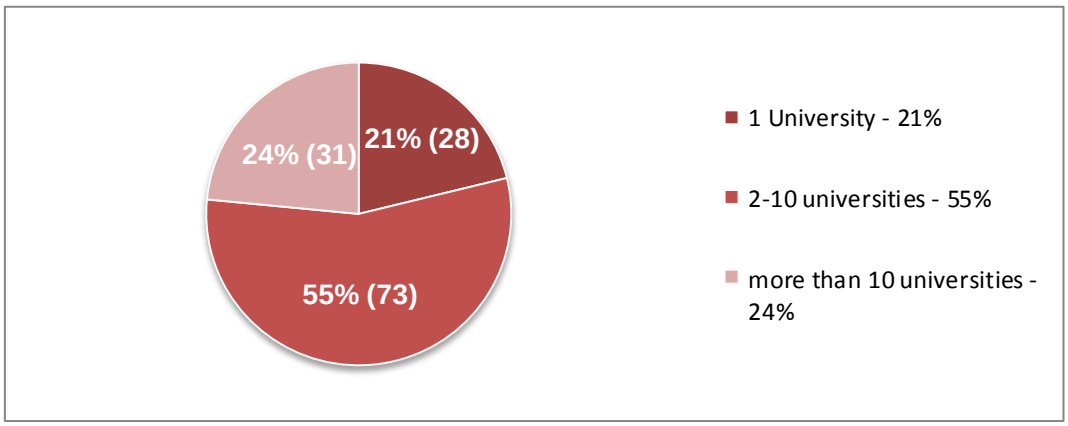
Online survey:

An online questionnaire (the main questions are presented in Annex 1, Tables 1 to 5), was used to gather evidence on businesses' experience with university interactions. The survey was sent to 1,690 companies based in the UK. This list of contacts was drawn from The Work Foundation's own database of contacts. In addition the survey was publicised through the Big Innovation Centre newsletter (sent to 3,000 contacts) and was promoted by a number of our partner universities. The survey received 190 responses, about 11 per cent of those that were contacted.

The sample of respondents was not constructed to be representative of the population of UK firms but rather designed to include a large platform of users of university knowledge. The objective in fact was not to study representative behaviour but rather highlight the different objectives, practices and experiences of users of academic knowledge. As these firms were chosen among the contacts of the Big Innovation Centre (which is an initiative of the University of Lancaster and The Work Foundation) and of its partner universities, they are a selective sample in which the likelihood to have had interactions with universities in the previous year is much higher than in the general population of firms: whilst international

evidence suggests that about 20 per cent of firms interact with universities[19], all the companies in our evidence base had interacted with universities in the previous 12 months: 55 per cent had interacted with between two and ten universities, 21 per cent had interacted with only one university and 24 per cent with more than ten universities.

Figure 1.2: Evidence base: The number of universities the companies engaged with in the previous year



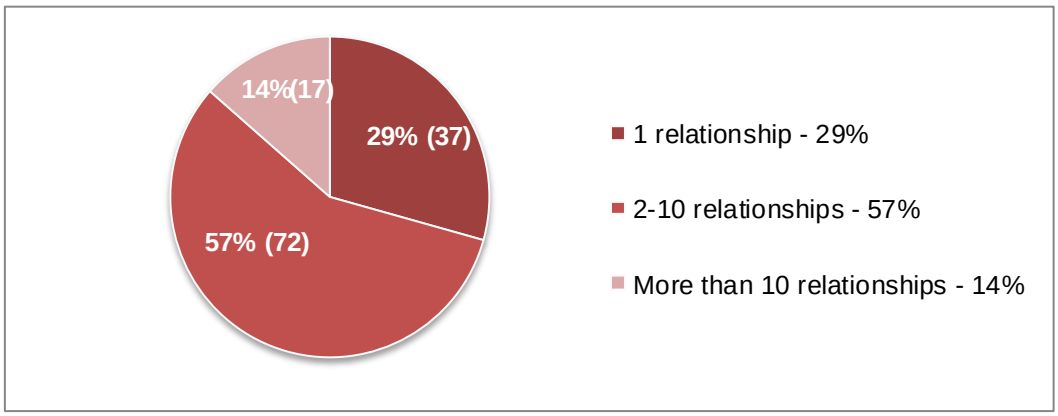
Percentage (and number) of respondents based on the number of universities with which the company interacted during the last year

Respondents were asked to indicate the main university with which they had interacted in the previous twelve months. Responses here indicated that our sample covers relationships with at least 47 UK institutions (See Annex 2 for the list of universities).

A majority of firms (57 per cent) reported having held on average between two and ten university–business relationships with each one of the universities they worked with during the previous 12 months. 29 per cent had one relationship and 14 per cent had more than 10 relationships on average.

[19] Mohnen, P. and Hoareau, C. (2003) "What type of enterprise forges close links with universities and government labs? Evidence from CIS 2." Managerial and Decision Economics 24: 133–145.

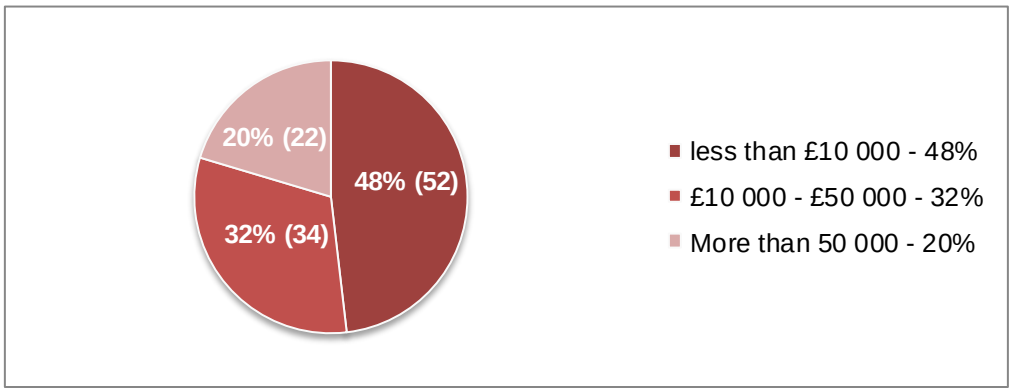
Figure 1.3: Evidence base: Number of university–business relationships that companies held per university during the previous 12 months



Percentage (and number) of respondents based on the number of relationships held with each university on average over the last 12 months

Companies were also asked to state the average financial value of university–industry contracts in the previous 12 months. The average value of contracts was less than £10,000, £10,000–£50,000, and more than £50,000 for 48 per cent, 32 per cent and 20 per cent of firms respectively.

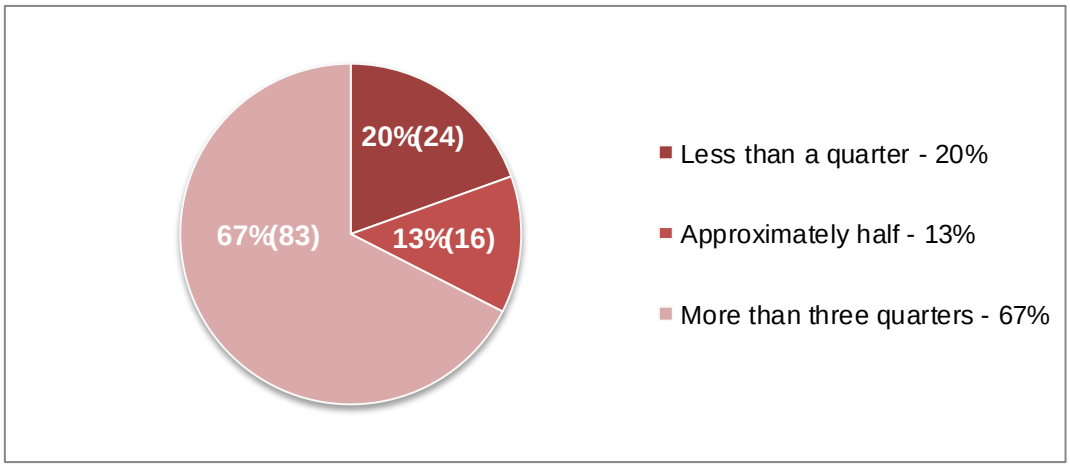
Figure 1.4: Evidence base: Average value per contract during the previous 12 months



Percentage (and number) of respondents based on the average value of contracts during the previous 12 months

The majority of companies (67 per cent) reported that more than three quarters of their university–business relationships were with universities in the UK. Thirteen per cent had approximately half of their university–business interactions with UK universities and for 20 per cent this proportion was less than a quarter, indicating a very global engagement profile.

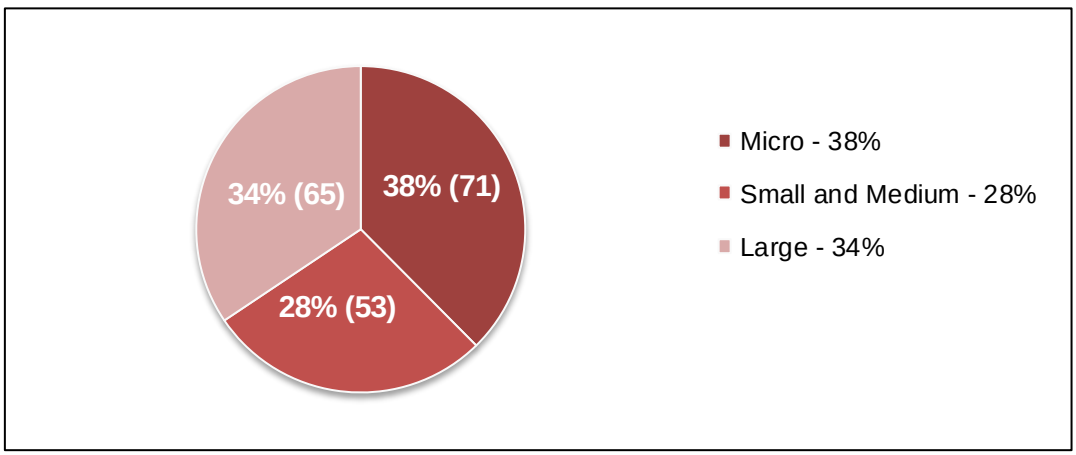
Figure 1.5: Evidence base: Share of university–business relationships with UK universities



Percentage (and number) of respondents based on the share of relationships held with UK universities

In terms of firm characteristics, our evidence base comprises micro (i.e. less than 10 employees), small and medium (i.e. 10–249 employees) and large (i.e. 250 or more) companies (Figure 1.6).

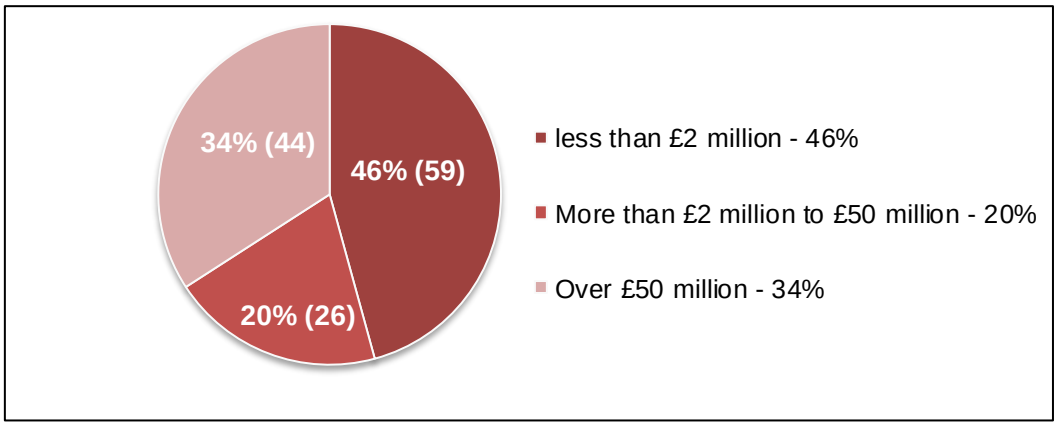
Figure 1.6: Evidence base: Firm size



Percentage (and number) of respondents based on size

Companies' turnover ranges from less than £2 million to over £50 million. The turnover (in 2012) of 46 per cent of the respondents was less than £2 million; 20 per cent had turnover between £2 million and £50 million and 34 per cent had turnover above £50 million – the sample therefore contains a fairly high share of large firms.

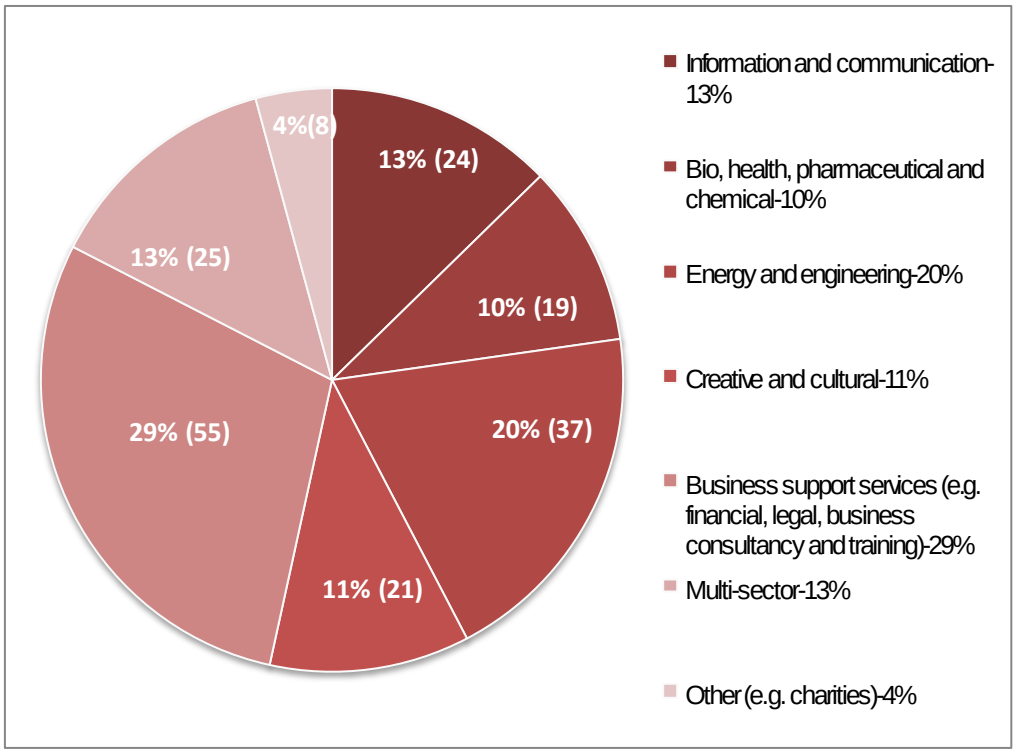
Figure 1.7: Evidence base: Firm turnover



Percentage (and number) of respondents based on turnover in the previous twelve months

The sample includes companies in five main industries, in both manufacturing and services: information and communication (13 per cent of respondents), bio, health, pharmaceutical and chemical (10 per cent), energy and engineering (20 per cent), creative and cultural (11 per cent) and business support services (e.g. financial, legal, business consultancy and training) (29 per cent). Additionally, 13 per cent belong to more than one of these industries (Figure 1.8).

Figure 1.8: Evidence base: The sectors of firms



Percentage (and number) of respondents based on their reported sector

In depth interviews:

We also conducted in-depth telephone interviews with seven randomly selected respondents of the survey. These addressed qualitative accounts on how companies engaged with universities, the best practices they adopted and their use of intellectual property protection strategies for value creation.

1.4 Indicators of 'what works well' in university–business links: the user perspective

If university–business links are playing an increasingly important role in our innovation ecosystem, indicators of 'what works well' are needed to better support these interactions. Based on existing evidence and our initial case studies we have identified five key areas that need to be addressed, and groups of variables or indicators within each area (a review of the literature underpinning the choice of these areas is presented in Annex 1). This is used as a framework to gather evidence on the user perspective of university-generated knowledge. The five key areas are:

- **Firms' strategic objectives when they engage with universities**, including (further details are presented in Table A1, Annex 1):

1. What are firms' strategic objectives when interacting with universities (related to innovation, resources, finance, strategic networking and market competitiveness)?
2. To what extent are firms able to achieve their objectives?

- **The role of practices and institutional support structures**, including (further details are presented in Table A2, Annex 1):

1. What practices enable firms to achieve their strategic objectives (related to access, communication and collaboration, negotiation and institutional support structures)?

- **The channels of university–business interactions**, including (further details are presented in Table A3, Annex 1):

1. What are the channels of interactions (research, service, education and placement-based interactions) that work well from the perspective of businesses?
2. Should businesses diversify their engagements or narrow down to a few types of interactions?
3. What could improve specific types of interactions?

- **The use of intellectual property protection strategies to create value from university–business interactions**, including (further details are presented in Table A4, Annex 1):

1. To what extent do businesses use formal and informal intellectual property (IP) protection strategies?
2. What formal and informal IP protection strategies successfully create value from university–business interactions?

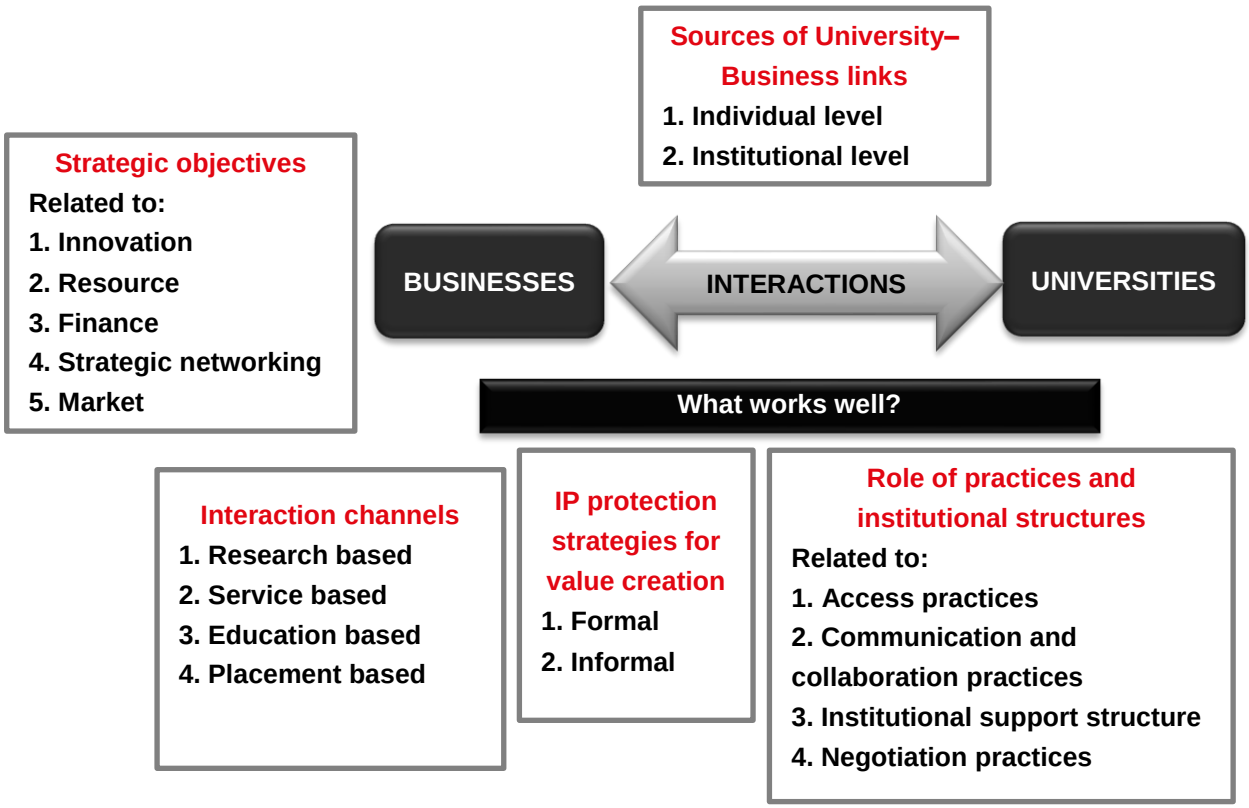
- **The sources of university–business links**, including (further details are presented in Table A5, Annex 1):

1. What are the most effective sources of university–business links?

2. What is the role of individual and institutional sources in the initiation of university–business interactions?

Figure 1.9 presents a conceptual framework highlighting how these five key areas allow us to better understand the business perspective on university interactions. Businesses interact with universities to achieve many strategic objectives. The extent to which businesses are able to fulfil these objectives enables us to understand how to improve university–business interactions, in terms of the channels of interactions, the role of practices and institutional structures and IP protection strategies for value creation. Furthermore, knowing how these relationships begin provides insights into how to promote them. Therefore, these five key areas provide a multi-dimensional and an in-depth view of the business perspective on interactions with universities.

Figure 1.9: Conceptual Framework: Business perspective on university–business interactions



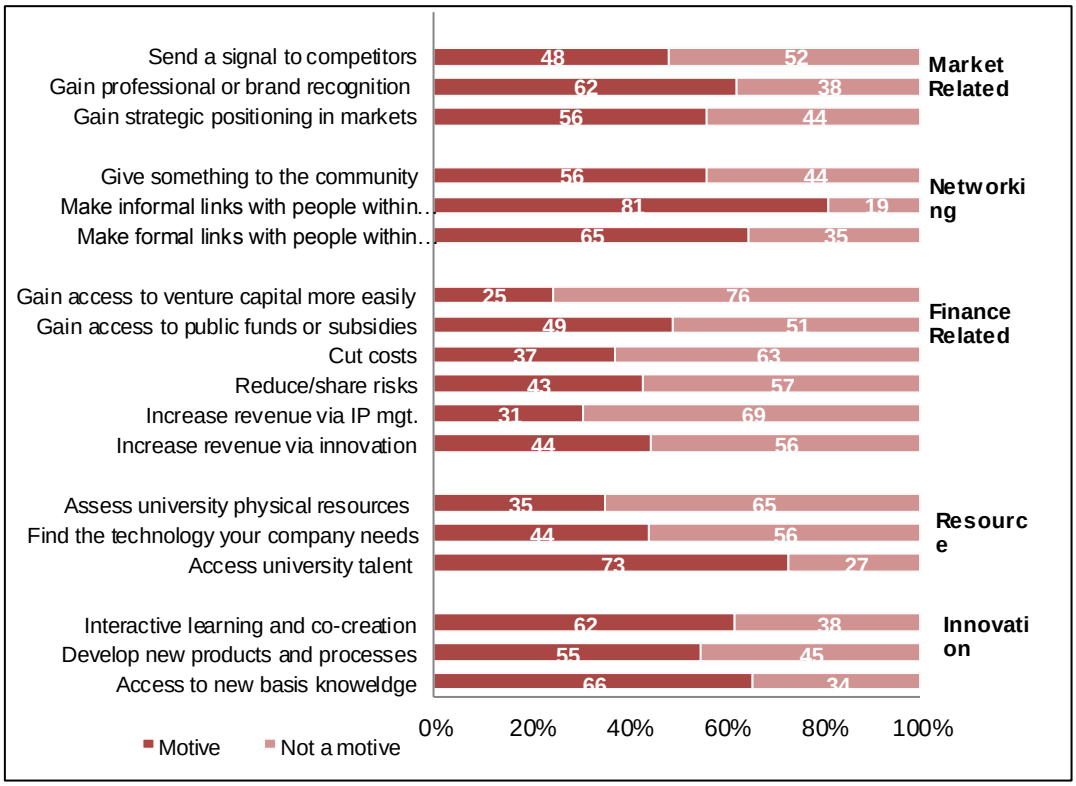
2. Strategic objectives: The most successful users of university–business interactions are able to meet both knowledge access and knowledge co-creation objectives

This section focuses on why companies choose to interact with universities and the extent to which they are able to achieve their strategic objectives when they do. Our evidence suggests that businesses interact with universities mainly to capitalise on the university knowledge base so as to achieve innovation, strategic networking and market related objectives, rather than for short-term financial gains. While about half of the firms are able to successfully achieve their strategic objectives, the rest are still struggling. This struggle is mainly due to difficulties in trying to achieve their objectives related to what we call 'knowledge co-creation', but at least two thirds are able to achieve their knowledge access objectives (See Boxes 1 and 2 below for the definitions of 'knowledge access' and 'knowledge co-creation'). As highlighted in the Introduction, not only gaining access to academic knowledge, but also being able to engage in knowledge co-creation to achieve complex objectives is of paramount importance if universities and businesses are to reap the full benefits of collaborations. Hence, universities and businesses should develop capabilities to co-create knowledge. This chapter discusses these findings in detail and in Chapters 3 to 5 of this report we assess what practices, university–business interactions and intellectual property protection strategies enable firms and businesses to engage in successful collaborations, and particularly, successful knowledge co-creation.

2.1 Businesses capitalise on the university knowledge base to achieve innovation, strategic networking and market-related objectives, not short-term financial gains

Businesses interact with universities to capitalise on the university knowledge base for innovation, strategic networking and market related purposes. As illustrated in Figure 2.1 these objectives were cited by more than 50 per cent of companies as reasons to engage with universities. Short-term financial motives such as gaining access to venture capital or public funds, cutting costs, reducing and sharing risks, increasing revenue, accessing technologies or accessing university physical resources were cited by less than 50 per cent of companies.

Figure 2.1: Companies' strategic motives for university interaction



Shares of firms that have (and have not) reported each strategic objective when interacting with universities

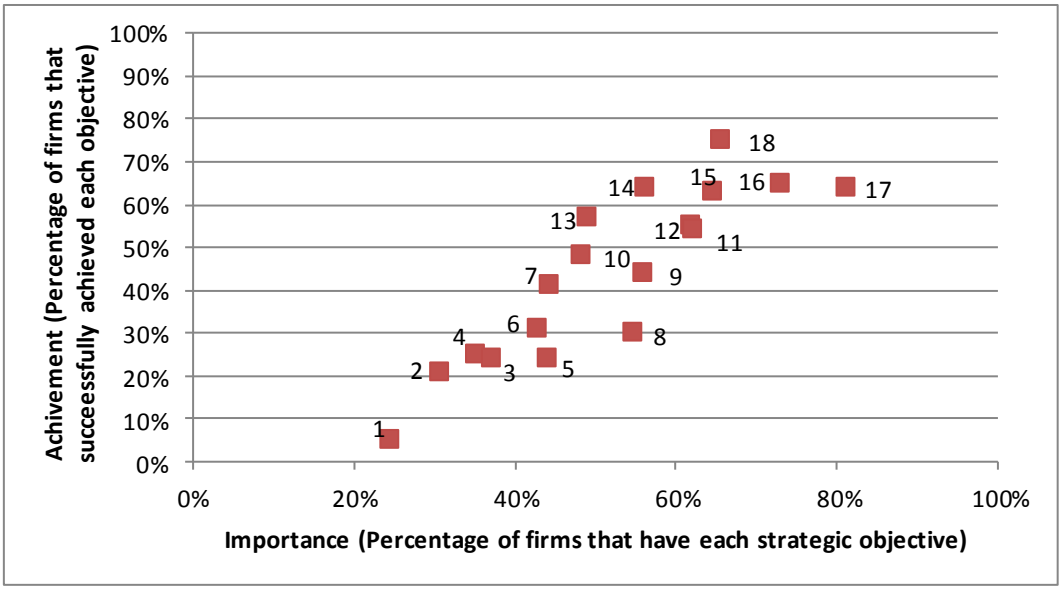
Supporting this view of university–business relationships, Dr Pauline Williams, Head of Academic Discovery Performance Unit GSK also emphasised that businesses mainly interact with universities to access knowledge:

> "The recognition that with the explosion in **knowledge** in biomedicine, that one company can only capture a fraction of this within its walls, and that spreading its net will open possibilities to access a much wider range of **expertise**."
>
> *Dr Pauline Williams, Head of Academic Discovery Performance Unit GSK*

In addition to their limited up-take, we found that firms that held short-term financial gain and access to physical resources as motives for engagement with universities tended to be less successful in achieving their strategic objectives (as shown in Figure 2.1, the firms that choose many of the finance and resource-related objectives (1–7) tend to score less well in terms of achievement). Given this less successful performance and limited uptake, we took the view that these financial and physical resource motives are not key for university–business relationships and have removed this group of motives from further analysis in this

chapter and our assessment of successful and unsuccessful collaborations. The elimination of these seven motives has not resulted in excluding any case (i.e. responded firms) since there was no firm who had only financial or physical resource objectives without other types of objectives.

Figure 2.1: Importance and achievement of strategic motives



Gain access to venture capital more easily	1
Increase revenue via intellectual property management	2
Cut costs	3
Assess equipment & other physical resources in universities	4
Find the technology your company needs	5
Reduce/share risks	6
Increase revenue via innovation	7
Develop new products and processes	8
Gain strategic positioning in the market	9
Send a signal to your competitors	10
Gain professional recognition or brand recognition	11
Interactive learning and co-creation	12
Gain access to public funds or subsidies	13
Give something to the community	14
Make formal links with people within universities	15
Access university talent (i.e. people and teams)	16
Make informal links with people within the university	17
Access new basic knowledge	18

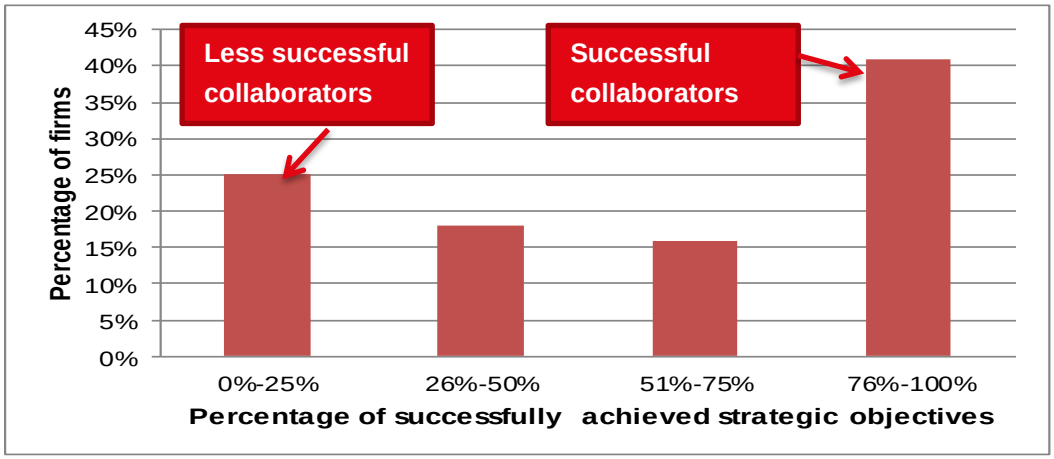
Note: Percentage of firms that have each strategic objective against percentage of firms that have successfully achieved these

When interacting with universities, a majority of firms reported successfully achieving their innovation, strategic networking and market related objectives. More than 40 per cent of

firms were able to achieve more than three quarters of their strategic objectives (we label this group “successful collaborators”). However, 25 per cent of firms were only able to achieve less than one quarter of their strategic motives (we label this group “less successful collaborators”) (Figure 2.2).

The degree of achievement of strategic objectives does not depend upon the firms’ size and sector of operation[20]. However, it may depend upon the practices and intellectual property regulations they adopt and the types of relationships they have with universities: these aspects will be investigated in Chapters 3 to 5.

Figure 2.2: Firms’ degree of achievement of strategic objectives



Note: The X axis illustrates the percentage of strategic objectives achieved by firms, while the Y axis indicates the percentage of firms that obtained each level of achievement (e.g. the histogram on the right indicates that just over 40% of firms were able to successfully achieve between 76% and 100% of their strategic objectives). Financial and physical resource motives were excluded, since the previous findings indicated that they are not very relevant for university–business interactions.

2.2 Successful access to university knowledge, but only some successfully engage in knowledge co-creation

In addition to identifying successful collaborators in general, we also investigated whether firms differ in terms of achieving different types of strategic objectives. We identified two groups of objectives – those involving access to university knowledge and those involving knowledge co-creation (see Box 1 for the definition of co-creation and Box 2 for the rationale for categorising motives in terms of knowledge access and knowledge co-creation). We found mixed results in the ability of businesses and universities to work together on knowledge co-creation initiatives, but a high level of success at accessing university knowledge.

[20] Differences across successful and less successful achievers in terms of: firms’ sizes (X^2 (1, N=98) = 1.542, P = .214); firms’ sectors: (X^2 (5, N=95) =.7.303, P =.199)

Box 1: 'Knowledge access' and 'knowledge co-creation'

At least since the 1990s, knowledge transfer from universities to businesses has been encouraged by deploying considerable financial and human resources. Initially, most efforts were focused on promoting knowledge transfer channels associated with a technology 'push' approach of commercialising university-generated knowledge, such as patenting, licensing and spin-off formations (Friedman and Silberman, 2003, Siegel et al., 2007). While these mechanisms play a major role in terms of creating value through university generated knowledge, there is growing recognition within research communities and government that more direct and involved interactions between business and university can magnify benefits for participants and foster innovation and growth more broadly (for example through engagement in joint research, developing products and processes, and co-creating knowledge).

As an attempt to encapsulate this wide array of university–business interactions, some studies have broadened the definition of 'knowledge transfer' to capture both unidirectional transfer as well as those interactions between universities and businesses that allow 'knowledge co-creation' (e.g. Perkmann and Walsh, 2007, Bramwell et al., 2012, OECD, 2013, Ternouth et al., 2012). Other studies have introduced the term 'knowledge exchange' to emphasise the bi-directional flow of knowledge between universities (e.g. Ternouth & Garner 2009, Garner & Ternouth 2011). Currently, the terms 'knowledge transfer' and 'knowledge exchange' are used to cover a variety of interactions between university and external stakeholders, including those that are aimed at the unidirectional transfer of knowledge from universities to businesses, the sharing of ideas between universities and businesses, as well as knowledge co-creation (See Annex 3 for details about the different uses of the term 'knowledge transfer' and 'knowledge exchange').

Since the main objective of this research is to investigate the business perspective to university interactions focusing on businesses' ability to attain different objectives, we have decided to introduce new terms to distinguish between the business objective to tap into universities' knowledge (with a unidirectional flow of knowledge from universities to businesses) and that to develop and integrate knowledge jointly with universities in order to address a business and social opportunity or challenge. We have defined the former as 'knowledge access' and the latter as 'knowledge co-creation'. It should be noted that we do not differentiate between activities, but objectives of firms which interact with universities, since a single activity (e.g. spin-off companies) could enable firms to fulfil both knowledge access and co-creation objectives.

Knowledge co-creation activities require development and integration of knowledge on the part of all stakeholders, to address opportunities which range from the development of a new product through to larger socio-economic issues such as green energy, health or crime. Stakeholders include businesses and citizens, universities and intermediary organisations, engaging with each other through multiple channels and pooling their internal resources; including knowledge as well as finance, people, markets and big data. This approach to knowledge co-creation is more than simply sharing risk and reward; it encapsulates the integration of the entire innovation ecosystem, and is about co-innovating new markets and more effective business models integrating supply chains that would not exist otherwise. This also means that all elements of the innovation ecosystem need to develop 'absorptive capacity' to take part. We have distinguished between objectives that have to do with securing access to university knowledge, and objectives that have to do with addressing a direct challenge with the support of universities, which requires, to a greater extent, knowledge co-creation. Box 2 below describes these two categories in more detail.

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Box 2. Achievement index of knowledge access and knowledge co-creation

Categorising objectives in terms of 'knowledge access' and 'knowledge co-creation'

The five strategic objectives considered in the knowledge access index are:

- ***Access to new basic knowledge*** *– this involves accessing the basic knowledge developed by academics to industry*
- ***Accessing university talent (i.e. people and teams)*** *– this involves tapping into the human resource pool of universities*
- ***Making formal links with people within university***
- ***Making informal links with people within university***
- ***Giving something to the community***

These three are objectives related to strategic networking (Table 2.2), where networking mainly involves the opportunity to access university knowledge rather than working together to directly address a business and social challenge

The five strategic objectives considered in the knowledge co-creation index are:

- ***Developing new products and processes*** *– the engagement of businesses and universities to develop products and processes involves knowledge co-creation, beyond the ability to access university knowledge, since this requires close collaboration between the parties (i.e. to use the expertise of businesses on the market and the technical knowledge and skills of universities)*
- ***Interactive learning and co-creation*** *– this involves direct co-creation*
- ***Gaining strategic positioning in the market***
- ***Gaining professional or brand recognition***
- ***Sending signals to competitors***

These three are market related motives (Table 2.2) that require universities and businesses to work together by capitalising on market related expertise of businesses and technical knowledge and skills of universities

Variables from finance and physical resource-related objectives were excluded as these were not reported as objectives by a majority of firms (see Table 2.1)

The development of an achievement index

The index is a percentage value that illustrates the extent to which each firm is able to successfully achieve their objectives related to knowledge access and knowledge co-creation.

A firm reporting 50 per cent knowledge access index indicates that it is able to successfully achieve 50 per cent of their objectives related to knowledge access. This could mean successfully achieving one out of two or two out of four knowledge access strategic objectives (See Annex 4 for details of the fulfilment of internal consistency and unidimensionality conditions of the index).

More than 60 per cent of firms have successfully realised their knowledge access objectives such as gaining access to new basic knowledge (75 per cent), accessing university talent

(i.e. people and teams) (65 per cent), establishing formal collaborations with people within universities (63 per cent), creating informal links with people within the university (64 per cent) and giving something to the community (64 per cent).

Performance against the knowledge co-creation objectives was generally lower. On most objectives, respondents were evenly split between those who thought that the interaction with the university had worked very well or less well. Only 30 per cent of businesses had found that developing new products and processes with universities worked very well.

Table 2.1: The achievement of strategic objectives by firms

Strategic Objectives	Works very well	Works less well
Knowledge access objectives		
Access new basic knowledge	75%	25%
Access university talent (i.e. people and teams)	65%	35%
Make formal links with people within the university	63%	37%
Make informal links with people within the university	64%	36%
Give something to the community	64%	36%
Knowledge co-creation objectives		
Develop new products and processes	30%	70%
Interactive learning and co-creation	55%	45%
Gain strategic positioning in the market	44%	56%
Gain professional recognition or brand recognition	54%	46%
Send a signal to your competitors	48%	52%

Percentage of firms that have reported that university interactions are working very well or less well with respect to each strategic objective.

In order to further understand this different performance between 'knowledge access' and 'knowledge co-creation' objectives, an 'achievement index' was developed (see Box 2 for further details). The knowledge access and co-creation indices show that while a majority of firms are able to successfully fulfil their knowledge access objectives, there are two extreme groups of firms in relation to objectives that have to do with knowledge co-creation. One group has fulfilled their knowledge co-creation objectives to a very high extent, while the other group has achieved their knowledge co-creation objectives to a low extent (Figure 2.3).

It is important to note that there is a close correlation between performance in knowledge access and performance in knowledge co-creation[21]. 94 per cent of high achievers of knowledge co-creation were also high achievers of knowledge access. This suggests that firms that are successful at addressing business-related challenges with the support of universities are also successful at accessing university knowledge, whether in the form of basic research, university talent, or academic networks. This supports the view that there is

[21] Chi-square test statistics (X^2 (1, N=69) = 30.658, P = .000)

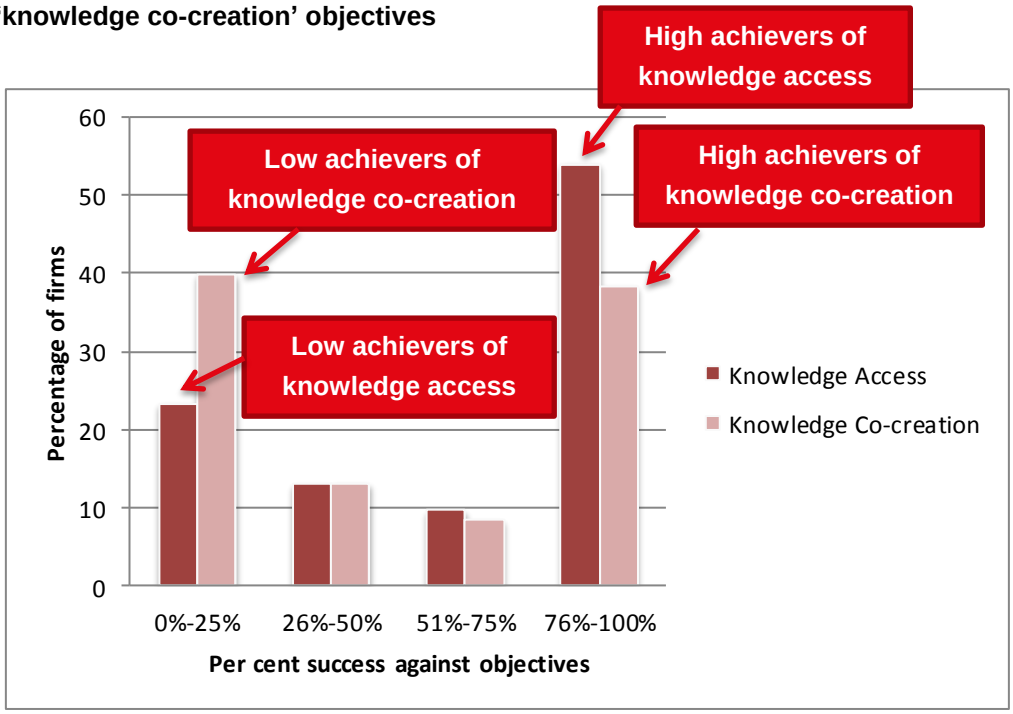
no opposition between collaborating with universities in order to address more direct business challenges and collaborating with universities around the more traditional research and teaching missions of universities, perhaps to achieve more indirect and long-term objectives (engaging in more radical innovation and long-term repositioning of the business, for example): rather, a group of sophisticated users of academic knowledge are able to successfully pursue all these objectives when interacting with universities. In the next chapters, we will explore in greater detail what are the practices that distinguish these high achieving companies.

We are not advocating that universities become 'like business' and give up their role of developers of basic research to suit the needs of business, but rather that universities and businesses can collaboratively tackle market challenges and capitalise on opportunities, each with their own distinctive roles to play, since there are synergies between businesses accessing university knowledge and co-creating knowledge with universities.

On the other hand, it is interesting to find that only 77 per cent of the high achievers of knowledge access were successful with respect to their knowledge co-creation objectives. This confirms that a group of firms are able to access university knowledge, but are finding close collaboration and working together with universities more difficult. For these firms, there is scope for learning how to better engage in knowledge co-creation with universities in order to address their more complex business challenges.

Finally, many of the 40% of firms that do not do well in knowledge co-creation also tend to be unable to access university knowledge; this may be another indication that the ability to benefit from interactions with universities to achieve one's strategic objectives is a general competence which depends on setting up the right practices and infrastructures, whatever objectives the relationship is designed to achieve.

Figure 2.3: The proportion of companies that achieve their 'knowledge access' and 'knowledge co-creation' objectives



Percentage of firms that have achieved different degrees of knowledge access and knowledge co-creation objectives (per cent success against identified objectives).

This mixed performance of knowledge co-creation is perhaps surprising. As set out in the Introduction, recent years have seen a shift in policy and language away from traditional models of knowledge transfer towards a more sophisticated model of knowledge exchange. Alongside these changes, universities have also introduced initiatives to engage in a broad range of Open Innovation activities.

The interview with Russell Craig, Manager, IBSG Public Sector Cisco, also highlighted that businesses are looking for opportunities to work together with universities in a knowledge co-creation approach. This included objectives around co-creation for positioning in product markets, rather than the purchase of services from the university.

> "[We have the] intention of setting up projects which build relationships between Cisco and our partner institutions which go far further than handing over cheques – **these apparently get the lowest rate of return for Cisco**. We prefer instead **to offer access to our talent, engineering competence, capital, ability to commercialise ideas and access to the other companies we work with. We would like to work together**"
>
> *Russell Craig, Manager, IBSG Public Sector Cisco*

Knowledge access and knowledge co-creation are both important elements of university–business interaction. It is positive that knowledge access appears to be working so well for many firms, and there are important lessons that those looking to start new interactions can learn from the best performers here. The findings on knowledge co-creation are also of value as the presence of two extreme groups suggests that there may be a great deal that can be learnt from the high achievers of knowledge co-creation.

The group of high achievers of knowledge co-creation comprises both small and large firms and firms from all sectors[22]. Hence, high achievers may have adopted practices, types of relationships and intellectual property rights that are different from those of low achievers. While investigating general findings on what works well, we also explored how high achievers differ from low achievers in relation to their experience of practices, types of relationships and intellectual property rights. These are discussed in Chapters 3 to 5 of this report.

[22] Differences across groups of achievers of knowledge co-creation in terms of: firms' sizes (X^2 (2, N=102) = 1.214, P = .545), sectors (X^2 (5, N=101) =3.464, P =.629);

Universities and businesses should develop knowledge co-creation strategies

Firms are looking to capitalise on the 'knowledge base' of universities for innovation, strategic networking and market related objectives, not for short-term financial gains

Businesses can successfully access academic knowledge, but many but find it difficult to successfully worked together with universities to co-create or co-innovate.

This comes at a time when businesses no longer look for a one-way transfer of knowledge from universities, but rather seek to develop knowledge and products together with universities.

3. Practices: The key to successful university–business collaboration is to adopt appropriate practices in communication, collaboration and negotiation and effective institutional support frameworks

What practices and institutional support structures drive successful university–business interactions? Are practices that enable successful knowledge access different from those that facilitate successful knowledge co-creation? To what extent do firms adopt these practices? Our survey offers insights into the use and effectiveness of 15 practices to support collaboration (Figure 3.1). For all of the practices for which we had sufficient data to make an assessment (i.e., 13 of 15), we found a significant association with successful collaborations (Table 3.1). However, there was a large variability in the perceived effectiveness of the practices and their use on the part of firms. Box 3 illustrates how we assess the extent to which each practice supports university–business interactions.

Box 3: Assessing the performance of practices to support university–business interactions

Each practice was assessed against five criteria:

1. Is it widely used? (percentage of firms that used the practice in the past 12 months)
2. Is it effective? (percentage of firms that used the practice and rated it as working well)
3. Is the successful pursuit of this practice associated with successful collaborations? (Whether there is a statistically significant difference between successful and less successful collaborators, as identified in Section 2.1, with respect to the effectiveness of each practice)
4. Is the successful pursuit of this practice associated with the successful pursuit of knowledge access objectives? (Whether there is a statistically significant difference between low and high achievers of knowledge access, as identified in Section 2.2, with respect to the effectiveness of each practice)
5. Is the successful pursuit of this practice associated with the successful pursuit of knowledge co-creation objectives? (Whether there is a statistically significant difference between low and high achievers of knowledge co-creation, as identified in Section 2.2, with respect to the effectiveness of each practice)

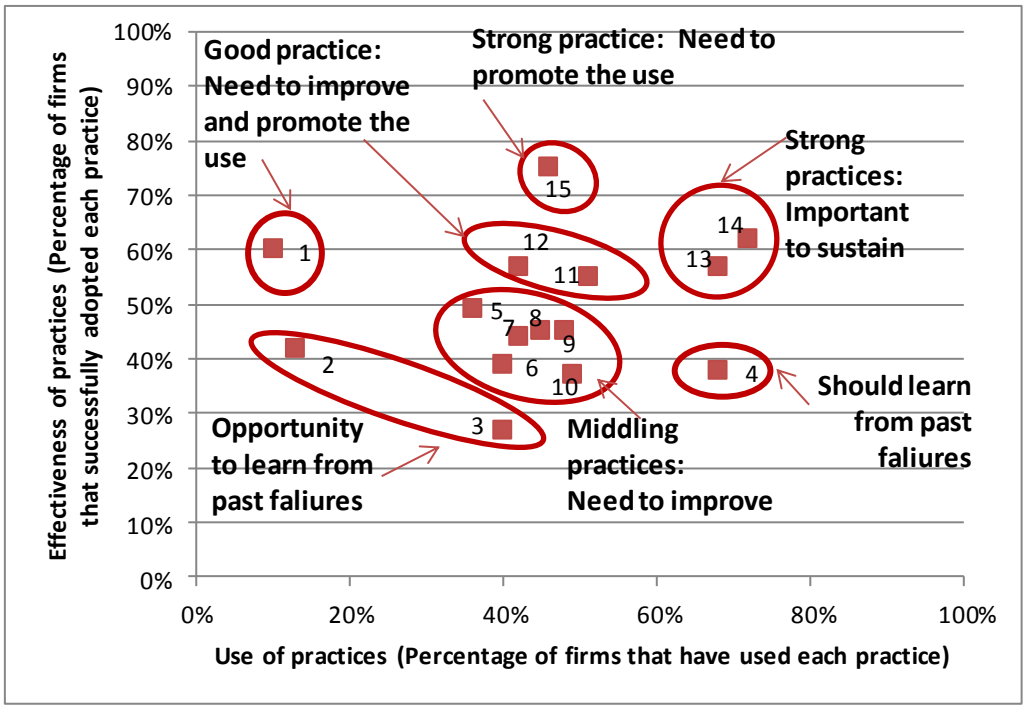
3.1 Widespread and effective adoption of practices

We found significant differences in the performance and use of practices (shown in Figure 3.1) by the sample in general, comprising both successful and less successful collaborators:

- Two practices (openness to collaboration with academics and reaching a shared understanding with academics) are both highly effective and widely used;
- Implementing strong work programme structures with clear milestones is a highly effective practice, but only approximately half of firms in the sample use it;
- Two practices (reducing top-down approaches with more team-level communications and increasing transparency) appear to work well, but are used by only between 40 and 50 per cent of firms[23];
- Lambert agreements appear to be effective, but are used by a small share of firms;
- Innovation vouchers are only used by a small share of firms and most of them rate them as working less well;
- The involvement of industry in setting university policy is used by approximately 50%, but few find this to work well;
- A strong majority of firms has attempted to match the practices of academics or universities to business routines, but more than half have found this to work poorly; and
- A cluster of six practices (the use of Open Innovation networks, negotiating with university technology support or business relations staff, enforcing contracts, negotiating on price or other terms of the contract, using a search engine to find academics/ institutions, and institutions that link academics and companies) were used by between 35 and 50 per cent of firms but were rated as working well only by about 40% of them.

[23] It is interesting to observe that these findings are in line with those of studies that have investigated what practices support the successful performance of Knowledge Transfer Partnerships (see Ternouth, P., Garner, C., Wood, L. and P. Forbes (2012) "Key Attributes for Successful Knowledge Transfer Partnerships", CIHE report).

Figure 3.1: Use and effectiveness of different practices



Lambert agreement (Lambert toolkit for Model Research Collaboration)	1
Innovation voucher scheme	2
The involvement of industry in setting university policy	3
Matching the practices of academics or universities to your business routines	4
Open Innovation networks (e.g. University of Glasgow Innovation Network, Eindhoven knowledge co-creation network, Local Enterprise Partnerships)	5
Negotiate with university technology support or business relations staff	6
Enforcing contracts (e.g. avoid opportunistic behaviour or other trust issues)	7
Negotiate price or other terms of the contract	8
A search engine to find academics/ institutions	9
Institutions that link academics and companies	10
Increasing transparency	11
Reducing top down approach with more team-level communications	12
Openness to collaboration with academics	13
Reaching a shared understanding with academics	14
Strong work programme structure with clear milestones	15

Note: Percentage of firms that have used each practice against percentage of firms that have successfully adopted these

The above findings refer to the whole sample. We then analysed the extent to which successful collaborators differ from less successful collaborators (Table 3.1).

Twelve of the 13 practices (for which we had sufficient data to support the statistical

analysis) are successfully adopted by a significantly higher number of successful collaborators than less successful collaborators (while less successful collaborators find them to be working less well) (Table 3.1). This result holds across both knowledge access objectives and knowledge co-creation objectives. A search engine to find academics/ institutions was the only aspect that was highlighted as 'working less well' by both successful and unsuccessful collaborators. In-depth interviews highlighted that there is a strong need for such a search engine, but there is no appropriate platform for it.

Hence, it could be concluded that successful collaborators effectively use the above-mentioned twelve practices to achieve successful knowledge access and knowledge co-creation. The implication is that there is potential scope to use what appear to be successful practices more effectively.

Our analysis also shows that practices have different effectiveness for companies of different sizes. When compared with SMEs, large firms have more successfully adopted 'reaching a shared understanding with academics', 'increasing transparency', 'reducing top-down approach with more team-level communications', 'strong work programme structure with clear milestones' and 'negotiating price or other terms of the contract with university technology support or business relations staff'. Since these practices ensure successful collaborations, universities, SMEs and government should explore how to overcome challenges faced by SMEs when adopting these practices[24]. Two successful vehicles reported to promote university–SME interactions are mini-KTPs and accelerators, highlighted in Case study 1 and Box 4 below respectively.

Sections 3.2 and 3.3 of this chapter further discuss the use and effectiveness of these practices, grouping them according to their nature of more interpersonal arrangements ('communication, collaboration and negotiation') and more structural practices ('institutional support').

[24] Differences between SMEs and large firms in terms of: 'reaching a shared understanding with academics' (X2 (1, N=109) =4.216, P = .040); 'increasing transparency' (X2 (1, N=109) =4.735, P =.030); 'reducing top-down approach with more team-level communications' (X2 (1, N=62) =4.120, P =.042); 'strong work programme structure with clear milestones' (X2 (1, N=69) =5.337, P =.021); 'negotiating price or other terms of the contract with university technology support or business relations staff' (X2 (1, N=67) =5.092, P =.024); (X2 (1, N=61) =8.050, P =.005)

Table 3.1: Successful adoption of practices: Successful collaborators vs less successful collaborators

The role of practices and institutional structures	Percentage of firms that have successfully adopted each practice		Chi-square statistics	Significance
	Less successful collaborators	Successful collaborators		
a. Access related:				
A search engine to find academics/ institutions	48%	50%	(X^2 (1, N=45) = .021, *P* = .884)	
Institutions that link academics and companies	22%	50%	(X^2 (1, N=47) = 4.063, *P* =.044)	*
b. Communication and collaboration related:				
Reaching a shared understanding with academics	30%	81%	(X^2 (1, N=64) = 17.131, *P* =.000)	***
Matching the practices of academics or universities to your business routines	15%	60%	(X^2 (1, N=63) =12.238, *P* =.000)	***
Enforcing contracts (e.g. avoid opportunistic behaviour or other trust issues)	25%	62%	(X^2 (1, N=37) = 4.980, *P* = .026)	*
Increasing transparency	21%	82%	(X^2 (1, N=46) = 16.571, *P* = .000)	***
Reducing top down approach with more team-level communications	28%	88%	(X^2 (1, N=34) =12.255, *P* =.000)	***
Openness to collaboration with academics	38%	82%	(X^2 (1, N=62) = 12.531, *P* = .000)	***
The involvement of industry in setting university policy	11%	57%	(X^2 (1, N=33) =8.294, *P* =.004)	**
c. Institutional support structure related:				
Lambert agreement (Lambert Toolkit for Model Research Collaboration)	Not enough data, since very low percentage has adopted			
Strong work programme structure with clear milestones	59%	90%	(X^2 (1, N=36) = 4.495, *P* = .034)	*
Knowledge co-creation networks (e.g. University of Glasgow Innovation Network, Eindhoven knowledge co-creation network, LEP)	46%	100%	(X^2 (1, N=22) = 8.250, *P* = .004)	**
Innovation voucher scheme	Not enough data, since very low percentage has adopted			
d. Negotiation related:				
Negotiate price or other terms of the contract	29%	74%	(X^2 (1, N=36) = 7.056, *P* = .008)	**
Negotiate with university technology support or business relations staff	35%	71%	(X^2 (1, N=34) =4.250, *P* = .039)	*

Percentage of firms that have reported that a practice is working very well. Significance levels: * p<0.05, ** p<0.01, *** p<0.001

3.2 Successful university–business interactions through communication, collaboration and negotiation

The following communication, collaboration and negotiation related practices are successfully adopted by a majority of successful collaborators and by the high achievers of knowledge co-creation: 'reaching a shared understanding with academics', 'increasing transparency', 'an openness to collaborate with academics', 'enforcing contracts (e.g. avoid opportunistic behaviour or other trust issues)','negotiating price and terms of the contract with university technology support or business relations staff', 'implementing a strong programme structure with clear milestones', 'reducing top-down approach with more team-level communications' and 'capitalising on differences rather than trying to match the practices of academics or universities to business routines'.

Reaching a shared understanding with academics, an openness to collaborate with academics and increasing transparency

'Openness to collaboration with academics' and 'reaching a shared understanding with academics' were used and rated as "working very well" by a majority of companies. Even though not as widely used as these two, increasing transparency is also adopted by 51 per cent of firms, and of these 55 per cent find that it works very well. Successful collaborators and high achievers of knowledge co-creation have had more successful experience than low achievers in relation to these two practices[25].

The importance of these practices was reinforced by Dr Pauline Williams, Head of Academic Discovery Performance Unit at GSK. She suggested that increasing transparency was key to agreeing joint objectives with universities and adding an impact section to the Research Excellence Framework had increased the openness to collaborations from universities.

> "With **agreed joint objectives and engagements** solutions can be found. GSK's change to **increased transparency** and drive to early publication of data has eased previous tensions between academia (need to publish early) and GSK (no need to publish early). '**Sensible' discussions** in partnerships about patent strategy that benefits both parties have meant that potential downstream issues are avoided."
>
> *Dr Pauline Williams, Head of Academic Discovery Performance Unit GSK*

Dr Anthony Ledford, Chief Scientist at AHL, Man Group plc, suggests that openness to

[25] Differences between successful and less successful collaborators in terms of: 'Openness to collaboration with academics' (X^2 (1, N=75) = 14.789, P = .000) (87% high achievers vs 43% low achievers); reaching a shared understanding with academics' X^2 (1, N=54) =5.404, P =.020) (73% high achievers vs 41% low achievers); 'increasing transparency' (X^2 (1, N=72) =.4.761, P =.029) (73% high achievers vs 48% low achievers).

collaboration by academics could increase further if both parties could reach a collaborative agreement, which would also allow them to overcome any conflicts of interest between them as well as issues faced by businesses due to academic freedom.

> "Handling academic independence within the venture appears to have been a potential, if not an actual, obstacle. The challenge was to find a way to sustain academic independence and also deliver commercial value for the partner. This was in the end solved through the use of a clear collaboration agreement."
>
> *Dr Anthony Ledford, Chief Scientist at AHL, Man Group plc (The Oxford-Man Institute is an academic research centre within Oxford University where Man Group is currently the main industry supporter)*

Implementing a strong programme structure with clear milestones

Implementing a strong programme structure with clear milestones has been mentioned as working very well by 75 per cent of firms that did it, though these only accounted for 46 per cent of the sample (Table 3.1). This practice was found to be important for successful university–business interactions, since 90 per cent of successful collaborators mentioned that this is working very well as opposed to only 59 per cent of less successful collaborators (Table 3.1).

Reducing top-down approaches with more team-level communications

Firms and universities should try to reduce top-down approaches in favour of direct communication at the team level, with a focus on those who are involved in the delivery of projects. A respondent from a large pharmaceutical company has stated that building a team around a single academic to drive the project and maintaining their engagement throughout, rather than having a divide between those who agree the contract and those who deliver the project, have brought about team-level communications and, in turn, close collaborations. Only 42 per cent of the respondents have adopted this, but successful collaborators as well as high achievers of knowledge co-creation have experienced a higher level of success with this practice than low achievers[26]; 88 per cent of successful collaborators and 87 per cent of high achievers of co-creation mentioned that it was "working very well" as opposed to only 22 per cent of less successful collaborators and 40 per cent of low achievers. Developing direct team-level communications within university–business relationships however requires an accommodating organizational framework as well as the involvement of 'boundary spanning' individuals who can communicate easily across organizational boundaries and who are able to see both the academic and business perspectives and the benefits of each.

[26] Differences between low and high achievers of knowledge co-creation in terms of 'Reducing top-down approaches with more team-level communications': X^2 (1, N=45) = 8.820, P = .003.

"**Top-down relationships have been less successful**. Projects need the full engagement of the **project team members** (the people who will do the work to deliver the project) on both company and university sides. Even if one member of team is not on board this can adversely affect the relationship. Communication between those who do the 'deal' and understanding of deal terms by the project team to ensure expectations are clear is critical. Building a team around a single academic to drive the project, maintaining their engagement throughout, is the model that has been successful."

A respondent from a large pharmaceutical company

Capitalising on differences, rather than trying to match the practices of academics or universities to business routines

The inherent difference between universities and businesses is not a hindering factor if it creates opportunities for value creation through interdependency. Rather than trying to change routines to make different groups look alike, both businesses and universities should aim to capitalise on opportunities generated as a result of their mutual heterogeneity. Although 68 per cent of respondents have tried to 'match the practices of academics or universities to business routines', only 38 per cent have experienced success.

Negotiating price or other terms of the contract

Negotiation-related practices such as negotiating on price or other terms of the contract and negotiating with university technology support staff are important for the collaboration. Even though a very low proportion of surveyed firms have successfully adopted 'negotiating price or other terms of the contract' (45 per cent) and 'negotiating with university technology support or business relations staff' (39 per cent), successful collaborators (74 per cent) and high achievers of knowledge co-creation (72 per cent) have experienced a higher level of success than less successful collaborators (29 per cent) and low achievers (31per cent)[27].

3.3 Successful university–business interactions through institutional support

Additional effort to publicise the use of the Lambert Toolkit and revising it to embrace new practices could yield strong returns. The innovation voucher scheme should be improved by learning from challenges faced by previous initiatives or should be replaced by alternative options to enable knowledge co-creation by universities and SMEs. Open Innovation networks are successfully exploited by successful collaborators.

[27] Differences between low and high achievers of knowledge co-creation in terms of 'negotiating price or other terms of the contract' and 'negotiating with university technology support or business relations staff': (X^2 (1, N=47) = 7.567, P = .006)

Increase the awareness of the Lambert Toolkit and develop it to consider new mechanisms for university–industry interactions

The Lambert Toolkit is a set of decision tools and standard agreements designed to improve the process of negotiating collaboration agreements between research establishments and business, which has been in place since 2005. The aim was to develop a fair and balanced tool, without favouring either industry or university interests[28].

Our analysis reveals that the Lambert Toolkit has been used by only 10 per cent of firms, but of these 60 per cent found it to work very well. This result is in line with that of the Lambert review evaluation, which found that although the agreement is often not used as a first choice, it provides "a solid foundation for negotiation, a source of clauses that can help resolve negotiation points, and an independent exemplar of a fair and reasonable approach"[29].

However, a significantly higher proportion of high achievers of knowledge co-creation have not used the Lambert Toolkit[30] (98 per cent), when compared with low achievers (84 per cent). This was mainly attributed to the lack of emphasis made in the agreement to supporting negotiations related to new knowledge co-creation practices. This finding seems to suggest that there is a need to revise the toolkit to facilitate negotiations related to new knowledge co-creation practices, which is also recommended in the Lambert Toolkit evaluation report. The evaluation report in particular highlights the difficulty of handling industry 'in-kind' support on projects. This is an important aspect for many forms of knowledge co-creation relationships. Furthermore, some interviewers mentioned that knowledge co-creation involves people, who tend to engage in dynamic interactions, which might not be confined to the initial agreement, but develop over time. Hence, some questioned the possibility of developing and the usefulness of a standard agreement document. The evaluation report has also highlighted a number of limitations of the agreement. The use of the Lambert Toolkit has been rejected by a number of large businesses who were either unhappy with its approach or simply feel that their way of working better suits their needs.

Support university–business interactions by using specific Open Innovation networks

Networks are forums that facilitate collaboration between universities, businesses, local authorities and other stakeholders. Some examples are the University of Glasgow Innovation Network, the Eindhoven Open Innovation Network, and Local Enterprise Partnerships. Only 36 per cent of respondents have used knowledge co-creation networks, and, as reported earlier, only about 50% reported that they worked well. However, a significantly higher proportion of high achievers of knowledge co-creation have mentioned that these are working very well. This suggests that supporting these networks and encouraging firms and

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[28] Eggington, E., Osborn. R. and Kaplan, C (2013, pp. 4) "Collaborative Research between Business and Universities: The Lambert Toolkit 8 Years On", Intellectual Property Office

[29] Eggington, E., Osborn. R. and Kaplan, C (2013, pp. 4) "Collaborative Research between Business and Universities: The Lambert Toolkit 8 Years On", Intellectual Property Office

[30] Differences between low and high achievers of knowledge co-creation in terms of using the Lambert Toolkit: X^2 (1, N=92) = 4.519, P = .034.

universities to make use of them could enhance firms' collaboration success.

See Case study 2 for a successful open innovation network which is involved in developing ideas into marketable products.

Learn from past experience of innovation voucher schemes

Innovation voucher schemes are a form of a financial incentive provided to small and medium enterprises to collaborate with universities and other knowledge providers. Multiple parties – such as Technology Strategy Board (TSB), individual universities, Science City Bristol and Health Enterprise East – have introduced such schemes, which basically involve providing a voucher to SMEs, who will use this to obtain a service from a knowledge provider.

Innovation voucher schemes are used by only 13 per cent of firms[31]. Of these, 58 per cent did not find them successful. On the basis of this evidence we would recommend that those managing these schemes should find ways to ensure they learn from the challenges faced by previous initiatives. However, it was not clear from our survey if the challenges are being faced by the schemes run centrally by the TSB, or those operated by individual universities. In general, businesses said that funding would not suffice as they are faced with multiple structural issues – such as engaging in co-creation interactions beyond consultancy-type ones, finding the right partner to interact with and solving the power struggle between universities and small firms – that need solving alongside funding provisions. Hence, voucher schemes should be coupled with other support services that ensure successful university–SME interactions.

Also, the respondents of the public consultation revealed that, given the choice, innovation voucher holders prefer business partners over academic partners. This has been the case with the North West Development agency's pilot 1000 voucher scheme, in which 50 per cent of SMEs have selected private sector partners, even though 17 out of 22 knowledge providers listed in the scheme were universities. They believe that this may be due to the ability of business partners to better understand the specific short-term needs of SMEs than academics or higher education institutions, which are not set up to deliver many small innovation services.

These findings suggest that future innovation voucher schemes should consider these specific concerns of SMEs.

[31] It must be noted that 66 per cent of firms in our sample are SMEs and thus eligible to apply for the scheme.

Case study 1: Successful adoption of Mini-KTP by a SME

Company Description

BOP consulting is a small consultancy firm with core expertise in the creative industries. The company is run by a small team comprising 3 directors, 7 consultants and 9 associates.

Origin of and drivers for interaction

The consultancy ran a mini Knowledge Transfer Partnership (KTP) project with Central Saint Martins College of Art and Design. The company wanted to reinvigorate how they use data to catch up with some of the visual representations that some of their competitors were using, but didn't have the skills to do this in house.

The company was aware of the KTP scheme from previous research with the university sector. They knew the area they wanted to strengthen. They spotted the fund and used personal contacts at the institution to start the relationship, without the involvement of third parties.

The nature of the relationship

The scheme consisted of engagement from two individuals. A recent MA graduate with a background in design was seconded over to the consultancy on a full time basis for a period of nine months. This project was further supported by contact with an experienced academic.

As noted above, a single academic managed the relationship from the university side. In the company, a team of 3, including the Managing Director managed the engagement. All employees were involved with the scheme, which reflects the small size of the consultancy. The company found that individual level interactions are very effective.

The project had four stages:

- Scoping - the academic and the graduate identified challenges / opportunities for improvement. This involved learning how the company operated
- New materials – redesign of the materials that the consultancy used (development of new report and graph templates, helping to find new fonts for the reports)
- Training – delivering the skills to use these new materials effectively; and
- Implementation – helping to persuade all staff to implement these new approaches.

The initial scoping phase identified a significant issue with the proposed project. The consultancy model meant that their working environment was entirely client-led. It was instead possible to broaden out the scope of the engagement to deliver a longer lasting impact. The focus of the partnership switched from improving visual representations to producing a new report template, helping to find new fonts, collaboratively building new templates, providing training not only in how to use these tools, but also in how they were

developed and the principles behind their design.

Outcome

The company received significant benefits from the engagement:

"Because our work looks modern, slicker, it looks more impressive, it's slicker, we look more professional. We have probably won more clients because of it. We can't be sure, but we think so."

They also suggested that this engagement was more dynamic and interactive – part of the project was about switching from being reactive towards being more proactive and trying to become forward thinking and leaders in their area of work.

The engagement also led to long term interactions between the company and university. They recruited the graduate to join them permanently. He continued to develop, gained more experience and new contacts and has now gone on to set up his own practice. They have kept the role within the organisation and recruited someone else to replace him. This was delivered through Ravensbourne's recruitment service.

The engagement was primarily focused on transferring knowledge about design rather than creating new IP. The only IP created was in the form of the templates developed.

Challenges and levers

While there is the appetite, capacity and funding issues make it difficult to do more of this type of work. However, the biggest barrier is identifying the need, or the purpose of another similar project. As the partnership progressed it became apparent that the real challenge was finding the right problem for the partnership to focus on.

Accepting change within the organisation presented a particular challenge. It was difficult to take the advice of someone who had only been working there for a short time. The academic was able to argue strongly for changes based on their experience of working with other sectors and other corporate clients, and had the authority to back this.

Lessons learnt from the case study:

Factors that influence successful university–industry collaborations:

1. Individual-level interactions: initiating interactions through an individual academic rather than through the university enables the company to access the talent they need and develop the relationship over time.

2. Spending time to identify the right problem to work on: the involvement of university and business partners to clearly identify the problem that needs addressing is crucial to deliver successful outcomes through a KTP partnership.

3. Flexible arrangements: reaching productive solutions requires that both universities and

businesses are flexible to change the direction of the project depending on the ongoing outcomes.

4. Support SMEs through the mini-KTP – the case study reveals the usefulness of the mini-KTP for SMEs to achieve their objectives, which would not otherwise be possible.

Box 4: Bringing together the ecosystem to accelerate start-ups and SMEs – the 'orchestrating' role of large firms and universities

UK Universities have long been at the forefront of developing programmes to support SMEs and start-ups. For example, the Royal College of Art's Innovation RCA Incubator nurtures and supports embryonic design-driven businesses, providing physical facilities as well as expertise and networks. Universities also frequently collaborate to provide SME support – for example the London Creative and Digital Fusion project sees five universities pooling resources and capabilities to deliver value to networks of small businesses in the London area.

Universities also have a strong history of developing strong productive partnerships with large organisations, such as the well-established and prestigious Oxford-Man Institute of Quantitative Finance, a collaboration between Man Group plc and the University of Oxford. Large firms themselves have developed a wide range of SME services: corporate incubators and small business accelerators like those successfully run by the BBC, Unilever or Telefonica-Wayra. Increasingly, universities are combining these models to adopt an 'ecosystem' approach to accelerating SMEs, in which large firms and universities play an 'orchestrating' role in developing innovation through open collaboration, but no one player exerts control. The idea is that each stakeholder brings their own strengths and looks to contribute to open-ended projects, rather than discrete contracts or goals or targets for each player.

The Stevenage BioSciences Catalyst is a collaboration between Local Authorities, several universities, and partially 'orchestrated' by GlaxoSmithKline. Together they provide resources, expertise and networks to a broad range of SME and start up 'tenants' of the facility whose development they look jointly to accelerate, with fluid movement of people and resources between the different enterprises, university facilities and research teams, and the market access provided by the large firm.

Such collaborations across the whole ecosystem are an increasingly important way for universities to productively engage in complex Open Innovation collaborations to support small businesses and start-ups.

Case study 2: A Successful Open Innovation Network

Organisation description

N8 is a partnership of the 8 most research-intensive universities in the North of England (Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield, York) focused on research collaborations. By working together they have achieved a better outcome than a single institutional endeavour.

Drivers for development

Working initially with the large R&D players in the North of England (for example Croda, Unilever, Procter & Gamble, Smith & Nephew) highlighted the attractiveness of bringing the power of 8 universities together to support new innovations.

The greatest opportunities and need identified by industry were to "interact, engage and translate new technologies and new science into their sectors" through new connections with both academic and industry experts across disciplines and supply chains.

TSB and HEFCE are critical partners and sponsors of this open innovation network, with a key focus on supporting innovation, R&D and growth.

N8 Industry Innovation Forum (N8IIF) – an open innovation network

N8IIF is industry-led and events are based on a specific opportunity area, for instance advanced materials (February 2012), healthy ageing (November 2012) or industrial biotechnology (October 2013). They have identified key industry innovation needs, and then the right academic experts to work on those challenges.

At the event, through facilitated discussions, academic and industry experts discuss ideas, refine and reshape key questions and develop ideas for innovation and R&D.

Outcomes

Each Forum leads to a range of new ideas for innovation and R&D – a total of 50 ideas emerged from the Advanced Materials and Healthy Ageing N8IIF meetings.

These ideas are then supported through a stage-gate process where pump-priming funding is available, and from some of the ideas, new partnerships and collaborations emerge, which then develop into new projects.

- From Advanced Materials four large collaborations have formed (including 14 multi-national and 8 SMEs) and so far have been successful in raising £2.5m of public and private funding.
- From Healthy Ageing five collaborative projects are moving forwards (with local authority, multi-national, and charity involvement) towards collaborative bids and proposals.

Lessons Learnt

Ensuring the right mixture of attendees at the open innovation networks has been critical; not only getting the right mixture of academic and industry expertise, but also finding partners that are open and looking to engage with collaborative research and have the drive and leadership qualities to ensure projects move forwards.

Provision of pump-prime funding and a stage-gate process has ensured that there is a structure to allow ideas to be developed until the point where the collaborations are self-supporting.

Without pre-conceived ideas of what collaborations should be, academic and industry partners have been free to generate ideas for novel approaches based on their complementary skills and their needs.

The journey from idea to co-creation can be long and complex and not all ideas will move forwards to a full multi-partner collaboration; there are, however, many opportunities to support different levels of collaboration on the pathway, including strong bi-lateral relationships. More needs to be done to identify means of supporting these opportunities as well as the large self-sustaining multi-partner collaborations.

Inducing successful university–business collaborations: The role of practices and institutional support structures

Inducing successful university–business interactions through communication, collaboration and negotiation

- Reaching a shared understanding with academics
- Increasing transparency, and an openness to collaborate with academics
- Implementing a strong programme structure with clear milestones
- Replacing top-down approaches with more team-level communications
- Capitalising on differences rather than trying to match the practices of academics or universities to business routines
- Learning how to negotiate with university technology support or business relations staff

Inducing successful university–business interactions through institutional support

- Revise Lambert Toolkit by incorporating knowledge co-creation interactions and the needs of different user groups
- Unlock open innovation by using specific open innovation networks and platforms
- Learn from past experience of innovation voucher schemes e.g. coupling financial incentives with other support schemes for SMEs

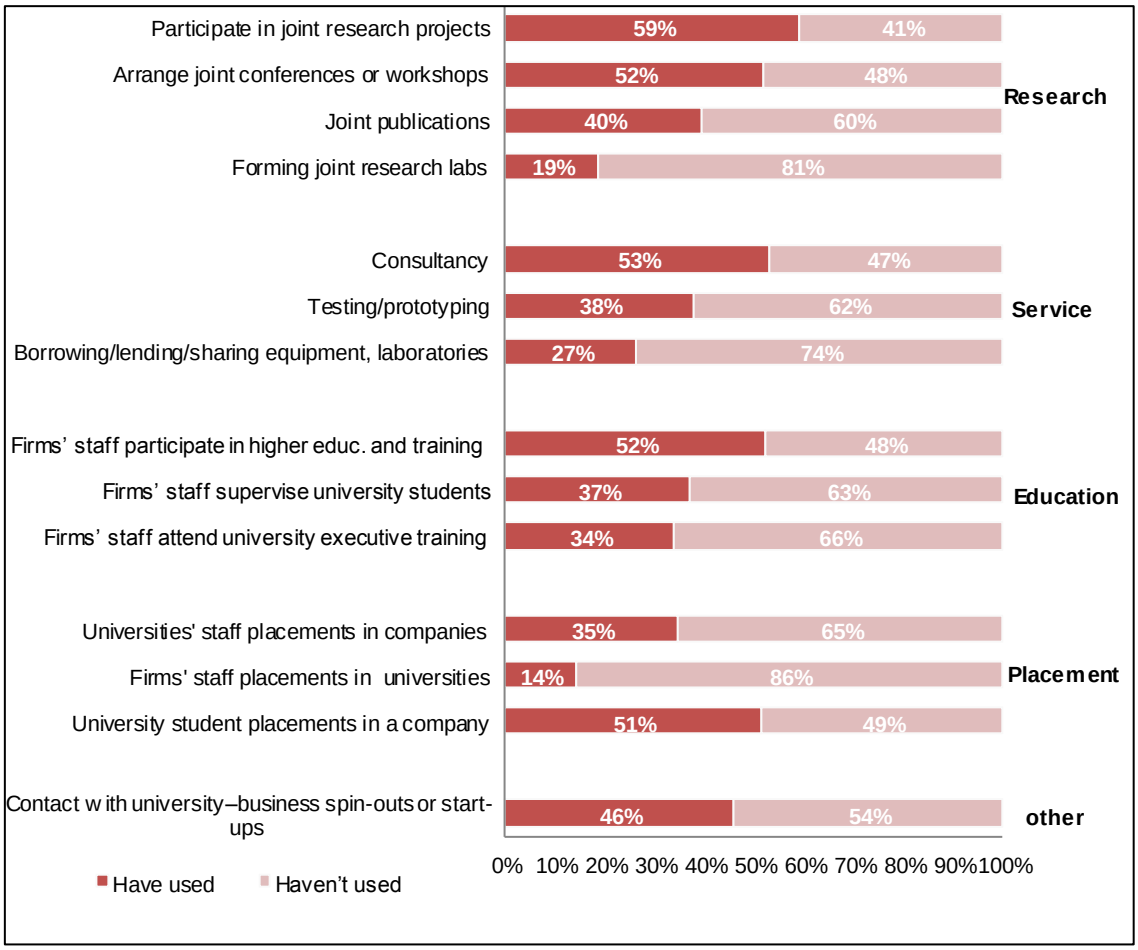
4. Interaction channels: Multi-functional engagements involving research, education, people placements, and technology services are the key to success

Our study also investigated what types of relationships drive successful university–business collaborations. The analysis suggests that firms successfully open multiple channels of interactions with universities, involving research, education and training, staff placements, and technology-based services. Individual firms generate higher value by engaging in a portfolio of interaction channels, which allows synergies between different relationships. Types of interactions that need improving are business staff placements in universities and the sharing of physical resources between firms and universities. University placements for industry should be based on specific research projects and have clear objectives. Adopting new models to share resources between universities and businesses as well as designing research-based industry placements in universities would ensure successful collaborations.

4.1 Value creation through multiple interaction channels

The most common interaction channel between companies and universities is joint research projects: 60 per cent of firms have engaged in this activity during the previous year. More than half the companies surveyed have also worked with universities on consultancy projects, for education and training, to arrange joint conferences or workshops or university placements in the company (Figure 4.1).

Figure 4.1: Use of different university–business interaction channels



Note: Percentage of firms that have used each university–business interaction channel

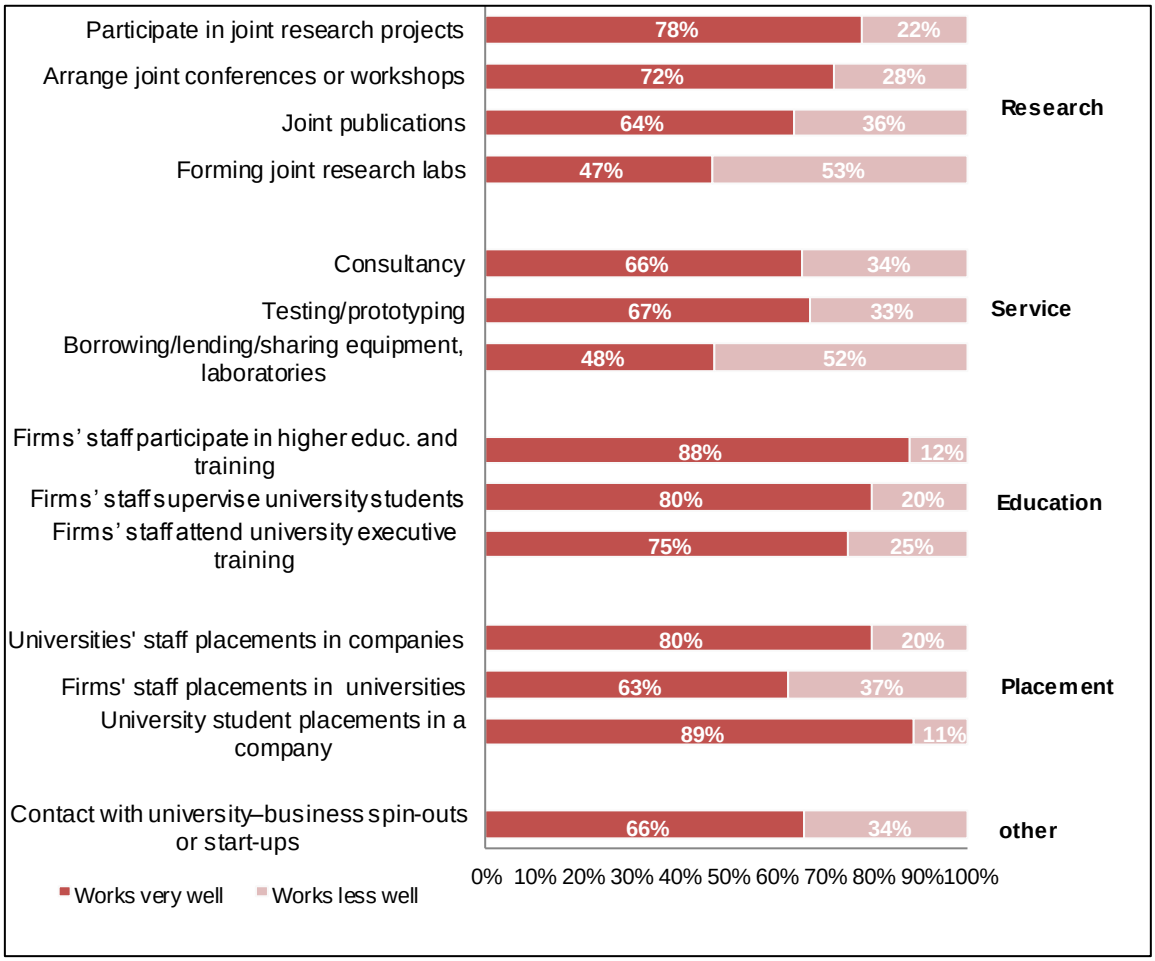
Firms that have engaged in interaction channels have found most to be working very well (Figure 4.2). Such interactions can be classified into five broad types – research-based, service-based, education-based, placement-based and those linked to engagements with university spin-outs or start-ups. The high success rates indicate the ability of UK firms to generate value through university–business links.

Student business placements and staff participation in higher education and training display the best performance, with almost 90 per cent of respondents stating that they had worked very well. University–business interactions generate positive impacts on the workforce's skill level.

The applied research orientation of firms and the advanced basic research capabilities of universities are complementary and generate mutual benefits when engaging in collaborative research: a majority of firms have experienced successful engagements in research-based interactions such as joint research projects (78 per cent), joint conferences or workshops (72 per cent) and joint publications (64 per cent).

About two thirds of businesses interacting with university spin-outs or start ups reported that this worked well (66 per cent). Another way to create value through university–business links are interactions around technology-based services (such as clinical testing, certification, prototyping) and research consultancies, with more than 65 per cent reporting that these are working very well.

Figure 4.2: Effectiveness of different university–business interaction channels



Note: Percentages of firms that have used each type of interaction channel and that consider them to be 'working very well'

Plotting the use against effectiveness of each interaction channel identifies three distinct groups (see Figure 4.3):

Successful and widely used interaction channels: Five types of relationships were used by the majority of firms, and most found them to work very well. These were: joint research projects, consultancy, joint conferences or workshops, firms' staff participation in higher education/training, and university student placements in the company. Both large firms and SMEs have successfully engaged in all these interactions except for joint research projects, where a higher proportion of large firms (93 per cent) than SMEs (68 per cent) have

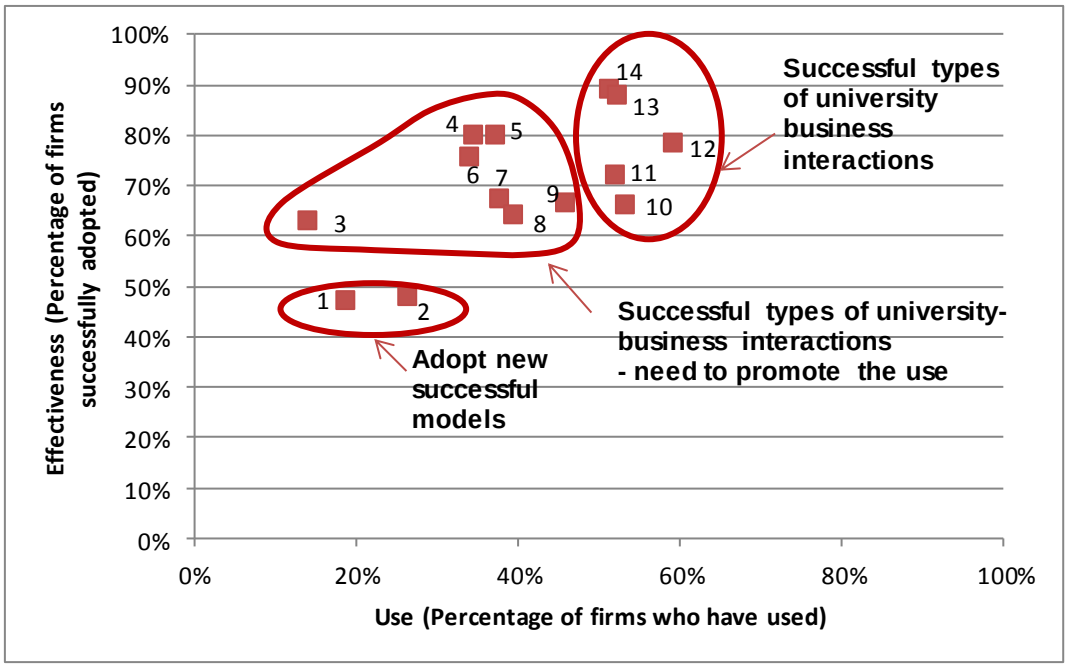
mentioned that they are 'working very well'[32]. SMEs highlighted that barriers to successful engagements in joint research projects were: conflicts between their short-term project goals and the long-term goals of universities, financial constraints, risk averseness and universities' bureaucratic rigidities. They mentioned that useful improvements would include: funding (KTPs were highlighted as very useful), mechanisms to help them to find the right academics, and less bureaucracy in universities. This evidence suggests that firms and universities should continue to engage in the above-mentioned interaction channels and SMEs should be supported to carry out joint research projects with universities.

Successful interaction channels used by few firms: A relatively low share of firms have engaged in firms' staff placements in universities, universities' staff placements in companies, firms' staff supervising university students, firms' staff attending university executive training, obtaining university services such as testing or prototyping, joint publications and contacts with university spin-outs or start-ups. However, a majority of those who did found them to work very well. Both large firms and SMEs have successfully carried out these interactions apart from universities' staff placements in companies, in which a higher proportion of large firms (93 per cent) than SMEs (68 per cent) have mentioned that they are 'working very well'[33]. Universities and businesses should be encouraged to carry out these collaborative interactions. Supporting university staff placements in SMEs may enable the companies to bridge their gap with universities (See Section 4.3 for more information about placements).

Low uptake and limited effectiveness: Less than 50% of firms have engaged in forming joint research labs and borrowing / lending / sharing equipment, and of these less than 50% have reported that they work well. Section 4.2 discusses this in detail.

[32] Differences across firm sizes in terms of successful engagement in joint research projects: X^2 (1, N=106) =9.229, P = .002.
[33] Differences across firm sizes in terms of successful engagement in universities' staff placements in companies: X^2 (1, N=60) =6.023, P = .014.

Figure 4.3: The use and effectiveness of university–business interaction channels



Forming joint research labs	1
Borrowing/lending/sharing equipment, laboratories	2
Firms' staff placements in universities	3
Universities' staff placements in companies	4
Firm’s staff supervise university students	5
Firm’s staff attend university executive training	6
Testing/prototyping	7
Joint publications	8
Contact with university spin-outs or start-ups	9
Consultancy	10
Arranging joint conferences or workshops	11
Participating in joint research projects	12
Firm’s staff participate in higher education/training	13
University student placements in a company	14

Note: Percentage of firms that have used each type of interaction vs percentage of firms that have mentioned that these are ‘working very well’

4.2 New models to share resources between universities and businesses

The least performing university–business relationships involve the formation of joint research labs and the sharing of resources: less than half of the firms that used these interaction channels stated that these are working very well (Figure 4.3). This is perhaps surprising

given that, according to the Higher Education–Business and Community Interaction Survey 2011, income from the use of facilities and equipment rose by around 12 per cent between 2009–10 and 2010–11.

A significantly greater proportion of high achievers of knowledge co-creation (80 per cent) than low achievers (25 per cent) mention that joint research labs 'work very well'[34]. This interaction channel may represent an important element of many knowledge co-creation relationships. A significantly higher number of large firms (65 per cent) than SMEs (21 per cent) state that joint research labs 'work very well'[35]. However, even many large firms struggle to achieve success.

University-owned or jointly owned labs and other research-related resources raise concerns over secrecy / confidentiality, since they are accessed by a wider community including students and staff. It was also suggested to us that technical and legal issues such as the charitable status of universities complicates and frustrates the joint ownership of research facilities.

Case studies 3 and 4 suggest that firms that have successfully engaged in the formation of joint research labs have adopted new business models that enable them to overcome these problems. The unique feature of these successful arrangements is that, rather than creating alignment on common research outputs, businesses and universities independently conduct their own research, but align on capabilities that both parties can access. Moreover, company staff is permanently seconded in labs located at universities. As a result, university and company researchers share common resources and equipment, collaboratively organise seminars, develop new advanced methods of conducting research and take part in constant knowledge sharing; whenever possible, they also conduct collaborative research. This has enabled knowledge spillovers and the exploration of new collaborative opportunities by university and company staff. This model has proved very successful in simultaneously meeting the commercial needs of companies and the academic needs of universities.

[34] Differences across high and low knowledge co-creation achievers in terms of successful engagement in forming joint research labs: X^2 (1, N=17) = 4.408, P = .036.

[35] Differences across large firms and SMEs in terms of successful engagement in forming joint research labsX^2 (1, N=34) =6.275, P = .012.

Case study 3: Successful formation of a science-based joint research lab

Company description

Unilever is a multinational consumer goods company with turnover of £51 billion in 2012 across four major categories, namely foods (30 per cent), personal care (33 per cent), refreshment (19 per cent) and homecare (18 per cent). During the last three years the turnover of the company has increased by £10 billion; the company believes that R&D is a core engine of its sustainable growth and Open Innovation plays a key role in meeting its innovation targets. Unilever reports that in 2012 approximately 80 per cent of their project deliverables were enabled through Open Innovation, a remarkable increase from 40 per cent in 2009. The company's commitment to Open Innovation is also evident by the appointment of a Vice President of Open Innovation.

The nature of relationship

Unilever has six R&D labs around the world; two in the UK (Colworth House and Port Sunlight), one in the Netherlands (Vlaardingen), one in the US (Trumbull), one in China (Shanghai) and one in India (Bangalore). These labs are designed to generate benefits through close collaborations with universities, companies and other stakeholders in an Open Innovation platform.

One such example is the R&D lab established by Unilever at the University of Liverpool, focused on Materials Discovery, Sustainable Materials, High Throughput Science and Behavioural Neuroscience. This £16 million Centre was co-funded by Unilever, the University of Liverpool, the Northwest Development Agency and the European Regional Development Fund.

The unique feature of this lab is that, rather than creating alignment on common research outputs, Unilever and the University of Liverpool conduct their own research, but align on capabilities that both parties access, in order to create different research outputs. The university and company share common resources and equipment, collaboratively organize seminars and constantly share knowledge. In their experience, long-term relationships are more effective than ad hoc short-term relationships. Dr Jon Hague, Vice President of Open Innovation says;

"We have invested over a prolonged period with the University of Liverpool. It is a winning partnership for both parties".

Whenever possible both the parties engage in collaborative research. Unilever staff are permanently seconded in the lab located within the University. This has enabled knowledge spillovers and new collaborative opportunities. University and business staff also collaboratively develop new advanced methods of conducting research. This model has proved very successful in simultaneously meeting the commercial needs of Unilever and the academic needs of the university. It has also smoothed tensions over intellectual property

rights.

Building upon the success achieved through this open access / co-location with world-class academia and other industry partners, Unilever and the University of Liverpool are now in the process of replicating this model with a new lab requiring £47 million investment over 5 years (£16m University of Liverpool, £11m HEFCE and £20m Industry). They expect to have up to 300 scientists, 100 Unilever staff and £10–15m of world-class equipment covering HT Materials, Biological and Formulation Sciences. They believe that this initiative will fully integrate Unilever's R&D in the university campus.

Lessons learnt from the case study:

1. The co-location of labs combined with independent research (conducting joint research whenever possible), is a successful model to meet the commercial objectives of businesses and the academic needs of universities.

2. The co-location of university and industry staff generates multiple spillovers favouring knowledge sharing and co-creation.

3. Long-term relationships between universities and businesses are more successful than ad hoc short-term relationships.

Case study 4: Successful formation of a joint commercial–academic collaboration

Company description

AHL, a wholly owned subsidiary of Man Group plc, is a systematic investment manager that develops quantitative models to forecast and trade in financial markets. AHL has approximately 130 employees, and Man about 1,200 worldwide.

The origin of the OMI collaboration

Man AHL was interested in initiating a research partnership with a leading UK or EU research university, but found it difficult to make meaningful initial contact. They contacted several universities to identify a suitable partner, but were often pushed down a path of talking to people in research services or IP management which did not prove useful. They decided to find a senior academic with enough 'clout' to find out if their idea was viable and to push through the activity, drawing in administrative support. This approach worked well and was the origin of the relationship between the University of Oxford and Man AHL.

The nature of the OMI collaboration

In 2006 the University of Oxford and Man AHL started detailed discussions about creating the Oxford-Man Institute of Quantitative Finance, which soon become known as OMI. The OMI opened in summer 2007 with an initial research grant from Man of £10.45m together with a £3.3m charitable gift to the University of Oxford to permanently endow the Man Chair of Quantitative Finance – the first chair in quantitative finance in the University's 800+ year history. To strengthen the collaboration between Man's commercial and Oxford's academic quantitative finance research interests, OMI would share premises with a self-contained and commercially focused Man Research Lab (MRL) that would be staffed by Man's own employees. Thus OMI became the first quantitative finance research institute in the world to bring together commercial and academic quantitative finance researchers under one roof.

This mechanism ensured the academic independence of OMI whilst enabling MRL to meet the confidentiality and commercial impact requirements of Man. While the Man Research Laboratory independently undertakes commercial research for Man AHL, the OMI pursues curiosity-driven academic research and excellence.

The relationship is managed through the close working arrangements of the OMI and MRL directors. This was necessary from the start to navigate through the contracting process, and continues now as a mechanism to protect potentially commercially valuable intellectual property (IP). In order to identify potential areas for either collaboration or acquisition of IP, all researchers submit three-monthly updates on their activities to the OMI Research Committee. The Directors of OMI and MRL regularly meet to review these updates, identify opportunities, discuss academic research themes and review industry developments more generally.

Outcomes

This physical arrangement of placing a commercial laboratory within an academic research centre resulted in a myriad of spillovers.

- Informal contact between academic and commercial researchers built a basis of understanding to support knowledge sharing. Longer term, day-to-day relationships supported the co-creation of knowledge, much more than could be achieved through ad hoc contact at conferences, for example.
- The Institute operates as an academic hub and is able to draw in international experts, as well as a diverse group of individuals from across the University of Oxford – the OMI run seminars, conferences and workshops attended by both academic and commercial researchers. Without this co-location, such neutral meetings between commercial researchers and leading academics would not have been possible. These allow the commercial partner early access to new academic ideas, eg. presented in seminars sometimes years before publication. Given that there is no tradition of patenting to protect key IP in this industry this time advantage can be a key driver for commercial research and value creation.
- Separate to OMI's academic research activities, the close OMI–MRL working environment makes it easier to communicate with individual academics and, via the collaboration agreement, the potential to offer consultancy on Man's commercial research. This approach also provides a further platform for collaborative research from time to time.
- Within the Collaboration Agreement between Man Group plc and the University of Oxford there is an agreed framework for the commercial partner to acquire a licence for IP that is created by OMI, but importantly this applies only for IP that OMI chooses to commercialise. In particular, OMI always has the right to publish its research. For such arrangements to succeed in practice the directors of OMI and MRL obviously need to have a close working relationship and a high degree of trust.
- OMI has been able to attract world-class staff and research students, and its unique proximity to industry practitioners has assisted in this.

Lessons learnt from the case study:

1. Originating the relationship through individual academics proved to be more successful than through the university-level institution.

2. The establishment of an independent commercial research centre within an academic research institute is a successful resource-sharing model that protects both academic independence and the company's confidentiality requirements.

A number of recent public policy interventions are aimed at promoting knowledge co-creation through resource sharing. A new approach to joint funding of research facilities has been introduced through the UK Research Partnership Investment Fund. If this new scheme is to

be successful, it should promote the sharing of resources through a knowledge co-creation platform and help partners to overcome 'secrecy/confidentiality' challenges. Another example is the development of Research and Innovation Campuses. Such campuses 'provide access to advanced world-leading facilities; scientific services; a unique training environment and world-leading expertise. They foster a culture of collaboration and innovation to support the creation and growth of new and existing business. UK facilities act as magnets for domestic and overseas investment by high-tech companies, and they give UK researchers sought-after expertise in international collaborations. This allows the UK to participate in major international research infrastructure projects that are too expensive and complex for any one country to develop in isolation' (Innovation and Research Strategy for Growth 2012, p. 50).

4.3 University placements in industry more frequent than industry placements in universities

University staff and student placements in industry are working very well and should be encouraged. Industry placements in universities should be improved, with universities and businesses collaboratively designing research-based placements with clearly defined objectives and outcomes.

Most firms report that business placements of university staff (80 per cent) and students (89 per cent) are working very well (Figure 4.2). Universities benefit from business placements by understanding research and teaching demands of industry, while businesses benefit by keeping abreast of advancements in science and technologies.

Although few firms have tried to place a member of staff within a university (14 per cent), most of those who did found it a positive experience (63 per cent). They found that placements without specific objectives were prone to failure, while those based on specific research projects and with clearer and more specific objectives and milestones were more likely to succeed.

Placements also correlate with successful engagements in other interaction channels. A higher percentage of firms that had conducted placements have successfully engaged in all the other types of interactions when compared with the overall sample (Table 4.1). Out of three types of placements (University staff placements in industry, Firm staff placements in university, University student placements in industry), firms' staff placements in university engender more spillover effects, since a higher proportion of firms whose staff had placements in universities stated that other interactions with universities are working 'very well'.

It is perhaps disappointing then that only 14% of firms have used this channel (Figure 4.1). Our findings are in line with the Wilson Review, which has found that placements were falling. Hence, this is an important area to address with calls for action from policy, universities and businesses.

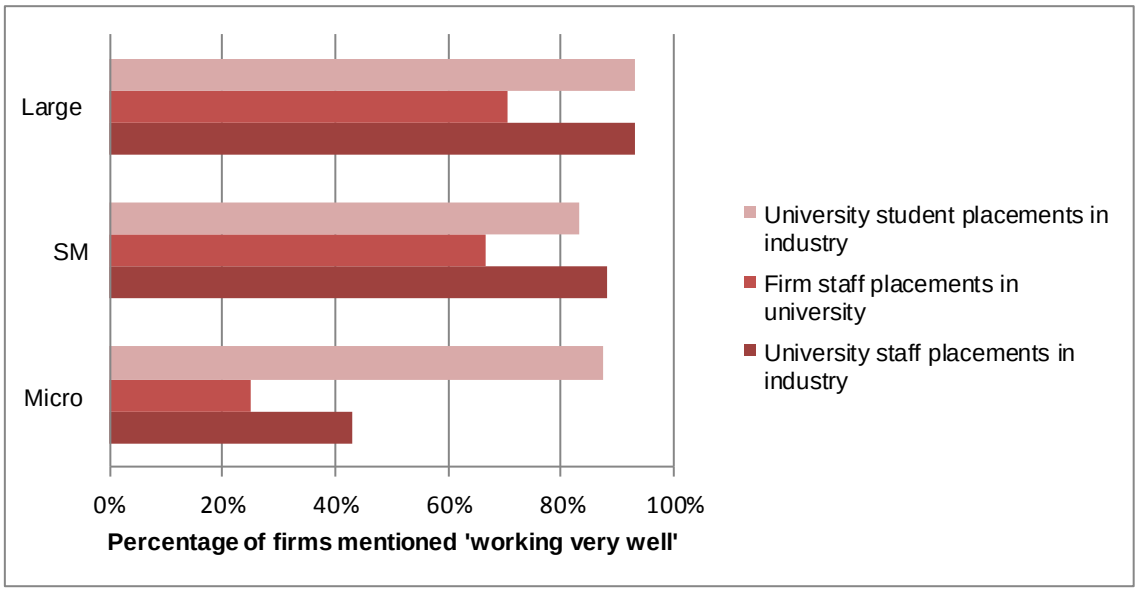
Table 4.1: The 'spillover effects' of placements

	Percentage of firms that state that each interaction channel works very well			
	University staff placements in industry	Firm staff placements in university	University student placements in industry	Overall sample
Research based interactions				
Forming joint research labs	19%	41%	14%	9%
Joint publications	36%	71%	35%	26%
Arranging joint conferences or workshops	46%	77%	51%	36%
Participating in joint research projects	63%	88%	56%	46%
Service based interactions				
Borrowing/lending/sharing equipment, laboratories	24%	35%	18%	12%
Testing/prototyping	30%	53%	30%	24%
Consultancy	40%	65%	39%	33%
Education based interactions				
Firm staff attending university executive training	36%	47%	31%	24%
Firm staff supervising university students	54%	71%	41%	27%
Firm staff participating in higher education and training	65%	71%	55%	44%
Other interactions				
Contact with university–business spin-outs or start-ups	32%	53%	37%	31%

Note: Firms that had mentioned that each type of interaction is working very well as a percentage of the total number of respondents (which also included those that have not engaged in each interaction and those that found that the interaction is working less well).

A majority of large, small and medium and micro firms have mentioned that student placements in industry are working very well. University staff placements in industry and industry staff placements in universities are successfully adopted by large, small and medium firms, but not micro firms (Figure 4.4) The issues faced by micro firms highlighted in the Section 4.1 may explain the difference between large and other firms in relation to university staff placements in industry.

Figure 4.4: Successful placements



Note: percentage of firms that state that each type of placement 'works very well'

Most placements are initiated through contacts with individual academics or by meeting academics at conferences or networking events. Public grant schemes and alumni connections also play a major role in starting industry staff placements in universities (Table 4.2).

Table 4.2: How placements are initiated

	Share of firms that have successfully engaged in placements that usually initiate interactions through each source		
	University staff placements in industry	**Firm staff placements in university**	**University student placements in industry**
Academics contact firms	**73%**	**82%**	**71%**
Firms contact academics	**87%**	**97%**	**88%**
TTOs contact firms	36%	53%	29%
Firms contact TTOs	42%	41%	34%
Firms contact university spinouts	55%	59%	57%
University spinouts contact firms	56%	65%	51%
Public grant schemes	40%	**82%**	56%
Meeting at conference / networking event	**91%**	**94%**	**98%**
Alumni connections	63%	**82%**	65%
Introduction through another company	43%	50%	56%

Share of firms that have successfully engaged in placements that usually initiate interactions through each source (e.g. 73% in the first line indicate that "of the firms that have successfully engaged in university placements in industry, 73 per cent have begun relationships with universities through an academic contacting the firm").

4.4 Portfolio engagements deliver high success due to synergies

Businesses and universities should create value through a portfolio of interaction channels rather than focusing on a few. There appear to be synergies between different types of interactions. More than half the firms in our sample have successfully carried out at least four different types of interactions, across research, education, technology services, people placements and more, in the previous twelve months (listed in Figure 4.2). While large firms have carried out five types of interactions on average, small and medium firms have carried out four and micro firms two. High achievers of knowledge co-creation have carried out a significantly larger variety of interactions per firm than low achievers[36]. Case study 5 illustrates how a large company engages in a portfolio of activities.

It is difficult to identify the direction of causality here, but this positive view of portfolio engagement is supported by previous studies that have highlighted that engagement in multiple entrepreneurial activities provides additional benefits, due to the synergies that can

[36] The mean number of interactions is significantly different across high and low achievers: t-test revealed $t(100)=-2.26$, $p=0.026<0.05$.

be developed between activities[37]. These synergistic effects arise as a result of the ability to use social networks, knowledge and skills, outputs, and physical resources[38] generated by engaging in one activity to carry out another activity.

There may be opportunities to build on this and better support multifaceted relationships. Our findings on the ability of universities and businesses to successfully engage in multiple types of interactions potentially support the recommendations from PACEC[39] that universities should further diversify business interactions and develop longer-term relationships and strategic partnerships rather than focus on single transactions. Universities and businesses should openly recognise the importance of engaging in a portfolio of activities. This evidence also increases the importance for universities to track and understand how and where they are engaging with businesses. This activity is essential if they are to identify and support these multiple-point relationships.

[37] De Silva, L. R., Uyarra, E. and Oakey, R. (2012) "Academic Entrepreneurship in a Resource Constrained Environment: Diversification and Synergistic Effects" In: Audretsch, D. B., Lehmann, E. E., Link, A. N., Starnecker, A. and Audretsch, D. (eds.) Technology Transfer in a Global Economy. New York: Springer; Westhead, P., Ucbasaran, D., Wright, M. and Bink, M. (2005) "Novice, Serial and Portfolio Entrepreneur Behaviour and Contributions", *Small Business Economics*, 25(2):109–132; Alsos, G.A., Ljunggren, E. and Pettersen, L.T. (2003). Farm-based entrepreneurs: what triggers the start-up of new business activities? *Journal of Small Business and Enterprise Development* 10(4): 435–443.

[38] Westhead, P., Ucbasaran, D., Wright, M. and Bink, M. (2005) "Novice, Serial and Portfolio Entrepreneur Behaviour and Contributions", *Small Business Economics*, 25(2):109–132; Alsos, G.A., Ljunggren, E. and Pettersen, L.T. (2003). Farm-based entrepreneurs: what triggers the start-up of new business activities? *Journal of Small Business and Enterprise Development* 10(4): 435–443.

[39] PACEC (2012) Strengthening the Contribution of English Higher Education Institutions to the Innovation System: Knowledge Exchange and HEIF Funding, HEFCE http://www.hefce.ac.uk/media/hefce/content/whatwedo/knowledgeexchangeandskills/heif/pacec-report.pdf

Case study 5: Successful adoption of a portfolio of relationships by a large firm

Company description

Cisco Systems is an information technology infrastructure provider employing 3,500 in the UK and 67,000 total. The company is a spin-out from Stanford University. They have historically worked very closely with Silicon Valley institutions, but are now increasingly broadening their outlook as they realise that 'talent' is globally distributed.

The origin of drivers for interaction

Cisco does not have a standardised or managed system for interacting with universities. There is no central body responsible for relationships and often multiple, non-connected individual level contacts can be found. Their absorption of ideas depends on the knowledge domain, which is different for different types of technologies.

The intention to set up projects that build relationships between Cisco and universities goes far further than handing over cheques (these apparently get the lowest rate of return for Cisco). They prefer instead to offer access to their talent, their engineering competence, their capital, their ability to commercialise ideas and the other companies they work with.

The nature of the relationship

Cisco has successfully engaged in a broad range of interactions from grants for basic research in areas related to their core competencies through to highly collaborative non-research projects such as the delivery of entrepreneurial education. They have also carried out seminars to informally share knowledge with academics and across the company. They consider universities as important partners of their open source communities; Silicon Valley Education Foundation is an example of an open source community, the objective of which is to support local education initiatives by encouraging collaboration, promoting educational resources and providing tools for teachers. Through open source sharing Cisco promotes technology innovation, achieves reduced time-to-market and lower cost of product development. Their scale supports the successful carrying out of a portfolio of interactions and there are synergies between different interactions.

Usually, one interaction leads to other types of interactions. For instance, often consultancy work has been developed from joint research, where the output of consultancy is used as an input to joint research.

Cisco values the ability to take time to build a relationship. They have experienced that trust between partners is crucial for successful interactions, since it is a platform that enables partners to work together and resolve things in a 'sensible' way. Senior individuals within Cisco spent a significant amount of time (i.e. 12 months to develop a project was acceptable) to design projects with clear objectives and milestones. Therefore, engaging in portfolio interactions with a client is found to be more effective than carrying out ad hoc collaborations with different clients.

As stated by Russell Craig, Manager, IBSG Public Sector Cisco, they have a boilerplate approach in which background IP remains with the originator. They do not expect to generate IP in a relationship, but if it emerges they stop and discuss ownership at the earliest possible point. They are adverse to long contracts which lock down options. Even though the person interviewed does not represent Cisco as a whole, he said that he was not aware of the Lambert agreements.

Lessons learnt from the case study:

Factors that influence successful university–industry collaborations:

1. Initiating university–business interactions through individual academics

2. Successful engagements in a wide array of interactions: portfolio engagements enable successful university–business interactions when the scale of firms supports this

3. Close and long-term collaborations with academics allow trust to develop, which is essential for successful engagement

4. Designing projects with clear objectives and milestones: spending time to scope projects during initial stages ensures the delivery of clear outcomes

5. Adopt a flexible approach to intellectual property rights

6. Adoption of practices that induce Open Innovation: commitment to supporting open source communities has been mutually beneficial for both universities and company

7. Lack of awareness of the Lambert agreements is reported

Induce successful university–business interactions: Channels

University business interactions create value through multiple channels involving research, education, people placements and technology services

Adopting new models to share resources between universities and businesses and designing industry placements based on Open Innovation challenges and projects will improve relationships

Portfolio engagements deliver high success due to synergies between activities

5. Intellectual property: value creation mechanisms must be open and flexible

Most firms in our sample have not used either formal or informal IP protection strategies in their interactions with universities. These firms are mainly in sectors such as business services, creative and cultural, and information and communication services, and they interact with fewer – mainly UK – universities. Firms that do use IP protection strategies generally rely upon bundles of both formal and informal mechanisms[40]: they protect their knowledge in different ways at the same time and over time where the nature of their relationship changes. Firms that are in science-based sectors, those that collaborate with a large number of universities and with international universities tend to use large IP bundles.

While holding a large bundle of different types of IP (e.g. more than 8 types) is associated with higher engagement in interactions with universities, this is not necessarily linked to greater success in these collaborations: the share of collaborations that 'work well' is the same across both heavy and low users of IP protection methods. 'Soft' IP such as cultivating commitment and trust, and secrecy/non disclosure agreements are working very well.

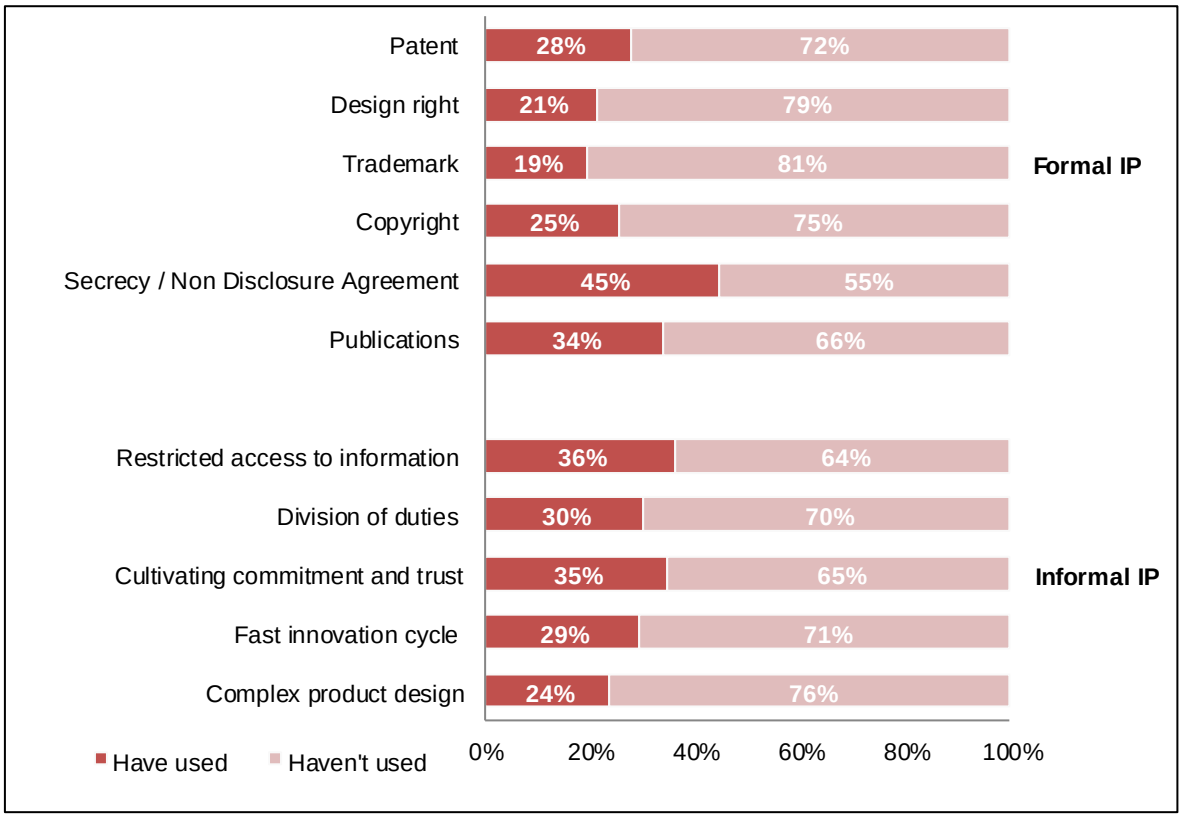
5.1 Firms' use of IP protection strategies when interacting with universities

Firms do not frequently use either formal or informal IP protection strategies for knowledge generated through university–business interactions. Of the surveyed firms, 44 per cent have not used any formal IP, including IPRs, 56 per cent have not used any informal IP and 41 per cent have not used either formal or informal IP[41] (Figure 5.1).

[40] We use the term 'formal IP' to refer to patents, copyright, design rights, trademarks, secrecy/non disclosure agreements (NDA), publications; of these, the first four are also identified as 'intellectual property rights' (IPR). We use the term 'informal IP' to refer to arrangements to protect IP such as restricted access to information, division of duties, cultivating commitment and trust, fast innovation cycle, complex product design.

[41] Although these figures are low, they are higher than the general share of all UK firms that use IPR, as revealed in the UK innovation survey 2011 (http://www.bis.gov.uk/assets/BISCore/science/docs/F/12-p107-first-findings-uk-innovation-survey-2011.pdf).

Figure 5.1: Share of firms using formal and informal IP protection strategies, including IPR



Percentage of firms that "have" and "have not" used different IP protection strategies. Open source/creative common licensing comprises only 54 responses since answers were obtained through a separate follow up email.

Companies use a diverse range of formal and informal IP protection strategies in their interaction with universities. In interviews, several firms suggested that universities are not very knowledgeable about IP strategy, especially in relation to covering costs of commercialisation, valuing IP, and in developing partnerships. This was highlighted as a barrier for engagement:

> *"Staff within the university without industrial experience do not always appreciate the cost of bringing IP to market, and therefore overvalue any IP generated. General understanding of (training in) IP law could improve this. I have encountered several universities (individuals and groups) who did not appreciate they were covered by Export Control legislation – an indication that understanding in this general area could be improved."*
>
> *A respondent from a large firm in the Engineering sector*

"Universities are now trying to **make more and more income from IP** – as a result we face big barriers to co-operation, they have heavy boilerplate and its largely not worth dealing with the legal mess they create."

A respondent from a micro company in Creative and cultural sector

"**A lack of commercial acumen in universities**. Formal mechanisms sometimes cumbersome. Universities **overvalue their IP. Attitudes need changing.**"

A respondent from a large service-based company in multi-sectors (a provider of business process management and outsourcing solutions to clients in many industries)

"The universities we try to work with spend a lot of time taking about how they must and should protect their IP rather than working with SMEs and sharing .... **Universities do not get Open Innovation ... their 'drivers' are all wrong!**"

A respondent from a micro firm in the Engineering sector

Firms have also stated that the use of informal IP protection strategies can be quite difficult in the university setting, even if a relaxed attitude is the preferred option. Challenges include academic freedom, easy access to information for a wider community (e.g. lab facilities being open to students and other academics), the long time taken by universities for delivery (e.g. it is difficult to use fast innovation cycles), the high priority placed by academics on publication and the tendency of academics towards indirectly stating (maybe unknowingly) some sensitive information in publications. Thus, building trust seems to be a challenge (a finding which is also restated in section 5.2). Bruneel et al (2009)[42] also reported (using over 3,000 cases) that building inter-organisational trust is a strong factor that diminishes barriers to university–business collaborations.

[42] Bruneel, J., D'Este, P. and Salter, A. (2009) Investigating the factors that diminish the barriers to university–industry collaboration. In: Triple Helix VII. 7th biennial International Conference on University, Industry & Government Linkages. Glasgow, UK 17–19 June 2009. Glasgow: Strathclyde University.

"Universities frequently work with multiple industrial partners in the same space either simultaneously or over time. This can lead to risks of cross-contamination and issues of access to strategic sideground which is perhaps not always visible. In many cases **universities do not adopt a strategic approach to managing trade secrets**; i.e. they default to one of two binary outcomes – **either publishing anything** or being extremely reluctant to tell a partner anything even when an NDA is in place."

A respondent from a large company in multi-sectors (i.e. oil, gas and chemical)

"**Fast innovation cycle**: that is something we do internally in our R&D department. **But for university projects, especially if they involve a PhD, it usually takes multiple years before something useful appears**. Funded projects using a post-doc researcher can produce useful results in a much shorter timescale, but is much more expensive (around three times)."

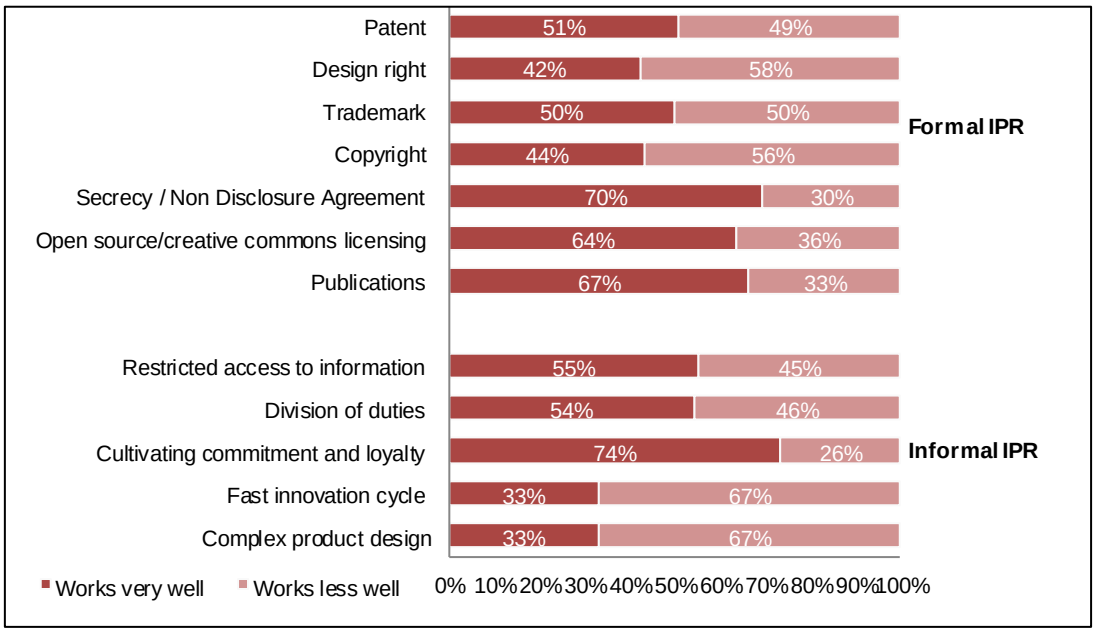
A respondent from a large company in the Information and Communications sector

Overall, it is clear that policymakers, universities and businesses need to take an open and flexible approach to managing their IP arrangements, and put in place suitable measures in the instances where this is relevant. For example, some academics and university bodies may be interested in learning more about the effective use of different forms of IP mechanisms.

5.2 Cultivating commitment and trust and non disclosure agreements work well as mechanisms for knowledge co-creation

We now address firms' experiences of how well the various forms of IP protection work, in relation to their interactions with universities. Opinions on the successful use of each IP tool are quite evenly split, with about half the respondents finding that they work well. But there are a couple of exceptions. Softer forms of formal and informal IP protection, such as 'cultivating commitment and loyalty' and secrecy/non disclosure, seem to work extremely well, as reported by at least 70% of firms participating in each of these IP strategies. Hence, overcoming trust-related challenges, as highlighted in the above Section 5.1, is an area to focus on.

Figure 5.2: Effectiveness of formal and informal IP protection strategies



Note: Percentage of firms that report each IP protection strategy working very well or less well. Open source/creative commons licensing comprises only 54 responses since answers were obtained through a separate follow-up email.

In open discussions with businesses, lack of mutual trust with academics was presented as an issue to be overcome. A particular challenge was reaching agreements with academics over what portion of the research would be made public, and what would be protected. It was presented to us that academics often have an interest in publishing, which often means releasing commercially sensitive information through publications. This practice is difficult to control. Hence, collaboration requires a high level of trust between academics and the commercial partners to achieve success.

There are many collaborative projects between businesses and universities where both parties contribute resources and receive outputs that fit their interests. For the company this often involves a confidential commercial output and for the academic this could be a related (but distinct) academic publication. One such example suggested by a respondent was a project where the academic output concerned the methods used in the research, without revealing any commercially sensitive details. However, despite the possibility of both commercial and academic advance this arrangement might be difficult under proposed arrangements for open access. If the university had used UK Research Council funding for the research, then all outputs from funded work would have had to be made public in the future. Usually, resolving disclosure issues requires a judgement between the importance of open access and the secrecy requirements of the commercial partner.

Despite this apparent success with the use of more informal IP protection strategies, a consistent theme of the research was the need to overcome persistent issues of trust around disclosure of the results of collaborative activities. This was highlighted in the case study interviews, in the comment section of the survey, and in the in-depth follow-up interviews.

5.3 Value creation from IP through a combination of strategies

5.3.1 Firms differ in the intensity with which they use IP protection strategies

Firms are heterogeneous in relation to the use of IP protection strategies. A two-step cluster analysis identified three typologies of firms (see table 5.1):

1. **Low users of IP** (34 per cent of firms): Firms that do not use either formal or informal IP, or use them to a very low extent)

2. **Medium users of IP** (25 per cent): Firms that use both formal and informal IP to an intermediate extent

3. **Heavy users of IP** (16 per cent): Firms that use both formal and informal IP to a very high extent

Medium users of IP have used a bundle of less than 6 types of formal and informal IP while heavy users have used 8 to 11 types of IP.

Table 5.1: Use of IP protection strategies by intensity of use: cluster composition

Composition of the three clusters in terms of IP adoption:	Low users of IP	Medium users of IP	Heavy users of IP
Number of IPRs	97% have adopted no IP	82% have adopted a bundle of less than 6 IP	94% have adopted a bundle of 8 to 11 IP
Number of types of formal IP	97% have adopted no formal IP	80% have adopted a bundle of less than 4 formal IP	81% have adopted a bundle of 4 to 6 formal IP
Number of types of informal IP	100% have adopted no informal IP	35 % have adopted no informal IP and 49% have used a bundle less than 4 IP	84% have adopted a bundle of 4 to 5 informal IP

Table 5.2: Use of IP protection strategies by intensity of use

	Low users of IP	Medium users of IP	Heavy users of IP
	Percentage of firms that use each type of IP		
Patent	2%	25%	87%
Design right	2%	10%	81%
Trademark	0%	10%	74%
Copyright	0%	23%	84%
Secrecy / Non Disclosure Agreement	0%	73%	90%
Publications	0%	44%	87%
Restricted access to information	0%	42%	97%
Division of duties	0%	33%	90%
Cultivating commitment and loyalty	0%	42%	100%
Fast innovation cycle	0%	33%	87%
Complex product design	0%	19%	84%

We now investigate further characteristics of these three different types of users of IPRs.

5.3.2 Firms in science-based sectors, collaborating with a large number of universities and having interactions with international universities use of IP bundles

Heavy and medium users of IP, which use a variety (bundle) of types of IP at the same time are more often found in sectors such as 'bio, health, pharmaceutical and chemical', 'engineering and energy' and 'multi-sector', among firms that had interacted with a large number of universities (during last year) and among firms that interacted with a higher proportion of international universities (Table 5.4).

A majority of firms in Business support services (e.g. financial, legal, business consultancy and training) (65 per cent), Creative and cultural (50 per cent) and Information and communication are low users of IP (50 per cent). A majority of firms in Bio, health, pharmaceutical and chemical (47 per cent), Engineering and energy (68 per cent) and multi-sector (83 per cent) are either medium or high users of IP[43].

Interacting with a higher number of universities increases the intensity in the use of IP: a larger share of heavy users of IP have interacted with more than 10 universities, compared to low users (33 per cent of heavy users vs 15 per cent of low users)[44].

However there was no significant difference between heavy and low users of IP in terms of

[43] Differences across groups of IP users in terms of firm sector: X^2 (10, N=139) = 27.984, P = .002.
[44] Differences across groups of IP users in terms of number of universities with which firms interact: X^2 (2, N=77) = 6.983, P = .030.

the number of interactions with each university[45]. Firms explained that once trust is developed between universities and businesses, they reduce the use of IP.

Companies that work more with UK universities tend to be low users of IP. 88 per cent of low users of IP had more than three quarters of their relationships with UK universities, whereas only 64 per cent of heavy users of IP had more than three quarters of their relationships with UK universities[46].

The size of the firm[47], whether the firm is a successful or less successful collaborator (identified in section 2.1)[48] or a high or low achiever of knowledge co-creation[49] (identified in section 2.2) were not correlated to the intensity of IP use.

5.3.3 Firms use bundles of formal and informal IP protection strategies, depending on the stage of relationship and the type of knowledge generated

Even within a single project, firms may use both formal and informal IP as a bundle, depending on the stage of relationship and the type of knowledge generated.

Different approaches were taken by different companies interviewed. Dr Pauline Williams, Head of Academic Discovery Performance Unit, GSK stated that the relationship begins with a non disclosure agreement, and over time the partners may start using formal IP, including IPR, dependent upon the type of knowledge generated. However, Russell Craig, Manager at IBSG Public Sector Cisco, mentioned that since the generation of commercially viable IP is not always guaranteed, they adopt a flexible approach and assert IPR only if IP with commercial value is generated.

> "Interactions are mainly **informal** at the beginning of a relationship. If informal engagement suggests mutual interest, then we would proceed to **discussions under confidential disclosure agreement** and thereafter to a formal structured alliance deal contract in which **IP rights** will be clearly defined, including reversion rights if GSK pulls out from development at later stages. Deal terms around IP are not a one size fits all as they may fit into an overarching agreement with the broader institute, or be bespoke for a specific project. **Flexibility is needed within contractual relationships** to expand the project scope. There may also be **development of new informal knowledge sharing** between parties in areas outside of the contracted partnership."
>
> *Dr Pauline Williams, Head of Academic Discovery Performance Unit, GSK*

[45] Differences across groups of IP users in terms of number of interactions with each university: X^2 (2, N=72) = .997, P = .607.
[46] Differences across groups of IP users in terms of share of interactions with UK universities: X^2 (4, N=111) = 15.236, P = .004.
[47] Differences across groups of IP users in terms of firm size: X^2 (4, N=144) = 1.771, P = .778.
[48] Differences across groups of IP users in terms of collaboration success: X^2 (2, N=86) =4.118, P =.128
[49] Differences across groups of IP users in terms of achievement in knowledge co-creation: X^2 (2, N=88) = 2.785, P = .248

"We have a boilerplate approach in which background IP remains with the originator. We do not expect to generate IP in a relationship, but **if it emerges we stop and discuss ownership at the earliest possible point**. We are adverse to long contracts which lock down options since these limit options."

Russell Craig, Manager IBSG Public Sector, Cisco

A firm's decision as to which bundle of IP to use is dependent upon the nature of the knowledge generated during their interactions with universities. How to strategically bundle IP to generate synergies between them is important. A recent publication by IPO[50] makes a valuable contribution by studying the impacts of using a bundle of formal IPRs.

This suggests that firms should be prepared to be open to the use of many different IP protection strategies and flexible in adopting different strategies according to what is appropriate in each specific interaction or even in each stage in the interaction process.

5.3.4 Heavy use of IP promotes engagement in university–business relationships, but does not necessarily determine success

Heavy users of IP are interacting more with universities, and engage more in all types of interactions (except for 'Firms' staff participate in higher education and training' where there is no significant difference among IP users). However, there was no difference between heavy, medium and low users of IP in terms of whether or not they have achieved success in meeting their strategic objectives.

[50] Helmers, C. and Schautschick, P. (2013) "The use of intellectual property right bundles by firms in the UK", Intellectual Property Office (http://www.ipo.gov.uk/ipresearch-iprbundles-report1.pdf)

Table 5.3: Use of IP protection strategy by type and effectiveness of different interaction channels

Interaction channels	Use and performance	% Low users of IPRs	% Medium users of IPRs	% Heavy users of IPRs
Participate in joint research projects	Have used*	31%	73%	94%
	Work very well	70%	83%	72%
Arrange joint conferences or workshops	Have used*	38%	65%	67%
	Work very well	67%	74%	70%
Joint publications	Have used*	17%	54%	71%
	Work very well	64%	58%	68%
Forming joint research labs	Have used*	9%	17%	45%
	Work very well	33%	75%	43%
Consultancy	Have used*	26%	71%	77%
	Work very well	77%	65%	50%
Testing/prototyping	Have used*	20%	44%	77%
	Work very well	77%	67%	61%
Borrowing/lending/sharing equipment, laboratories	Have used*	9%	19%	70%
	Work very well	17%	44%	62%
Firms' staff participate in higher education and training	Have used	43%	52%	68%
	Work very well	96%	88%	76%
Firms' staff supervise university students	Have used*	25%	40%	74%
	Work very well	88%	79%	83%
Firms' staff attend university executive training	Have used*	22%	33%	55%
	Work very well	93%	69%	65%
University staff placements in companies	Have used*	22%	42%	58%
	Work very well	86%	85%	72%
Firms' staff placements in universities	Have used*	0%	23%	39%
	Work very well		73%	67%
University student placements in companies	Have used*	38%	59%	71%
	Work very well	88%	93%	86%
Contact with university–business spin-outs or start-ups	Have used*	24%	57%	84%
	Work very well*	93%	63%	54%

Note: *The difference between heavy, medium and low users of IPRs is significant at 95% confidence level (i.e. $p<0.05$). The figures indicate the percentage of each type of user that has engaged in each type of relationship and has reported it to 'work very well'.

Induce successful university–business collaborations: Intellectual property value creation mechanisms

- Firms in business services, creative and cultural and information and communication sectors, those that interact with a low number of universities and whose engagements are mainly with UK universities have a lower tendancy to use IP protection strategies
- Those that do, use bundles of formal and informal IP protection strategies
- Being active in science-based sectors, collaborating with more universities and with international universities are associated with greater use of IP bundles
- More intense use of IP is associated with higher engagement in university–business relationships, but not higher success in achieving strategic objectives
- Cultivating commitment and trust and secrecy/non disclosure agreements work successfully as mechanisms for open innovation

6. Infrastructures: Academics and users are catalysts for university–business links, but Technology Transfer Offices strengthen institutional links

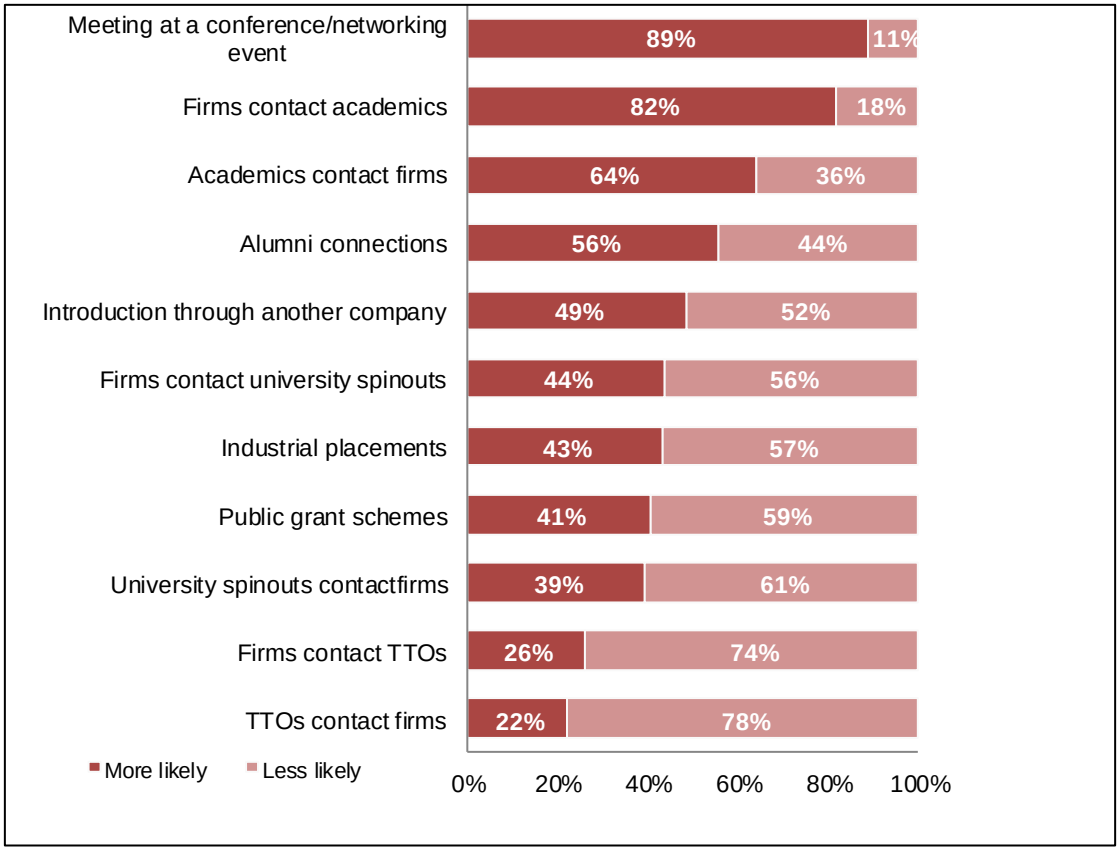
An important question in order to understand university–business relationships is: how do they begin? We asked businesses how their relationships with universities were initiated. Also, could the 'origin' of a relationship depend upon the type of relationship and the size of the firm?

6.1 Empowering academics

Individual academics are key to starting most interactions between universities and businesses. Hence, important mechanisms to encourage interactions could be: universities doing more to empower and encourage academics to work with business (including providing better support); universities and/or businesses developing new platforms that could help build links between them.

A majority of relationships are initiated either by firms contacting individual academics (82 per cent of firms) or academics directly approaching firms (64 per cent of firms). 89 per cent of firms described their relationships with academics as usually arising out of conferences or networking events (Figure 6.1). Other forums used to begin relationships through individual academics are public speaking engagements, industrial consortia, professional bodies, online networks (e.g. LinkedIn), student societies (e.g. The Bright Futures Societies) and university careers events. In-depth interviews also confirmed this by highlighting the importance of individual academics as the origin of relationships with universities. In some firms, a manager is responsible for academic contacts, including visiting individual academics, keeping abreast of new developments and identifying opportunities for collaboration.

Figure 6.1: Origins of university–business relationships



Note: Percentage of firms that are 'more likely' and 'less likely' to use different modes to begin relationships with universities

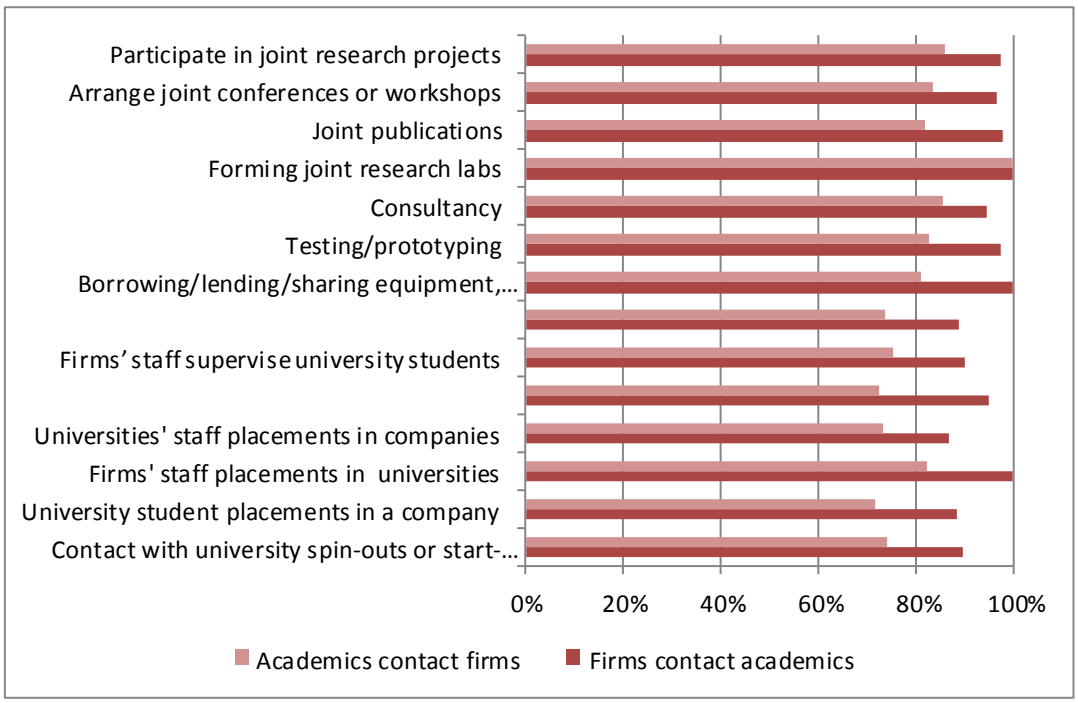
Dr Anthony Ledford, Chief Scientist, AHL, part of Man Group plc illustrated how OMI's programme of seminars, conferences and workshops promotes university–business links by providing a forum to understand the work of individual academics and therefore improving relationships and more productive interactions.

> "The Institute operates as an academic hub and is able to draw in international experts, as well as a diverse group of individuals from across the University of Oxford – they run seminars, conferences, workshops which are attended by both academic and commercial researchers. It was not thought to be possible to arrange this type of neutral meeting **between commercial researchers and leading academics in this field in any other way."**
>
> Dr Anthony Ledford, Chief Scientist, AHL, part of Man Group plc

The importance of contacting academics rather than institutions was further emphasised during the public consultation. It was highlighted that since the most cited strategic objectives are people related (see Figure 2.1), a majority of successful interaction channels represent different forms of people interactions (see Figure 4.2), and the highly effective IP strategies such as trust and commitment and non disclosure agreements are based on people (see Figure 5.2), initiating interactions through people make more sense than through institutions.

The importance of individual academics to begin university–business links was not found to vary dependent upon the type of relationship. Of the firms who have successfully adopted each type of relationship, more than 75 per cent have mentioned that they are 'more likely' to initiate relationships through academics.

Figure 6.2: Shares of firms that usually begin relationships with universities through academics



Firms that usually use academics to begin relationships with universities as a percentage of those that have successfully adopted each type of relationship (e.g. 85% in the upper histogram indicates that "of the firms that have successfully participated in joint research projects, 85 per cent are more likely to use individual academics to begin relationships with universities").

Case study 6: Successful engagement through individuals rather than institutions

Company description

GSK's Academic Discovery Performance Unit (AcDPU), a small unit comprising less than 10 employees within GSK's Research and Development division, focuses on very early development of medicines.

Origin of and intentions for collaborations

The types of knowledge and intellectual property (IP) of interest to AcDPU involve molecules that have been discovered in academia around which they wish to develop medicines in partnership with academics. The main business driver is the desire to broaden access to potential new medicines that are discovered in academia.

One example that explains how interactions are initiated through individual academics is GSK's involvement with a professor at a London University to develop a new molecule to treat a rare serious disease. The Head of R&D understood the potential clinical value of the medicine that the academic was trying to develop, had the vision of increasing Open Innovation in GSK and the authority to champion the assessment of collaboration opportunities. This led to discussions between AcDPU and the academic, and eventually resulted in the formation of a formal partnership.

The academic co-leads and is embedded within the GSK development team and will be involved all the way through development right out to medicine launch. He is able to share his expertise and keep working on the product until commercialisation. There is an agreement on the IP/royalties and divestment rights. Being part of the project has enabled him to appreciate the challenges of drug development. Unplanned side-benefits for both partners have been that i) the partnership led GSK to work with the academic on an earlier pipeline for other different options in the same therapeutic area; ii) GSK has been able to provide some support to the academic for a project in his group in a different therapeutic area that GSK is not seeking to in-license.

This successful experience has now been repeated in other circumstances. AcDPU takes a targeted approach, working with a single academic; building a team around them, rather than trying to force fit them into a company framework that does not suit personal and institutional needs and expectations. The passion, synergism and shared objectives are used to drive the deal objectives and equitable risk–reward sharing, clear the IP approach up front, and provide a generous approach to reversion rights (if GSK pulls out the academic partner maintains freedom to operate).

The nature of the relationship

AcDPU has experienced that top-down relationships have been less successful. They have highlighted the need for full engagement of the project team members (the people who will do the work to deliver the project) on both the company and university side. Communication between those who do the 'deal' and understanding of deal terms by the project team to ensure expectations are clear is critical. Building a team around a single academic to drive the project, maintaining their engagement throughout, has been a successful model.

Lessons learnt from the case study:

1. Forming relationships through individual academics and then building a team around them works best

2. Freedom of interaction between project partners, rather than top-down project management on the part of the company, ensures success

3. A successful collaboration could lead to a portfolio of interactions

In confirming that businesses are more likely to start interactions with universities through individual academics than through institutional structures our results match with existing literature[51]. Below we have identified a number of ways in which this activity could be supported.

New platforms could help build links between academics and businesses

Despite the apparent success of academics in starting relationships, the Chief Executive Officer of JustGiving mentioned that businesses that are not already connected in existing networks found it difficult to find academics to collaborate with. New platform technologies could be used to help build new links.

> "The company has access to a large amount of data concerning the way its users navigate the site but did not have the skills needed to run an analysis that would produce useful information on user 'personas'. We were able to identify academics with the required skills through existing relationships of an employee. **There is a lack of clarity as to which institutions have the skills required**, which acts as a barrier to the formation of

[51] D'Este, P. and Patel, P. (2007) "University–industry linkages in the UK: what are the factors underlying the variety of interactions with industry?" *Research Policy*, 36: 1295–1313; Ambos, T. C., Makela, K., Birkinshaw, J. and D'Este, P. (2008) "When Does University Research Get Commercialized? Creating Ambidexterity in Research Institutions", *Journal of Management Studies*, 45: 1424–1447; De Silva, L. R., Uyarra, E. and Oakey, R. (2012) "Academic Entrepreneurship in a Resource Constrained Environment: Diversification and Synergistic Effects" In: Audretsch, D. B., Lehmann, E. E., Link, A. N., Starnecker, A. and Audretsch, D. (eds.) Technology Transfer in a Global Economy. New York: Springer.

relationships outside the existing networks of employees. It is felt, therefore, that a **more centralised point of contact or mechanism for matching companies with suitable academics** could increase the amount of collaboration."

JustGiving, a UK-based provider of online charitable fundraising and donations services

The Research Gateway portal from the Research Councils illustrates what is possible here. By offering an online database of successful research proposals it is possible for a business to search on a topic and to find academics who have secured funding in that area. The implication is that these might be strong potential collaborators.

This is a type of horizon-scanning activity which only large companies could afford to conduct previously, but it is only a start. For example, the Star Metrics portal in the USA is able to link from this apparent research interest through to outputs, academic HR information and CVs. Other countries, such as Brazil have set up systems to pool information on elements of the scientific networks in one database.[52] Other private platforms go further still. Acabiz, for example is a private venture aimed at connecting businesses with consultants from the academic world. Participating academics are searchable by their field of expertise. Companies post research proposals that academics bid for. Academics receive company feedback on completion of their projects.

In the UK there are already a number of businesses who seek to provide match-making services between universities and businesses. However, the distributed nature of governance in the UK higher education system makes building this type of sophisticated data system difficult. There is a strong argument here for funders and policy makers to consider what additional data or changed requirements might help support the development of these platforms. Modest changes could unlock new models from either the public or the private sector.

Better support could enable academics to engage more with enterprise

While we find that academics are the most important source of university–industry relationships our results also suggested that modest changes could better support this activity. We identified a perception from businesses that elements of university administration are making academic-led relationships with business more difficult than they need to be. The implication is that universities could do more to place academics at the centre of most university–business relationships.

[52] For further details of the Brazilian platform see Mena-Chalco, J.P. and Marcondes Cesar Junior , R. (2009) "script Lattes: an open-source knowledge extraction system from the Lattes platform" Journal of the Brazilia Computer Society, 15(4).

In practical terms this could involve universities offering more supportive administrative arrangements to academics when working with businesses. The evidence presented here suggests that many institutions need to redesign the processes with less bureaucratic barriers, so that individual academics and businesses can interact efficiently and effectively.

The strategies of government initiatives such as Local Enterprise Partnerships and Catapult centres, which are intended to improve collaborations between universities and businesses, should address and take into account the important role played by individual academics in initiating relationships. Otherwise, it will be inevitable to overcome the institutional inefficiencies of initiating university–business interactions.

Universities doing more to empower and encourage academics to work with business

There is a broader issue here around the empowerment of academics to engage in activities with business. Our research has confirmed the significance of academics for collaborations, however a large number of previous studies have strongly suggested that universities fail to do all they can to deliver this empowerment. Continuing to signal that this is an important activity could be just as important a change as altering the process as discussed above.

Strategies for recruitment, workload allocation, training and development, rewards and promotions all help to signal the importance of this activity, as does the general attitude of heads of departments. Further change here could help to promote this activity as more of a priority within institutions. If universities are to promote university–business links, it is essential to recruit entrepreneurial academics (the literature has mentioned that entrepreneurial academics are better teachers and researchers than non-entrepreneurial academics), reward entrepreneurial behaviours and provide training and development opportunities needed for their entrepreneurial engagements. Hence, the university culture should be changed if we are to unlock successful university–business interactions.

Pay, progression and business engagement

Our research uncovered a widely held perception from businesses that engaging with them is not considered as a significant element when determining progression and promotion within academic environments. This was a consistent theme through a number of the interviews and the issue of early career researchers being encouraged to focus exclusively on academic publications was flagged by a number of respondents to our consultation on the draft report. This is of course a particular issue where collaborating with businesses is unlikely to yield an academic output.

The design of pay and progression systems is the responsibility of individual universities. The majority of systems were revised following the national Framework Agreement for the Modernisation of Pay Structures agreed by the joint Negotiating Committee for Higher Education Staff (JNCHES) in 2003. This was an agreement between employers and employee representatives which put in place a single salary spine for all staff, and offered guidance on how individual institutions could design their own approaches for progressing staff through grades. While “links with businesses” was included here as a potential criterion

for progression, it is believed to have been given only limited significance in most organisations.

There are indications, however, that as policy changes to increasingly encourage business engagement, universities are passing some of these incentives on to their staff and are updating progression frameworks.

For example the Vice-Chancellor of the University of Northampton recently claimed to have established a system which gives equal weight to research, teaching, professional practice and enterprise:

“Universities need to move away from the obsession with research as the primary route to promotion. At the University of Northampton and elsewhere, teaching and learning, professional practice and enterprise are all equally valid routes to promotion, from senior lecturer through associate professor to full professor. This is not theory, it has already happened.” Professor Nick Petford, 3rd June 2013

Other universities have made similar changes. Plymouth University for example, have adapted their job titles to be more understandable by businesses. Many universities also have well-developed policies for managing the sharing of revenue that results from intellectual property. For example the University of Manchester’s IP Policy states:

“There is no general obligation on an employer to reward employees for IP which is generated in the course of their employment. The only exception is where an invention is of ‘outstanding benefit’ to the employer. However, the University’s IP policy is designed to create strong incentives for the creation and development of IP. Hence the sharing of rewards is strongly biased in favour of employees and students.”

Pressure from central government for publicly funded institutions to move away from automatic incremental pay progression based on time in service may lead some HEIs to revisit their own arrangements but others will already be reviewing these in light of their own business needs. It is important that any changes offer opportunities for departments to reflect engagement with businesses in progression frameworks.

The consultees in our research strongly argued that this change needs to go further, and the process needs to accelerate. This will depend on continued policy development to support business engagement. In addition to the other approaches mentioned in this report, increasing the remit of the impact element of the Research Excellence Framework could be a relatively low-cost win. Building on and learning from the first round of this process it may be possible to increase the number of case studies required from each academic. Together with developing the ‘impact template’ would be important for ensuring that academics at all levels are focused on the REF impact metric rather than a select few.

But, the ability of universities to find ways to reward both academic excellence and business engagement in their human resource management practice will determine success. Sector groups such as the Universities and Colleges Employers Association (UCEA) and the Leadership Foundation for Higher Education (LFHE) have been working to increase awareness of good practice across the sector and provide support in leading change. This type of activity and work to facilitate change should be encouraged and supported through the funding councils.

6.2 Strengths and institutional roles of Technology Transfer Offices

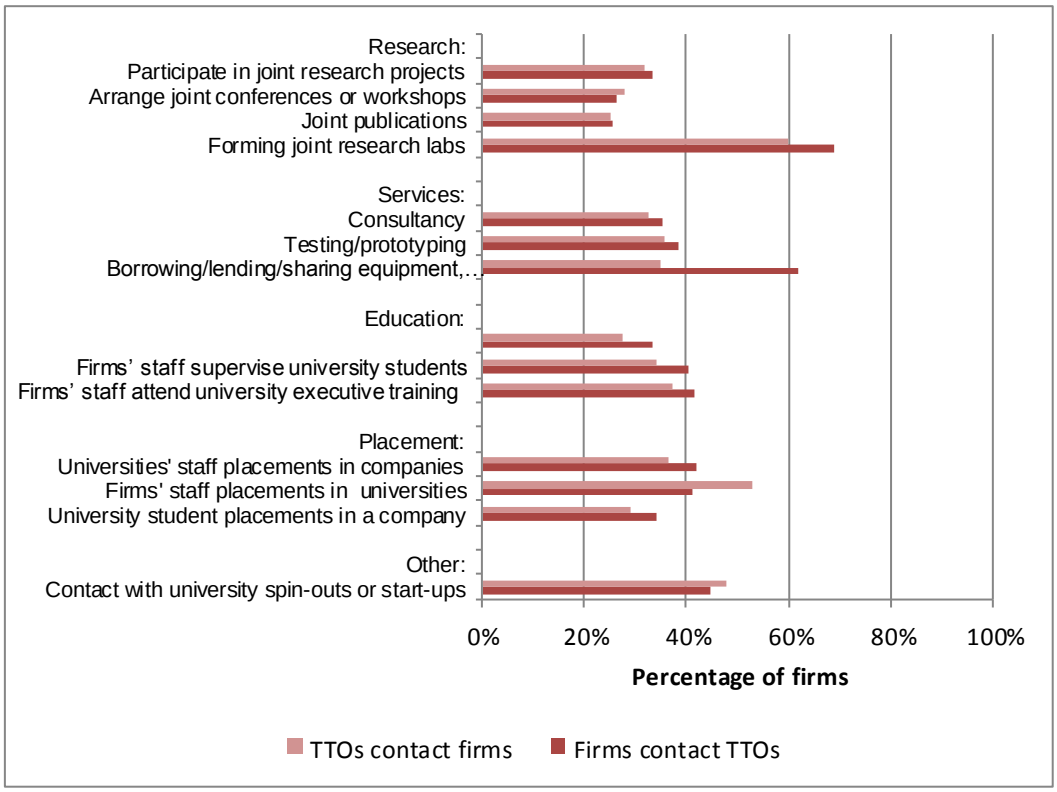
In our sample only a quarter of the firms have mentioned that interactions with universities begin through Technology Transfer Offices (including research support staff) (Figure 6.1). This appears to be mainly because companies are looking for specific 'expertise' embodied in specific academics, which lead them to contact academics rather than institutions. This is also confirmed by Dr Anthony Ledford.

> "Man AHL was interested in initiating a research partnership with a leading UK or EU research university, but found it difficult to make meaningful initial contact. They contacted several universities to identify a suitable partner, but were often pushed down a path of talking to people in research services or IP management which did not prove useful. They decided to find a senior academic with enough 'clout' to find out if their idea was viable and to push through the activity, drawing in administrative support. This approach worked well and was the origin of the relationship between the University of Oxford and Man AHL."
>
> *Dr Anthony Ledford, Chief Scientist, AHL, part of Man Investments Limited (The Oxford-Man Institute is an academic centre supported by the Man group)*

However, the TTOs' role is found to be relatively more important when beginning interactions that involve the institution, such as forming joint research labs or lending/borrowing/sharing equipment and laboratory space (Figure 6.3). TTOs are hugely important when supporting academics' interactions with businesses once the relationship is formed, to provide support services such as administrative, legal and coordinating work. Legal matters associated with intellectual property and administrative aspects of relationships are areas where academics have low levels of competence when sorting out the terms of contracts.

However, some firms report to have experienced that TTOs have bureaucratic systems that delay the process and the delivery of outputs. Also, several firms were not aware of the presence of TTOs in certain universities.

Figure 6.3: Shares of firms that usually use TTOs to begin relationships with universities



Note: Firms that usually use TTOs to begin relationships with universities as a percentage of those that have successfully adopted each type of relationship (e.g. 30% in the top histogram indicates that "of the academics who have successfully participated in joint research projects, 30 per cent use TTOs to begin relationships with universities").

The implication is that when attempting to initiate relationships with businesses, TTOs should focus on these resource-oriented relationships. In contrast many TTOs are presented as initiators of university–business relationships. Taken together with the evidence presented above on the support needed by academics there is a strong case for TTOs moving towards enabling rather than initiating relationships for all but a narrow set of specific relationships. TTOs could focus on training academics to initiate relationships and create positive entrepreneurial conditions within universities to nurture further university–business links.

6.3 Tackling the challenges of engaging with SMEs

There are still issues in terms of how universities start relationships with smaller businesses. Links with small firms were less likely to have originated from some form of outreach activity from the university side (from either individual academics or TTOs) compared to those for large firms.

It is possible that this apparent low rate of university outreach to SMEs reflects a lower probability of success in forming relationships.[53] However the evidence gathered in the qualitative responses to our survey and through the in-depth interviews confirms that SMEs believe that universities are still poorly set up to work with them. Our findings support that of Lord Young's recent review of the role of business schools in local economies, in which he recommended that the Association of Business Schools develop a support scheme to incentivise business schools to help grow SMEs[54].

> "We find it difficult to get the interest of academia to do the work that Cellzome needs to complete. Universities see the work as being 'contract', too small or short term to engage their interest and energy, and they appear to be more interested in the larger, longer-term strategic industry–academic alliances coming from big pharma. This is frustrating for Cellzome"
>
> *Alan Watt, Chief Science Officer, Cellzome Inc (Cellzome is a privately-owned small company (<50 people), based in Germany and Cambridge, UK)*

This is in spite of the fact that HEFCE to a large extent match fund the income that universities can generate from SMEs through the HEIF scheme, and despite recent analysis suggesting that 30 per cent of Higher Education institutions are focusing on ways to bring SMEs on to campus.[55] Hence, any support scheme should learn from the experience of these existing projects intended to support SME–university interactions.

To some extent it is inevitable that collaboration will be easier with larger firms as they can carry the costs of interaction over a wider base. Alumni connection could play a role in the establishment of more relationships with SMEs.

6.4 Capitalising alumni connections

Alumni connections also play a key role as a source of university–business links. More than 60 per cent of firms have used alumni connections to begin each type of interaction (Figure 2.4). In-depth interviews revealed that alumni are useful to find suitable academics to collaborate with since alumni, through their own experiences, have knowledge about the expertise of, as well as the nature of working relationships with, individual academics. Alumni working in industry may have a natural tendency to go to their own universities when opportunities for collaboration emerge.

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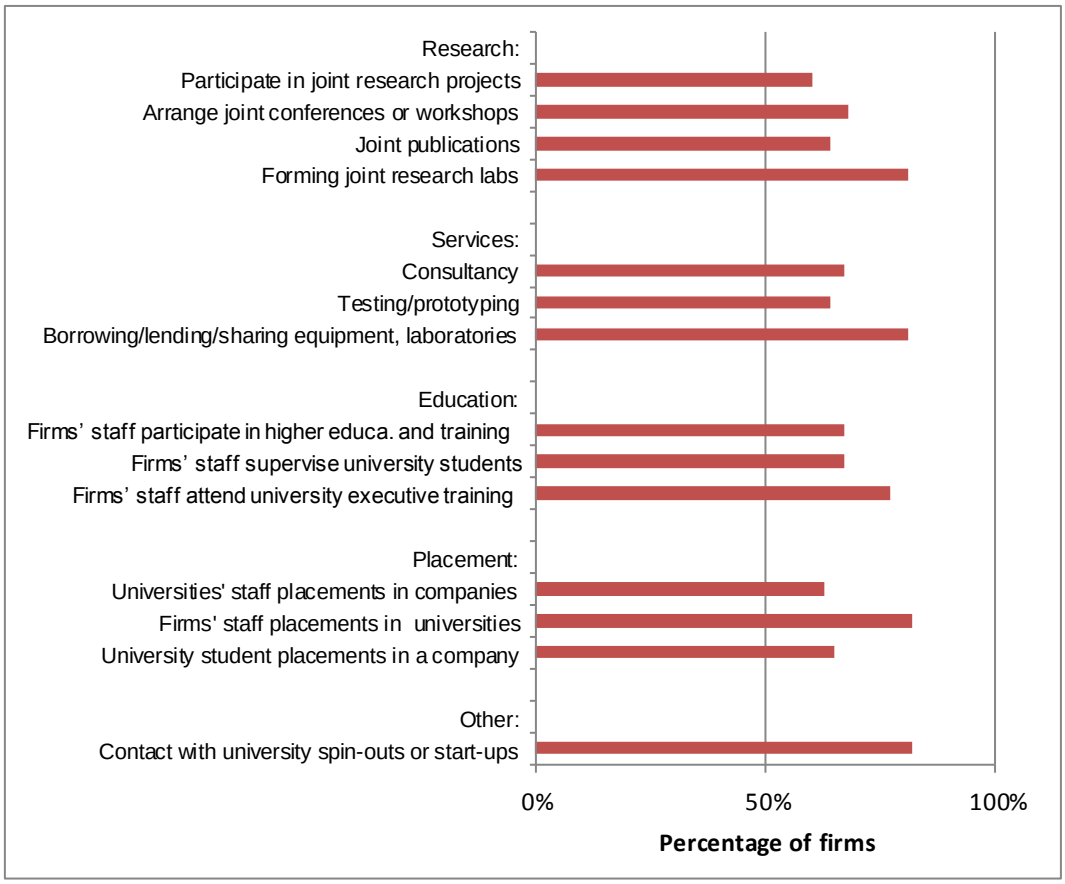
[53] Even if universities were focusing their efforts on SMEs, this activity could be poorly represented in our sample if SME engagement was less likely to lead to the forming of relationships.
[54] Young, Lord (2013) Growing your business: A report on growing micro businesses, Business. Government report
[55] PACEC (2012) Strengthening the Contribution of English Higher Education Institutions to the Innovation System: Knowledge Exchange and HEIF Funding, HEFCE http://www.hefce.ac.uk/media/hefce/content/whatwedo/knowledgeexchangeandskills/heif/pacec-report.pdf

Figure 2.4: Share of firms that use alumni contacts to begin relationships with universities



Note: Firms that use contacts with alumni to begin relationships with universities as a percentage of those that have successfully adopted each type of relationship (e.g. 60% in the top histogram indicates that "of the academics who have successfully participated in joint research projects, 60 per cent use alumni to begin relationships with universities")

This highlights the importance of universities and businesses managing and capitalising on alumni connections as a source of creating opportunities for collaboration. There appears to be potential here. Even though universities tend to manage their alumni connections to raise funds and to promote the employability of graduates we are not aware of universities managing alumni connections as a source of university–business links. Hence, Alumni Offices, TTOs and leading academics should collaboratively design a strategy to capitalise on alumni connections for university–business interactions.

Induce open innovation: Origin of university–business interactions

- Academics are key to starting most interactions between universities and businesses
- Technology Transfer Offices strengthen institutional links and support academics once the relationship begins
- The challenges of university engagements with SMEs should be tackled
- Alumni connections play a key role as a source of university–business links

7. Conclusion: What works well in university–business interaction?

7.1 Access to university knowledge is feasible, but many are failing to exploit opportunities for knowledge co-creation

Overall our research confirms that UK universities and businesses are good at working together. This matches evidence from the World Economic Forum that British business leaders are second only to the Swiss in their praise for the receptiveness to collaboration of domestic universities.

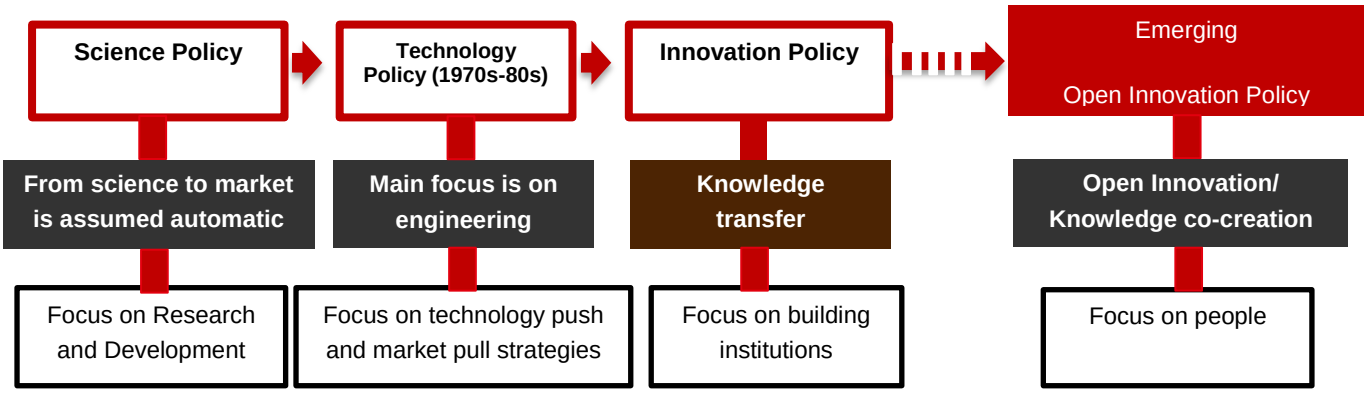
Businesses appear to have become very good at managing relationships that allow them to access academic knowledge. This is important as universities have historically been criticised as 'ivory towers' completely insulated from the economy. It is therefore encouraging that businesses feel that they are able to access the ideas, knowledge and talent produced by universities.

However, not all strategic objectives of firms for interacting with universities are met. More complex relationships, in which the objective is to address more immediate business-related issues, remain a challenge for many. When, for example, the objective is to develop a new product or process, things become more difficult and collaborations appear to work less well for a significant portion of the companies that attempt them.

Businesses are clearly looking to universities for these collaborative knowledge co-creation activities. Yet a significant proportion of businesses that have tried here have been unable to achieve this objective. This is in sharp contrast to their experience when relationships are set up to access knowledge.

Knowledge co-creation is an important element of Open Innovation, so this position suggests that there are ways to improve how businesses and universities work together in an Open Innovation paradigm. It has been suggested that Government policy has moved from the linear model of science policy in the 1950s–60s (i.e. a research-driven approach), which primarily focused on supporting the basic research base, to technology policy in the 1970s and 1980s with clear utilitarian – often engineering – perspectives (i.e. technology push and market pull approaches). More recently, innovation policy in the 1990s–2000s incorporated a knowledge transfer mission through building institutions, e.g. technology transfer offices in universities and tighter intellectual property (IP) enforcement. It looks as though a new open innovation landscape is emerging with a major focus on people and open innovation infrastructure. This idea is illustrated in Figure 7.1 (see Appendix for details about this paradigm shift).

Figure 7.1: Paradigm shift from 'knowledge transfer' to 'knowledge co-creation'



Public policy and actions introduced under the leadership of Rt Hon David Willetts, Minister for Science and Universities, made a great contribution to this emerging open innovation policy. Policies that promote open science, open access and relaxed intellectual property[56] (i.e. limitations and exceptions to copyrights and flexible IP) are a few examples of successful changes that were proposed to promote collaboration between the stakeholders of our ecosystem. Open science initiatives have promoted businesses working closely with academics. One example is the new funding of £64 million by ESRC to be invested in Business and Local Government Data Research Centres[57]. HEFCE's proposal on open access publications for the post-2014 Research Excellence Framework, which encourages making the output of publicly funded research available openly, is another initiative.

Similarly, a range of reports has highlighted the commitment of various government bodies to promoting and supporting this open innovation policy landscape as a strategy for economic growth: the Higher Education Innovation Fund 2011–15 strategies; the 2012 Innovation report by the Department for Business, Innovation and Skills; the 2013 PACEC report on Knowledge Exchange and HEIF Funding; HEFCE's proposal on open access publications for the Research Excellence Framework, the Government response to the consultation on copyright exceptions and clarifying copyright law, as well as the Skills and Research Councils Knowledge Exchange Principles.

The evidence presented here suggests that, regardless of these government initiatives, in practice we may still be some way off achieving this new paradigm of consistently effective knowledge co-creation between universities and businesses. What is encouraging is that a non-negligible share of firms are successful in meeting all their strategic objectives when interacting with universities – both those related to accessing academic knowledge as well as those relating to addressing business challenges through knowledge co-creation activities. Hence, there appears to be no inherent contradiction between these objectives, but rather the key issue is to develop the kind of practices and relationships between

[56] http://www.ipo.gov.uk/response-2011-copyright-final.pdf
[57] http://www.esrc.ac.uk/funding-and-guidance/funding-opportunities/27813/business-and-local-government-data-research-centreshomepage-promo.aspx

businesses and universities that allow all kinds of complex objectives to be met, to the satisfaction of all parties.

7.2 The importance of knowledge co-creation between universities and business

We might expect that, compared to knowledge access, relationships that require knowledge co-creation in order to address pressing business challenges might be more difficult and prone to problems.[58] These types of interactions rely on more involved relationships and more complex arrangements.

Successful and mutually beneficial co-creation activities require a complex co-incidence of wants on the part of both the business and the university. They depend upon finding a challenge where: both have an interest in the issue; both have something to bring to the challenge; both are interested in what the other can offer; both can agree on the balance of inputs; a timetable that suits both organisations can be found; both can agree on the mix of academic and commercial outputs, as well also upon the ownership of any intellectual property generated.

However, the scale of the challenge here is matched by the opportunity. Our research on systems of innovation confirms the importance of a set of strong research institutions deeply embedded into an economy.[59] A central message of our work here has been that any future vision of a healthy and wealth-creating UK innovation ecosystem relies on successful complementarity of the innovation strengths of universities and business. The apparent limited ability of some firms to achieve knowledge co-creation objectives when interacting with universities suggests that there is scope for learning, on the part of both business and universities, how to build truly collaborative relationships.

We would not suggest that one type of interaction channel or mode of collaboration between universities and businesses is more important than another. However, it is interesting that not all objectives that businesses set out to achieve when interacting with universities are met with the same ease: those requiring mutual knowledge co-creation are more difficult to achieve. Although more difficult, reaching these objectives generates value. The fact that businesses are attempting to reach these objectives when interacting with universities, but are finding them problematic, adds a sense of urgency to the situation. There is a risk that businesses will become frustrated and deterred from working with universities on ambitious objectives if rapid progress is not made. This means that businesses, universities and policymakers urgently need to learn from what works well in terms of university–business collaboration.

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[58] Recent research from the Big Innovation Centre has mapped the challenges faced by businesses when engaging in all types of Open Innovation activity. Golightly, J., Ford, C., Sureka, P. and Reid, B. (2012) “Realising the value of Open Innovation”, Big Innovation Centre report.
[59] Andersen, B., Brinkley, I and Hutton, W. (2011), “Making the UK a Global Innovation Hub. How business, finance and an enterprising state can transform the UK”, Big Innovation Centre report.

7.3 How to unlock knowledge co-creation between universities and business?

Our evidence suggests that a non-negligible share of businesses have learned how to successfully meet their objectives when interacting with universities, even the most complex ones. Successful firms overwhelmingly adopt certain practices and build upon their resources and experience. Any opportunities to learn from successful relationships and to improve how these interactions work will help us to deliver more mutually beneficial university–business collaborations.

Adopting practices that unlock collaboration

We have highlighted the importance of particular behavioural practices that appear to unlock successful university–business relationships:

- Working to reach a shared understanding with individual academics and to build trust around disclosure;
- Implementing a strong programme structure with clear milestones;
- Pursuing a clear approach to negotiations;
- Reducing top-down management approaches, instead focusing on team-level communications; and
- Embracing the different styles of academics rather than trying to match their practices to business routines.

Our research has also offered insights into a number of institutional approaches to support university–business collaboration:

- The Lambert Toolkit appears to work well and its use could be increased;
- Knowledge co-creation networks can unlock collaborative relationships; and
- We have identified opportunities to learn from the past experience of innovation voucher schemes.

Multi-functional engagement involving research, education, people placements, and technology services are key to success

We found that universities and businesses successfully engage in multiple types of relationships. A few key findings on the types of engagement are:

- Businesses engaging in a portfolio of relationships with universities rather than focusing on a few forms deliver a higher level of success due to synergies between activities
- Universities and businesses which are more open to sharing resources benefit from resource synergies
- Industry placements in universities work well when these are based on knowledge co-creation challenges and projects

Intellectual property value creation mechanisms must be flexible

Most of the businesses have not used either formal or informal IP protection strategies, which gives a positive signal since being open is key to Open Innovation. Some firms have used formal and informal IP protection strategies as a gateway for Open Innovation. Key findings in relation to the use of IP protection strategies are:

- The use of IP protection strategies varies depending on the sector. Heavy users of IP protection strategies are firms in ‘Bio, health, pharmaceutical and chemical’, ‘Engineering and energy’ and 'Multi-sector' (i.e. they belong to more than one sector). Firms in ‘Creative and cultural’, ‘Business support services’ and ‘Information and communication’ have a lower tendency to use IP protection strategies.
- Firms use ‘soft’ IP protection strategies to engage in knowledge co-creation. Cultivating commitment and loyalty and secrecy/non disclosure agreements enable Open Innovation.
- Firms use a bundle of formal and informal IP protection strategies. Depending on the stage of relationship and the nature of knowledge generated firms use a bundle of formal and informal IP protection strategies.
- Issues of trust over disclosure persist. Firms continue to have concerns about the release of commercially sensitive IP when working with universities. Open access requirements placed on Research Council funding may exacerbate these issues, however investing in relationships and building trust appears to be the way forward.

Academics and users are catalysts for starting university–business links, but central support services can strengthen institutional links

Academics and users are catalysts for starting university–business links. There is a case for Technology Transfer Offices focusing on the management of a specific set of institutional relationships. Alumni connections are also a major source of university–business relationships.

7.4 Messages for universities, businesses and policy makers

Success will depend on empowered academics, supported by truly enabling academic institutions, fully engaged businesses and an enterprising state willing to invest in these relationships. The current level of success reflects the fact that in many institutions, businesses and areas of policy, this system is already in place.

Our research does not identify specific messages for individual institutions. From a national survey of companies we have offered a snapshot of the perceptions that approximately 200 businesses hold when working with almost 50 UK universities. Given the diversity within our higher education sector and commercial world this is unlikely to accurately reflect the complete picture of institutions and businesses. However, delivering improved performance at the national level will depend on individual universities and businesses reflecting on the messages presented here and considering where there is scope for improvement within their

own organisations.

Reflective recommendations for universities and business together – how to pursue good practices

- Invest in relationships to reach a shared understanding and to build trust between partners
- Place greater focus on agreeing clear delivery plans, objectives and identifying milestones, especially important when establishing placements from business into universities
- Commit to finding ways to move from top-down management approaches towards team-level communication between university and business staff
- Increase university–business placements through co-funding and knowledge co-creation challenges and projects
- Increase engagement in a portfolio of interaction channels rather than focusing on a few
- Be open and flexible in relation to the use of intellectual property protection mechanisms depending on the type and stage of interaction, the sector of operation and the type of output
- Increase awareness and develop skills on the effective and flexible use of a bundle of formal and informal IP protection strategies
- Adopt new business models when forming joint research labs in order to enable academics and businesses to carry out independent research, whilst also engaging in collaborative work whenever possible, which allows both academic and commercial objectives to be achieved
- Invest on the skill development (e.g. relationship development and management, communication and understanding business and academic 'language' etc) of academics, support staff and business personal essential to unlock successful co-creation and co-innovation.

Specific messages for universities

- Build stronger administrative support arrangements for academics to engage with business. The arrangements in many institutions have been reported to be too bureaucratic, and too focused on managing relationships rather than supporting the work of academics
- Facilitate collaboration between centralised support services (e.g. Technology Transfer Offices, Business Development Offices and Research Support Offices) and individual academics. The role of centralised services as providers of support services to academics (e.g. legal, administrative and coordination services) is more important than being initiators of university–business links.
- Develop an entrepreneurial culture within universities
- Empower individual academics to collaborate with businesses and reward their business engagements
- Continue to improve the user experience for SMEs that try to work with universities

- Invest in opportunities to better exploit alumni connections to build relationships with companies

Messages for policy makers and funders

- Revise Lambert Toolkit by incorporating knowledge co-creation interactions and the needs of different user groups
- Knowledge co-creation/open innovation networks appear to work well and should be a priority for continuing support
- Support the adoption of new business models when forming joint research labs in order to enable academics and businesses to carry out independent research, whilst also engaging in collaborative work, which allows both academic and commercial objectives to be achieved
- Secure expanded funding for university–industry placements
- Support the skill development (e.g. relationship development and management, communication and understanding business and academic 'language' etc) of academics, support staff and business personal essential to unlock successful co-creation and co-innovation
- Support the adoption of open and flexible intellectual property rights/strategies
- Research how to support the bundling of different forms of formal and informal IP protection strategies in university–business relationships
- Support the development of new platforms to link businesses and academics
- Demonstrate how current schemes have learnt from past experience of innovation vouchers – e.g. coupling financial incentives with other support schemes for SMEs
- Support SMEs to adopt good practice and provide them with additional support to engage with universities
- Continue funding support on schemes that work well for SME–university interactions – e.g. Mini-knowledge transfer partnerships
- Support and encourage the adoption of new models that encourage collaborations between universities and SMEs – e.g. the accelerator model, in which large firms act as intermediaries between universities and SMEs

Annex 1: Research framework driving the analysis of 'what works well' in university–business interactions

As university–business links play an increasingly important role in our innovation ecosystem, indicators of what works well are needed in order to evaluate the extent to which universities and businesses successfully work together and engage in knowledge transfer and co-creation. Based on current literature, we have identified five key areas that need to be addressed, together with groups of variables within each key area. This was used as a framework to gather evidence on the user perspective of university-generated knowledge. These five key areas are:

- Strategic objectives of firms which engage with universities
- Best practices adopted by universities and businesses
- Channels of university–business interactions
- Use of intellectual property protection strategies to create value in university-business interactions
- Origin of the relationships between universities and businesses

1. Strategic objectives: To what extent do businesses successfully meet their strategic objectives when working with universities?

Recent changes in government policy towards promoting Open Innovation and knowledge-driven economic growth have altered our understanding of the nature of university–business collaboration (Eggington et al 2013). This has heightened the need to improve our knowledge on how university–business relationships move from simple knowledge access to the achievement of more complex objectives (Abreu et al 2008). In this new innovation landscape, the motivations of university and business partners are crucial to achieve success through close collaborations (Ternouth et al 2012). Past studies have investigated the motivation of academics to interact with industry (Jones-Evans, 1997, Franklin et al., 2001, Otto, 1999, Oakey, 2003, Van Dierdonck and Debackere, 1988, Erdıs and Varga, 2009). However, our understanding of industry managers' motivations for collaboration shows considerable gaps, especially in areas that are directly related to knowledge co-creation between universities and businesses (Edmondson et al 2012).

The extent to which the strategic objectives of businesses translate into new forms of close collaborations and co-creation is also less established in the literature. In investigating the attributes of successful Knowledge Transfer Partnerships, Ternouth et al. (2012) argue, based on OECD (2006) research, that "Co-operation within a partnership is collaborative; it will be effective if the partners share a strategic vision, pursue compatible targets, and are all equal members in a predetermined organisational structure" (p.7). However, inherent differences between universities and businesses question the extent to which they can develop shared strategic visions (Barnes et al., 2002), and thus, achieve knowledge access and co-creation strategic objectives.

This study furthers these arguments by examining whether knowledge access and co-creation are strategic objectives of firms which collaborate with universities and to what extent they are able to fulfil their objectives. In order to address these questions this report investigates the strategic objectives (innovation, resource, finance, strategic networking and market related) of firms that work with universities, which were either mentioned in the literature or identified in case studies conducted to scope this study (Table A1).

Table A1: Strategic objectives of firms which work with universities

Strategic Objectives	Literature
Innovation related	
➢ Develop new basic knowledge	(Caloghirou et al., 2001)
➢ Develop new products and processes	(Blumenthal et al., 1996, Tether, 2002, Lam, 2005)
➢ Interactive learning and co-creation	(Blumenthal et al., 1996)
Resource related	
➢ Access university talent (i.e. people and teams)	(Caloghirou et al., 2001) (Blumenthal et al., 1996)
➢ Find the technology your company needs	(Balconi and Laboranti, 2006)
➢ Assess equipment and other physical resources in universities	(Balconi and Laboranti, 2006)
Finance related	
➢ Increase revenue via innovation	(Blumenthal et al., 1996)
➢ Increase revenue via intellectual property management (e.g. royalty)	(Blumenthal et al., 1996) (Caloghirou et al., 2001)
➢ Reduce/share risks	(Caloghirou et al., 2001)
➢ Cut costs	(Caloghirou et al., 2001)
➢ Gain access to public funds or subsidies	(Ternouth et al 2012)
➢ Gain access to venture capital more easily	(Edmondson et al 2012)
Strategic networking related	
➢ Enter formal collaborative agreements	(Abreu et al, 2008) (Lam, 2005, Balconi and Laboranti, 2006)
➢ Make informal and meaningful links with a wider range of people within the university	(Blumenthal et al., 1996)
➢ Give something to the community	(Moore et al 2010)
Market related	
➢ Gain access to strategic positioning in the market	(Edmondson et al 2012)
➢ Gain professional recognition or brand recognition (e.g. market visibility or innovation profile)	(Edmondson et al 2012)
➢ Send a signal to your competitors	(Edmondson et al 2012)

2. What is the role of practices and institutional support structures?

Interactions between universities and industry are not performed without challenges. The central issue highlighted in the literature is the conflict of interests due to inherently different university and business cultures (Ambos et al., 2008, Barnes et al., 2002). While firms are profit oriented, the traditional environment of universities has less commercial orientation (Lockett and Wright, 2005a, Azaroff, 1982). Businesses often seek to prioritise less risky, short-term research with direct commercial applicability, whilst universities tend to undertake long-term research with a basic research focus. Furthermore, universities are keen to disseminate knowledge, and to have as many publications as possible. On the contrary, industry seeks to acquire ownership, and sometimes to keep certain findings secret as a strategy of achieving competitive advantage (Barnes et al., 2002). Some authors have also

highlighted that whilst universities are motivated by the need to generate additional research income, industry is interested in the informal transfer of know-how and knowledge on product and process developments (Siegel et al., 2004). These differences indicate that, if cultural tensions are not properly handled, the relationship could end in failure (Barnes et al., 2002) or in the deterioration of the quality of university–business interactions (Siegel et al., 2004).

The adoption of practices and the introduction of institutional support structures that facilitate university–business interactions is of paramount importance in achieving successful collaboration and co-creation (Ternouth et al 2012). Andersen and Rossi (2010), who have studied best practices from the perspective of universities, suggested that no one best practice model exists; they find that the diverse needs of universities and industry require a variety of flexible knowledge transfer models. These models may comprise practices that induce links between universities and businesses (Powers and McDougall, 2005) and those that improve communication, collaboration and negotiation between two parties (Siegel et al., 2003) (Chakrabarti and Santoro, 2004, Blumenthal et al., 1996) (Caloghirou et al., 2001). Also, institutional support structures such as the Lambert Agreements (Eggington et al 2013), Open Innovation networks (e.g. University of Glasgow Innovation Network, Eindhoven Open Innovation network, Local Enterprise Partnerships) and innovation voucher schemes (Ternouth et al 2012) have been introduced in recent years to support university–business collaborations.

While past studies have made significant contributions in terms of assessing the effectiveness of practices for enabling successful university–business interactions in general, these have not particularly differentiated their usefulness for achieving different strategic objectives. This study, considering a wide array of practices (Table A2), investigates the experience of businesses in terms of which of these practices induce successful collaboration in general, knowledge access and co-creation.

Table A2: The role of practices and institutional support structures

Practices	Literature
Access related	
➢ A search engine to find academics/ institutions	Gateway to Research, RCUK 2012
➢ Institutions that link academics and companies	(Powers and McDougall, 2005)
Communication and collaboration related	
➢ Reaching a shared understanding with academics	(Siegel et al., 2003, Chakrabarti and Santoro, 2004)
➢ Matching the practices of academics or universities to your business routines	(Chakrabarti and Santoro, 2004)
➢ Enforcing contracts (e.g. avoid opportunistic behaviour or other trust issues)	(Blumenthal et al., 1996)
➢ Increasing transparency	From initial case studies
➢ Reducing top-down approach with more team-level communications	(Siegel et al., 2003) (Blumenthal et al., 1996)
➢ Openness to collaboration by academics	(Chakrabarti and Santoro, 2004)
➢ The involvement of industry in setting university policy	(Etzkowitz and Leydesdorff, 2000)
➢ Strong work programme structure with clear milestones	From initial case studies
Institutional support structure related	
➢ Lambert agreement (Lambert Toolkit for Model Research Collaboration)	(Eggington et al, 2013)
➢ Open Innovation networks (e.g. University of Glasgow Innovation Network, Eindhoven Open Innovation network, Local Enterprise Partnerships)	(Ternouth et al, 2012)
➢ Innovation voucher scheme	From initial case studies
Negotiation related	
➢ Negotiate price or other terms of the contract	From initial case studies
➢ Negotiate with university technology support or business relations staff	From initial case studies

3. Interaction channels: What are the types of interactions that work well in relation to university–business links?

The literature has widely discussed different mechanisms used for university and business interactions including their relative importance (D'Este and Patel, 2007, De Silva et al., 2012, Jones-Evans and Klofsten, 2000, Faulkner and Senker, 1995, Arundel and Geuna, 2004, Louis et al., 1989). While some studies have argued that patenting, licensing and spin-outs are very important (Narin et al., 1997; Swann, 2002; Monjon and Waelbroeck, 2003), other studies have revealed that these have less value when compared with other types of 'soft' interactions such as consultancy, contract and joint research, external teaching and joint publications (Zucker et al.,2002).

Cohen et al (2002), using data from the Carnegie Mellon Survey on industrial research and development in the U.S. manufacturing sector, concluded that licensing and spin-off creation by academics represent only a minor form of technology transfer in comparison to published papers and reports, public conferences and meetings, and consulting. Moreover, Agrawal and Henderson (2002), studying the Departments of Mechanical and Electrical Engineering

at Massachusetts Institute of Technology (MIT), found that patents represent less than 10 per cent of the total knowledge transferred from their labs. Additionally, Jones-Evans (1997, 2000) in a similar study in Europe, revealed that there is a higher propensity for academics to carry out contract research, consulting, large scale science projects, and external teaching than spin-off formations. Also, D'Este and Patel (2007), in their European study, found that other knowledge-transfer activities are equally, or even more, important than company creation, both in terms of frequency and economic impact.

Most previous research has focused on evaluating either the extent of knowledge transfer, or economic importance, of different university–business interactions. So far, however, there has been little discussion on the business perspective of the role of different types of relationships in facilitating knowledge access and co-creation objectives. This study addresses this gap by evaluating the effectiveness of many interaction channels, around research, service, education and placements (Table A3), in nurturing knowledge access and co-creation.

Table A3: Interaction channels between universities and businesses

Interaction channels	Literature
Research based interactions	
➢ Participate in joint research projects	(Louis et al., 1989; Ramos-Vielba and Fernandez-Esquinas, 2012;
➢ Arrange joint conferences or workshops	Ponomariov and Boardman, 2012)
➢ Joint publications	(Ponomariov and Boardman, 2012;
➢ Forming joint research labs	Louis et al., 1989; (Goldfarb and Henrekson, 2003);(Hall et al., 2001)
Service based interactions	
➢ Consultancy provided to you by the university	(Glassman et al., 2003), Ramos-Vielba and Fernandez-Esquinas (2012),
➢ Service provided to you by the university (such as testing or prototyping)	(Lee, 1996)
➢ Borrowing/lending equipment, sharing laboratories or other facilities	(Robson and Achur, 2012)
Education based interactions	
➢ Your staff participate in higher education and training (e.g. MSc or PhD programme)	Jones-Evans (1997)
➢ Your staff supervise university students (e.g. on MSc or PhD programme)	(Ramos-Vielba and Fernandez-Esquinas, 2012)
➢ Your staff attend executive training offered by the university	Jones-Evans, 1997, Schmoch (1997) D'Este and Patel (2007)
Placement based interactions	
➢ Staff from a university undertake a placement in your company	(Lashley, 2011, Arlett et al., 2010)
➢ Staff from your company undertake a placement in a university	D'Este and Patel (2007)
➢ University students work as trainees in your company	D'Este and Patel (2007)
Other interactions	
➢ Contact with university–business spin-outs or start-ups	Radosevich (1995) Samson and Gurdon (1993) (Daniels and Hofer, 1993)

4. Intellectual property protection strategies: What formal and informal IP protection strategies work well in university–business interactions?

There has been increasing interest in the types of formal and informal intellectual property protection strategies used by businesses in general (Päällysaho and Kuusisto 2011; Hall et al 2001). In the case of university–business links, Bruneel et al (2009) finds that university use of formal intellectual property rights (IPRs) is increasing: "technology transfer from UK higher education institutions has observed a dramatic increase in patents granted (the number granted to UK HEIs has more than doubled between 2000/01 and 2005/06), as well as in the income from licensing intellectual property (which has more than tripled within the same period)" (p.7). However, it has also been shown in the literature (Bruneel et al, 2009; Cohen et al, 2002; Mowery and Sampat, 2005) that industry considers "open science" channels such as publications and conferences as the most important ways to access academic knowledge, whereas the value of patents always ranks much lower. This view is further supported by Ramos-Vielba and Fernandez-Esquinas (2012) arguing that, since university–business interactions mainly involve tacit knowledge, formal mechanisms such as patents have less use, but there is a high trend towards the use of informal/soft types of IP mechanisms. This suggests that a process of collaboration based on co-creation within an open structure facilitated by informal and soft types of IP protection strategies is aligned with industry preferences.

Table A4: Formal and informal IP protection strategies

IP protection stretegies	Literature
Formal IP protection strategies	
➢ Patent	(Blumenthal et al., 1996) (Lockett and Wright, 2005b)
➢ Design right	(Muzaka 2010)
➢ Trademark	(Muzaka 2010)
➢ Copyright	(Muzaka 2010)
➢ Secrecy / Non Disclosure Agreement	(Blumenthal et al., 1996)
➢ Open source/Creative commons license	(Muzaka 2010)
➢ Publications	(Muzaka 2010)
Informal IP protection strategies	
➢ Restricted access to information	(Päällysaho and Kuusisto, 2011)
➢ Division of duties	(Päällysaho and Kuusisto, 2011)
➢ Cultivating trust and commitment	(Päällysaho and Kuusisto, 2011)
➢ Fast innovation cycle	(Päällysaho and Kuusisto, 2011)
➢ Complex product design	(Päällysaho and Kuusisto, 2011)

5. The origins of university–business links: What sources do businesses use to begin interactions with universities?

Overall, there is an increase in university–industry collaborations, with Eggington et al (2013) finding that more than half the universities and companies they surveyed are engaging in more strategic relationships than they did in 2005. How these interactions begin is a very important piece of the puzzle. The literature argues that many university–business projects start as a result of face-to-face encounters, at events and conferences, or more generally

where the university operates in its “public space” role, engaging with the business community (Ternouth and Garner 2009). Abreu et al (2008) further supported this by revealing that companies often tend to originate relationships through individual academics with whom they have already built up trust.

Even though linking institutions such as Technology Transfer Offices (TTO) are reported to be useful in bridging cultural gaps between university and industry (Ambos et al., 2008, Lockett and Wright, 2005), they are criticised for poor performance (Siegel et al., 2004). For instance, it is highlighted that individual academics are directly contacted by firms, since TTOs seem to have inefficient, inflexible and bureaucratic administrative structures that slow down the process (Van Dierdonck and Debackere, 1988; Siegel et al., 2004).

While most previous studies discuss the origin of relationships from the perspective of universities, so far, there has been little emphasis on the ‘user side’. Indeed, the origins of university–industry knowledge transfer via co-creation are even less understood. Hence, this study investigates what sources businesses usually use to begin interactions with universities.

Table A5: Origins of university–business links

Origin	Literature
➢ An academic contacts us	(Siegel et al., 2003, Siegel et al., 2004)
➢ We contact an academic	Siegel et al. (2003, 2004)
➢ The university Technology Transfer Office contacts us	(Siegel et al., 2003) (Clarysse et al., 2005; Siegel et al., 2003)
➢ We contact the university Technology Transfer Office	(Siegel et al., 2003, Clarysse et al., 2005)
➢ We contact a university spin-out	From initial case studies
➢ A university spin-out contacts us	From initial case studies
➢ Industrial placements	(Bekkers and Bodas Freitas, 2008)
➢ Public grant schemes	From initial case studies
➢ Meeting at a conference or networking event	Council for Industry and Higher Education 2009
➢ Alumni connections	(Bekkers and Bodas Freitas, 2008)
➢ Introduction through another company in our supply chain	From initial case studies

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Annex 2: Main universities with which responding firms interact

Below is the list of universities which respondents have mentioned as the main university with which they interact (if they have one). Please note that, as illustrated in Figure 1.2 (p. 19), 55 per cent had interacted with between two and ten universities and 24 per cent with more than ten universities during the last 12 months. Therefore, it is highly likely that the majority of firms might not be in a position to state a main university with which they interact, and thus, we may have covered more universities than those mentioned below.

1. Anglia Ruskin University
2. Aston University
3. University College London
4. Brunel University
5. Cambridge University
6. City University
7. Cranfield University
8. Edinburgh University
9. European Business School
10. Henley Business School
11. Heriot-Watt University
12. Imperial College London
13. King's College London
14. Liverpool University
15. Manchester Metropolitan University
16. Middlesex University
17. Newcastle University
18. Nottingham Trent
19. Nottingham University
20. Oxford Brookes
21. Portsmouth University
22. Queen Mary University of London
23. Reading University
24. Salford University
25. Sheffield Hallam University
26. Surrey University
27. Swansea University
28. University College London
29. University of Bath
30. University of Brighton
31. University of Bristol
32. University of Durham
33. University of Essex
34. University of Glasgow
35. University of Hertfordshire
36. University of Kent
37. University of Lancaster
38. University of Leeds
39. University of Manchester
40. University of Oxford
41. University of Sheffield
42. University of St Andrews
43. University of Strathclyde
44. University of Sussex
45. University of Ulster
46. University of Yorkshire
47. Wiltshire College

Annex 3: The use of the terms 'Knowledge transfer' and 'Knowledge exchange'

Knowledge transfer

Source	Definition	Comment
(Friedman and Silberman, 2003), p.18	Commercialisation of university generated knowledge mainly includes patents, licensing and start-up formation - 'process whereby invention or intellectual property from academic research is licensed or conveyed through use rights to a for-profit entity and eventually commercialised'	The unidirectional transfer of knowledge from universities to businesses
(Siegel et al., 2007)	Commercialisation of science through mechanisms such as patents, licences and spin-outs.	The unidirectional transfer of knowledge from universities to businesses
(Perkmann and Walsh, 2007)	Bi-directional transfer of knowledge between universities and businesses, which may involve "open, networked and interactive innovation"	Broad view, but does not include universities and businesses working together to capitalise on market opportunities
(Bramwell et al., 2012), p.10	A multi-dimensional conception of the knowledge transfer process is consistent with the view of universities as engaged key players embedded in that process underpinning successful regional innovation systems	Broad view, but does not include universities and businesses working together to capitalise on market opportunities
(OECD, 2013) p.14	"These knowledge transfer channels often operate simultaneously or in a complementary fashion, underscoring the interaction between tacit and codified flows of knowledge as well as the multi-directional nature of flows. Knowledge does not only flow from university to industry but also the other way around. University inventions are embryonic and their commercialisation often requires additional input from faculty and students and entrepreneurs"	Broad view, but does not include universities and businesses working together to capitalise on market opportunities
(Ternouth et al., 2012), p.11	"Successful knowledge transfer draws on academic and business knowledge to create successful innovations"	Broad including market related activities

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Knowledge exchange

Source	Definition	Comment
1. Higher Education Funding Council for England http://www.hefce.ac.uk/media/hefce/content/whatwedo/knowledgeexchangeandskills/heif/pacec-report.pdf	Knowledge exchange (KE) is a two way flow of knowledge between universities and their users, which includes interactions between higher education (HE) and businesses, public and third sectors, community bodies and the wider public.	The definition is mainly about the exchange of knowledge between parties rather than the co-creation
2. Department for Business innovation and Skills https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/34805/12-p188-annual-innovation-report-2012.pdf (pp. 23 and 56)	Process of transferring university research to real world products and services	The definition mainly focuses on the transfer of knowledge
3. Research Councils UK http://www.rcuk.ac.uk/kei/expectation/Pages/kePrinciples.aspx	The two-way exchange of knowledge between academia and research users in business, public and the third sectors	The definition is mainly about the exchange of knowledge between parties rather than the co-creation
4. UK-IRC http://www.cbr.cam.ac.uk/pdf/AcademicSurveyReport.pdf	It is not simply about the codified transfer of science (patents and licences etc.) but includes many people based, problem solving and community driven activities	Acknowledges the wider use of university generated knowledge

Annex 4: Achievement index: the fulfilment of unidimentionality and reliability

The creation of two factors – knowledge access and knowledge co-creation – through Principle Component analysis

Principle component analysis further confirmed our theoretical categorisation of objectives into two groups (See Box 1 and 2 for theoretical categorisation). Even though developing basic knowledge is identified as a different category, we decided to group it with 'knowledge access', since it is related with 'knowledge access'. Combining theory with factor analysis when designing groups is recommended in the literature.

Rotated Component Matrix[a]

	Component		
	1	2	3
Knowledge Access			
1. Develop new basic knowledge	.201	.047	.862
2. Access university talent (i.e. people and teams)	.156	.885	.127
3. Make informal and meaningful links with a wider range of people within the university	-.051	.741	.341
4. Give something to the community	.279	.831	-.125
5. Make formal links with people within universities	.374	.703	-.338
Knowledge Co-creation			
6. Interactive learning and co-creation	.548	.398	-.095
7. Develop new products and processes	.855	.099	.205
8. Send a signal to your competitors	.757	.056	.284
9. Gain professional recognition or brand recognition (e.g. market visibility or innovation profile)	.830	.234	.017
10. Gain access to strategic positioning in the market	.903	.157	-.058

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Internal consistency and unidimentionality were tested to assess the possibility of generating two scores to represent 'knowledge access' and 'knowledge co-creation' objectives.

Reliability of the scale

Cronbach's Alpha – Internal consistency

We also checked how closely each item in the two groups is related. We used Cronbach's Alpha Reliability Statistics:

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$$

Here N is equal to the number of items, c-bar is the average inter-item covariance among the items and v-bar equals the average variance.

For both groups the alpha value was more than 0.7, which indicated a high level of internal consistency.

Knowledge access .726> 0.7

Knowledge co-creation .777>0.7

Factor analysis – unidimentionality

Factor analysis was performed separately for each group to check unidimentionality. For knowledge access, the eigen value for the first component was larger than the second component (2.5 vs 1.0), and the first component explained 50% of variance.

Knowledge access

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	2.463	49.263	49.263
2	1.035	20.703	69.966
3	.884	17.682	87.648
4	.341	6.817	94.465
5	.277	5.535	100.000

Extraction Method: Principal Component Analysis.

Similarly, for knowledge co-creation, the eigen value for the first component was larger than the second component (3.1 vs 0.6), and the first component explained 62% of variance.

Knowledge co-creation

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	3.098	61.958	61.958
2	.647	12.946	74.904
3	.563	11.267	86.171
4	.439	8.780	94.950
5	.252	5.050	100.000

Extraction Method: Principal Component Analysis.

The above results suggested that ‘knowledge access’ and ‘knowledge co-creation’ indices reasonably achieve internal consistency and unidimentionality characteristics.

Appendix 5: Transformation of Public Policy towards an Open Innovation Paradigm

Introduction

Government policy has moved from the linear model of science policy in the 1950s–60s (i.e. a research driven approach), which primarily focused on supporting the basic research base, to technology policy in the 1970s and 1980s with clear utilitarian – often engineering – perspectives (i.e. technology push and market pull approaches). More recently, innovation policy in the 1990s–2000s incorporated a knowledge transfer mission through building institutions, e.g. technology transfer offices in universities and tighter intellectual policy (IP) enforcement. It looks as though a new open innovation landscape is emerging with a major focus on people and open innovation infrastructure. Even though the major focus and activities were different in each era, it should be noted that these are not contrasting shifts from one policy to another, but rather building upon the achievements of one to the other. The following sections discuss this policy transformation in detail.

Science policy

The pioneering work of Bernal (1939)[60] has widely been recognised as the influential piece that paved the way to design a science policy, which had assumed that investments in science generate positive impacts on economic growth and social welfare. Hence, universities and other research institutions were the major focus. It was assumed that funding basic research would automatically generate marketable products and/or services, and thus, the quality and usefulness of research are considered highly positively correlated. University research and training received the main funding grants.

Technology policy

However, it was evident over time that the distance between the excellence of basic research and the fulfilment of user needs was widening. As a result, in the 1970s and 1980s technology policy was introduced with the aim of closing these gaps (Lundvall and Borras, 2009)[61]. This policy especially paid attention to 'strategic engineering technologies' – such as nuclear power, space technology, computers, drugs and genetic engineering – as the core of economic growth.

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[60] Bernal, J. D. 1939. The Social Function of Science, London, Routledge & Kegan Paul.
[61] Lundvall, B. & Borras, S. 2009. Science, Technology, and Innovation Policy. In: FAGERBERG, J., Mowery, D. C. & Nelson, R. R. (eds.) The Oxford Handbook of Innovation. Oxford: Oxford University Press.

The selection of strategic technological sectors was based on either 'technology push' or 'demand pull' approaches. The 'technology push approach' involves developing research outputs to marketable products in a linear process of research/invention, development, prototype design, production, marketing and sales, while the 'demand pull approach' starts with market needs, which ultimately shape research activities. Hence, the basis for 'strategic engineering technologies' was 'research competencies' (i.e. technology-push) and 'market needs' (i.e. market pull). The success is achieved when we have the best of both the approaches with a combined and non-linear model, since no technology will be commercially successful if it is not needed (the market sets limits / shapes) and we cannot develop what we do not have the knowledge for, even if the need is very large (science sets limits / shapes) (Dosi, 1982)[62].

Innovation policy

Even though science and technology policies seemed to be 'ideal' types, concerns were raised (in late 80s) over the practicality of these policies since these do not necessarily illustrate how different actors work together to achieve policy objectives. In order to fill this gap, innovation policy, which was mainly aimed at designing framework conditions and institutions to support collaborations, was introduced in the 1990s. Lord Sainsbury and Lord Mandelson should be credited for the success of innovation policy.

A major change introduced by this policy was the creation of institutions that promote and support entrepreneurship, science and technology, with no prioritizing of specific sectors or technologies (Lundvall and Borras, 2009; North 1990)[63]. The formation of Technology Transfer Offices, University Enterprise Centres and Business Relations Units, which are aimed at the transfer of knowledge from universities to businesses, were major university level initiatives of the innovation policy. The main national level initiatives of this policy are the establishment of institutions such as Technology Strategy Board, Nesta and Design Council with the mandate to promote innovation.

Open innovation policy

While most of these institutions formed under innovation policy were successful at delivering their tasks, as institutions are developed collectively to address vested interests of people, changing institutions to reflect learning effects is a long conflict-ridden process (North, 1990)[64]. Furthermore, the nature of collaborations between universities, businesses and the stakeholders of innovation ecosystems is changing from the unidirectional transfer of knowledge from universities to businesses, to all stakeholders working closely together to co-create knowledge.

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[62] Dosi, G. 1982. Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. Research Policy, 11, 147-162.
[63] (see footnote 61 for Lundvall and Borras) North, D. 1990. Institutions, Institutional Change and Economic Performance, Cambridge, Cambridge University Press.
[64] North, D. 1990. Institutions, Institutional Change and Economic Performance, Cambridge, Cambridge University Press

These changes have paved the way for a new open innovation policy post 2010. This policy takes an ecosystem perspective on innovation: one that recognizes that UK businesses, universities, education and financial institutions need to be working together to 'co-create' knowledge as a strategy to achieve economic growth. The new focus is on open innovation, by which we mean close collaboration by all stakeholders in addressing a business and social opportunity or challenge. These opportunities range from the development of a new product through to a larger socio-economic issues such as green energy, health or crime. Stakeholders would clearly include businesses and citizens, but also universities, banks and other intermediate organizations, engaging with each other through multiple channels and pooling their internal resources, including, knowledge, finance, people, markets, big data and IP.

This approach to innovation is more than simply sharing risk and reward or the unidirectional transfer of knowledge from universities to businesses; it encapsulates the integration of the entire innovation ecosystem, and is about innovating new markets and more effective business models, that would not exist otherwise. This regime also considers that interactions between the stakeholders of an innovation ecosystem primarily involve people, and thus, underpins the importance of empowering people to reap the full benefits.

Public policy and actions introduced under the leadership of Rt Hon David Willetts, Minister for Science and Universities, made a great contribution to this emerging open innovation policy. Policies that promote open science, open access and relaxed intellectual property[65] (i.e. limitations and exceptions to copyrights and flexible IP) are a few examples of successful changes introduced for promoting collaboration between the stakeholders of our ecosystem. Open science initiatives have promoted businesses working closely with academics. One example is the new funding of £64 million by ESRC to be invested in Business and Local Government Data Research Centres[66]. HEFCE's proposal on open access publications for the post-2014 Research Excellence Framework, which encourages making the output of publicly funded research openly available is another initiative.

Similarly, a range of reports has highlighted the commitment of various government bodies to promoting and supporting this open innovation policy landscape as a strategy for economic growth: the Higher Education Innovation Fund 2011–15 strategies; the 2012 Innovation report by the Department for Business, Innovation and Skills; the 2013 PACEC report on Knowledge Exchange and HEIF Funding; HEFCE's proposal on open access publications for the Research Excellence Framework, the Government response to the consultation on copyright exceptions and clarifying copyright law, as well as the Skills and Research Councils Knowledge Exchange Principles.

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[65] Modernising Copyright: A modern, robust and flexible framework. HM Government http://www.ipo.gov.uk/response-2011-copyright-final.pdf

[66] Business and Local Government Data Research Centres - Big Data Network Phase 2 http://www.esrc.ac.uk/funding-and-guidance/funding-opportunities/27813/business-and-local-government-data-research-centreshomepage-promo.aspx

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