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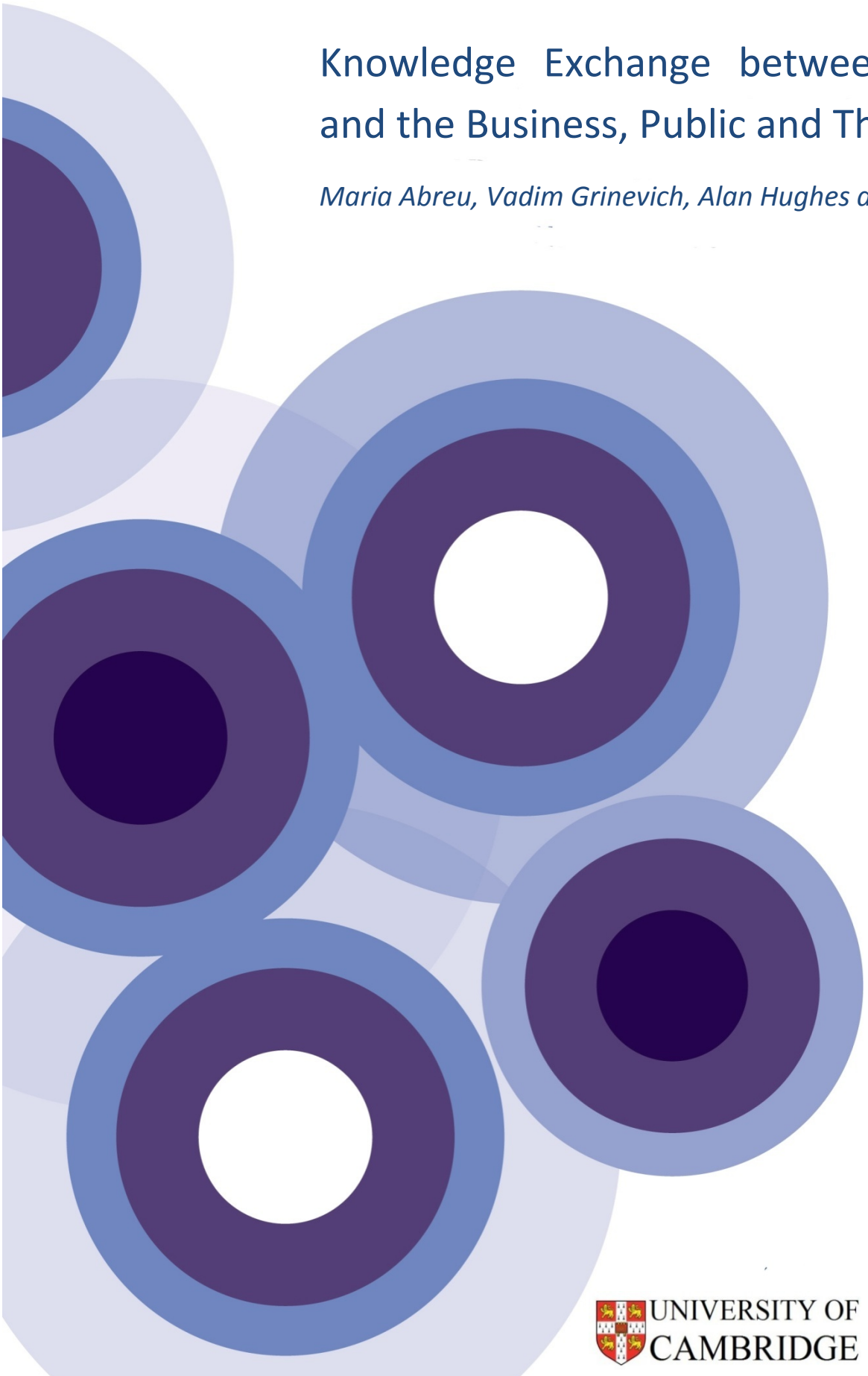
Knowledge Exchange between Academics and the Business, Public and Third Sectors

Maria Abreu, Vadim Grinevich, Alan Hughes and Michael Kitson



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The usual disclaimers apply.

About the authors

Maria Abreu, Research Fellow, *Department of Economic Geography, University of Groningen*

ma405@cam.ac.uk

Dr Maria Abreu is a Research Fellow at the Department of Economic Geography, University of Groningen, The Netherlands, and a Research Fellow of the Programme on Regional Innovation, Judge Business School, University of Cambridge. Prior to joining the University of Groningen, Maria was based at the Centre for Business Research, University of Cambridge, working on the ESRC funded project on University-Industry links. Her research interests include regional economic development, regional innovation and spatial economics. Prior to coming to Cambridge she worked for the World Bank as a consultant on the regional economic development. She completed her PhD on the "Spatial Determinants of Economic Growth and Technology Diffusion" at the Free University Amsterdam in August 2005.

Vadim Grinevich, Research Fellow, *Department of Architecture, University of Cambridge*

vvg22@cam.ac.uk

Vadim Grinevich is a Research Fellow at the Department of Architecture, University of Cambridge, where he works on an EPSRC funded project on Regional Visions for Sustainable Infrastructure. Prior to joining the Architecture Department, Vadim was based at the Centre for Business Research, University of Cambridge, working on the ESRC funded project on University-Industry links as well as innovation research projects funded by the Advanced Institute for Science and Technology Japan and the Australian Business Foundation. As part of the Programme on Regional Innovation at the Judge Business School, he has conducted innovation related research for the former Department of Innovation, Universities and Skills, the National Endowment for Science, Technology and the Arts, and the Department of Enterprise, Trade and Investment in Northern Ireland. Before moving to Cambridge, Vadim worked as an economic analyst in public academic institutions and in the private sector in Moscow. He holds an MPhil Degree in Planning, Growth and Regeneration from the University of Cambridge and a Doctoral Degree in Economic Theory from the Moscow State University.

Alan Hughes, *Margaret Thatcher Professor of Enterprise Studies, Judge Business School, Director, Centre for Business Research, Director, UK~IRC, University of Cambridge*

a.hughes@cbr.cam.ac.uk

Alan Hughes is Director of the Centre for Business Research (CBR) and Margaret Thatcher Professor of Enterprise Studies at the Judge Business School, and a Fellow of Sidney Sussex College, University of Cambridge. In 2009 he was appointed Director of the UK Innovation Research Centre (UK~IRC), a joint venture between Imperial College and the University of Cambridge. Professor Hughes has held visiting Professorships in the USA, Japan, France and Australia. He holds an Honorary Professorship in Economics and Business at the University of Queensland, Australia. His research interests include industrial and technology policy; the innovation, financial and acquisition characteristics of large, small and medium sized enterprises; the analysis of the relationship between corporate takeovers, corporate governance, executive pay and innovation performance; and the evaluation of industrial and business support policy. His most recent work on innovation includes the ESRC funded project on university-industry links and work funded by the EPSRC on new business development policy in optoelectronics and photonics. At CBR he has recently completed with PACEC a HEFCE funded evaluation of third stream funding in the English universities. He is a member of the Prime Minister's Council for Science and Technology.

Michael Kitson, *University Senior Lecturer in Economics, Judge Business School and Centre for Business Research, University of Cambridge*

m.kitson@jbs.cam.ac.uk

Michael Kitson is University Senior Lecturer in global macroeconomics at the Judge Business School, Cambridge; Director of the Knowledge Hub of the UK Innovation Research Centre (UK~IRC); Director of the Programme on Regional Innovation at the Cambridge-MIT Institute; Fellow of St Catharine's College, Cambridge; and Research Associate of the Centre for Business Research, Cambridge. His research interests include, economic policy, regional economics, corporate performance, innovation and the commercialisation of science. He has undertaken major research projects for the former UK Department of Innovation, Universities and Skills; the National Endowment for Science, Technology and the Arts; the Economic and Social Research Council; and the Engineering and Physical Sciences Research Council. He has also provided evidence as an expert witness for the House of Lords Economic Affairs Committee's enquiry into globalisation. His current work is concerned with assessing the factors that drive regional competitiveness and innovation.

Contents

Section 1. Introduction

There has been an increasing focus on the role that Universities can play in contributing to economic growth (Lambert, 2003; Sainsbury, 2007). In addition to the important core missions of research and teaching, policy has focused on promoting 'technology transfer' concentrating on the commercialisation of science through such mechanisms as patents, licences and spin-outs. As this study shows, these mechanisms are important, but as it also shows, they are an incomplete representation of the wide process of knowledge exchange that takes place between academics from all disciplines with partners in the private, public and the so-called third sector which includes charities, voluntary organisations and social enterprises.

Recent research has highlighted the multifaceted role that universities play in stimulating innovation and economic growth (Cosh et al., 2006, and Kitson et al., 2009). But there is a lack of systematic quantitative evidence on the interactions that academics, from a wide range of disciplines, have with external organisations. This report addresses that gap by reporting the results of a unique large scale survey of academics in the UK. The survey by virtue of its sample size, which amounts to more than 22,000 responses, allows us to paint a detailed picture of: the activities of academics; how they are interacting with external organisations; what motivates or constrains interactions; and how academics see the role of academia in society.

This report shows that academics from all disciplines are engaged in the knowledge exchange process – it does not simply involve those from science and technology based disciplines but also includes academics from the arts and humanities and the social sciences. And the knowledge exchange mechanisms are wide and varied – it is not simply about the codified transfer of science (patents, licences, etc) but includes many people based, problem solving and community driven activities. Academics are engaged with a range of partners – and in the private business sector the range is not confined to the high-technology manufacturing industries but includes services and many so-called low technology sectors. Furthermore, many academics are interacting with the public and third sectors – and on many metrics the level of interaction is higher with these sectors than with the private sector. There is a wide range of constraints that hinder interactions with external organisations – the conventional wisdom is that cultural differences and conflict over intellectual property (IP) are important barriers. But, in general, this is not supported by the evidence from academics; culture and IP are not considered important - by far the most important constraint is a lack of time.

This report shows the rich and varied ways that academics engage with wider society. It also shows that such interactions often strengthen research and teaching activities. But of course not all academics are engaging with external organisations – and for some it may not be necessary to the proper fulfillment of their wider university role. As the respondents to the survey stated - across all disciplines - academic freedom is of fundamental importance to the future wellbeing of society.

Section 2. The Survey Coverage and the Presentation of Data

The web based survey on which this report is based covered all individuals in the UK academic community who were active in research or teaching in 2008-9. It was carried out between autumn 2008 and early summer 2009. The achieved sample of 22,170 represents a response rate of over 17% from a specially constructed sampling frame of 125,900 individual academics in all disciplines in virtually all Higher Education Institutions in the UK (throughout this report, for ease of reading, the term "universities" is used to mean all higher education institutions). The sample encompasses all grades of staff; 19% are Professors, 30% are Readers, Senior Lecturers, or Senior Researchers; 42% are Lecturers, Researchers or Teaching or Research Assistants, and 9% are other grades of staff. The sample is split roughly equally between the Arts, Humanities and Social Sciences disciplinary grouping and the Medical and Science, Technology, Engineering and Mathematics disciplinary grouping. Around 60% of the sample are males and around 40% females, with 6% aged under 30 years and 38% aged over 50.

A description of the survey method used to obtain the sample, possible response biases and the representativeness of the sample is contained in Annex B. That Annex also discusses the use of tests of statistical significance in the large sample sizes on which we report. It explains that we have not reported such tests in the main exhibits since the large sample sizes mean that virtually any differences, however small, are statistically significant at normally accepted levels. We therefore focus on the quantitative significance of differences rather than statistical significance.

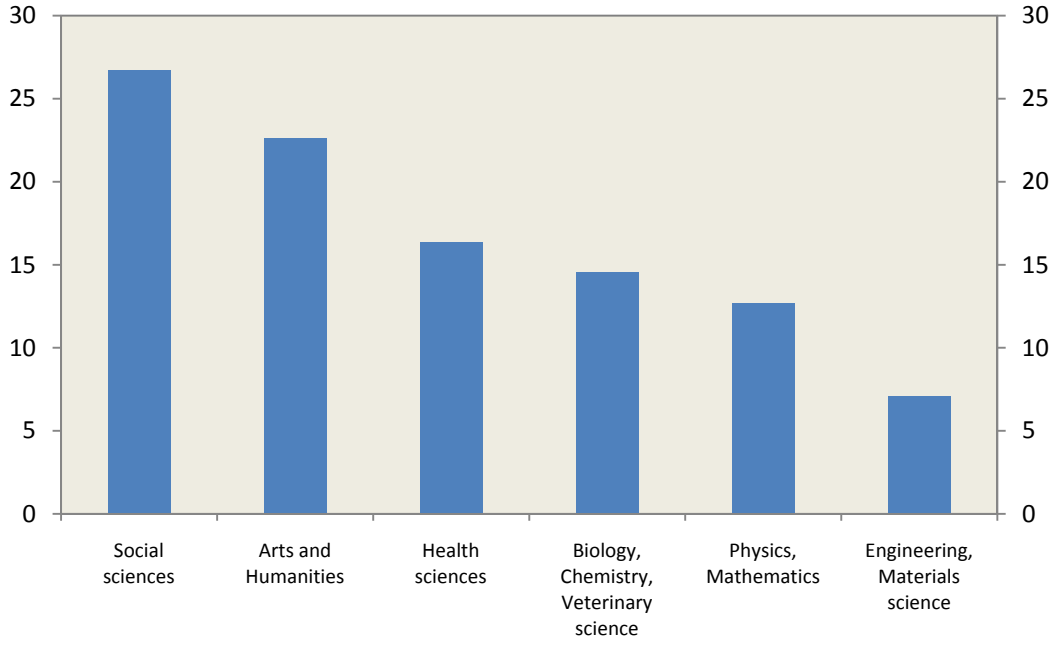
In presenting results we typically provide cross-cuts of the data split according to groupings of academics by seniority, by age and by gender. We also provide splits by broad disciplinary background and by type of research, distinguishing between applied research, user-inspired basic research and basic research. Finally we provide some analysis by type of university distinguishing between the Russell Group, Older Universities (non-Russell Group founded pre-1992), Younger Universities (founded post-1992) and Specialist Arts Institutions. We also analyse the data cross-cut by the 9 English Regions and the three devolved administrations of Northern Ireland, Scotland and Wales. To simplify presentation we have focused on selected key findings in the exhibits we present in the main text. Annex A, to which we occasionally refer in the main text, contains a full set of tables reprinting results by each of the cross-cuts that we have employed.

Section 3. Disciplines, Activities and Types of Research

Disciplinary Background

The distribution of the 22,170 sample respondents by discipline is shown in Exhibit 1. This shows the split by the six broad categories which we use throughout the rest of this report in examining the way in which responses vary across disciplines. The sample is roughly equally split between the social sciences and arts and humanities on the one hand and health sciences, biology, chemistry, veterinary science, physics, mathematics and engineering and materials science on the other. In this context it is worth noting that discussions of the role of universities in the UK which emphasise STEM (Science, Technology, Engineering and Mathematics) subjects is focusing on an important, but small proportion of the total academic community.

Exhibit 1 Discipline (% of respondents)

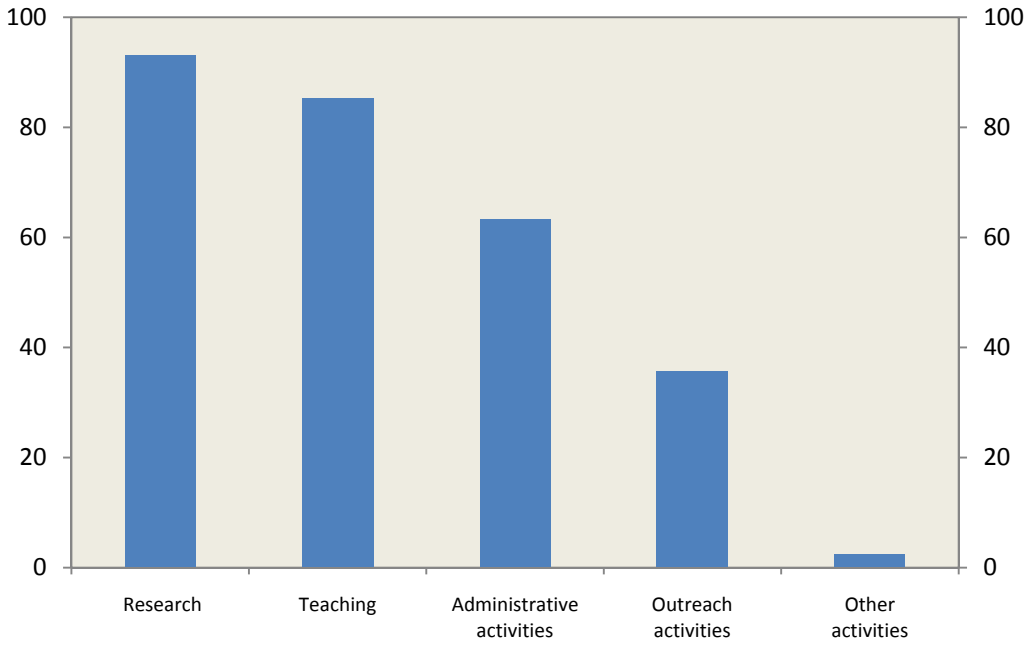


The contribution of the arts and humanities and the social sciences is, as we shall see, an important one and the weight they carry in the academic population as a whole is therefore of significance. In this report we are able to address an imbalance in discussions of the attitudes towards interactions which in previous work has focused on only one part of the academic community.

Teaching, Research and Other Activities

The extent to which individuals take on a range of roles in their academic life is an important one. The balance between teaching, research, administrative activities and outreach activities is shown in Exhibit 2.

Exhibit 2 Activities (% of respondents)



A very small portion of the sample was concerned solely with research or solely with teaching. This is reflected in the fact that over 90% of the academics surveyed reported that they took part in some research activity, and over 85% took part in some teaching activity. Therefore a combination of teaching and research is the predominant mode of academic activity. Nearly two thirds were also concerned with administrative activities of some kind, many in senior roles. Over 35% also reported an involvement in outreach activities. An analysis of the pattern of activity by age and gender (reported in Annex A: Exhibit A1) shows, as might be expected, that administrative activities assume greater significance as the age of the respondent rises; whereas only around a third of those under 30 reported administrative activies, over two thirds of those aged over 50 did so. The proportions reporting that they carried out research fell with age from 97% of those aged between 30 and 39 to a little under 90% for those aged over 50, whereas the proportion teaching under the age of 30 was around 62% and the proportion teaching aged over 50 was over 89%. These patterns reflect the likelihood that the sample contains a number of individuals who are in the initial stages of research careers, for instance as research fellows, in the younger age group. On the other hand there is some tendency for individuals to sacrifice research activity for administrative activities at the upper end of the age range. Outreach activities rise notably with age doubling to nearly 40% from just over 20% when comparing the under 30 age group with those aged over 50.

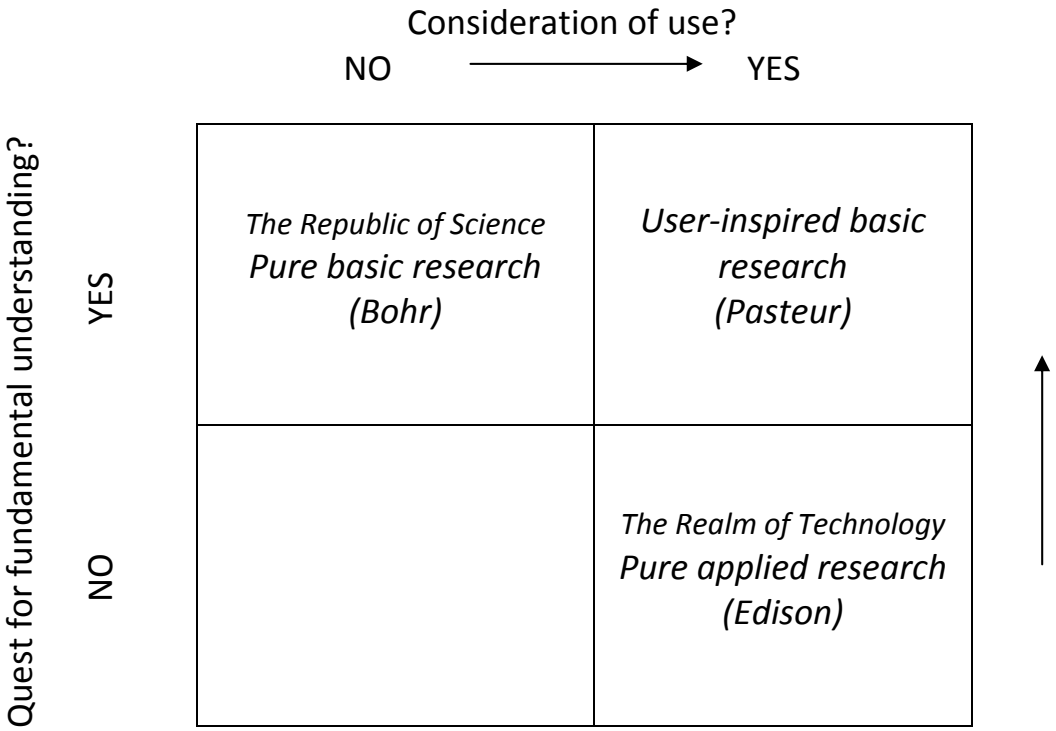
We also asked the respondents whether they had management responsibility as opposed to just taking part in administrative activities: 47% of the sample responded that they did have management responsibility and, as might be expected, this was significantly positively related to age. Only 11% of those under 30 had such responsibilities whereas 57% of those aged over 50 had.

There were relatively few differences when these activities were analysed by gender. Women were relatively less likely to be involved in administrative activities or management responsibilities which may be a reflection of the tendency for the male academics in the survey to be older on average than the female respondents.

"Basic" and "Applied" Research

One of the constant themes in discussion of the relevance of academic research activity to the wider social and economic welfare of society is the claim that the UK is good at basic research and weak at its application. This is sometimes accompanied by the argument that there should be a realignment of funding towards more applied areas and an emphasis on the identification of impacts as a criterion in screening research projects for funding alongside conventional peer review assessment. The distinction between basic and applied research is, in our view, overemphasised. It neglects the consistent interplay in research activity between considerations of use and the pursuit of fundamental understanding. This interplay and its relative significance compared to the pursuit purely of fundamental understanding or of applications is represented in Exhibit 3 which reproduces the analysis of Stokes (1997).

Exhibit 3 Stokes's Quadrants



Source: Adapted from Stokes (1997) and Dasgupta and David (1994)

This well known quadrant diagram provides a useful heuristic device. It compares research which is not interested in considerations of use at all and is solely concerned with the pursuit of fundamental understanding (represented by the Bohr quadrant) with research concerned solely with considerations of use (represented by the Edison quadrant). These may be taken to represent

respectively, in the terminology of Dasgupta and David (1994), the republic of science and the realm of technology. The quadrant that combines both considerations of use and fundamental understanding is Pasteur's in which useful and important reflexive interactions between applications and fundamental understanding take place. It is interesting to consider how academics themselves consider their research to be characterised in terms of this quadrant analysis. We therefore asked our respondents how they would characterise the nature of their research activity providing definitions based on the *Frascati Manual* (OECD, 2002 and 2005) which correspond to the three quadrants identified in the diagram. These we classified as basic research (Bohr), user-inspired basic research (Pasteur) and applied research (Edison). For the sample as a whole, taking all disciplines together, 27.4% considered themselves to be primarily conducting basic research, whilst 29.7% considered themselves as doing user-inspired basic research and 43% described themselves as applied researchers (*see* Annex A: Exhibit A2). There were, however, some important differences in this pattern across disciplines which are shown in Exhibits 4a-4c.

Exhibit 4a Basic research (% of respondents)

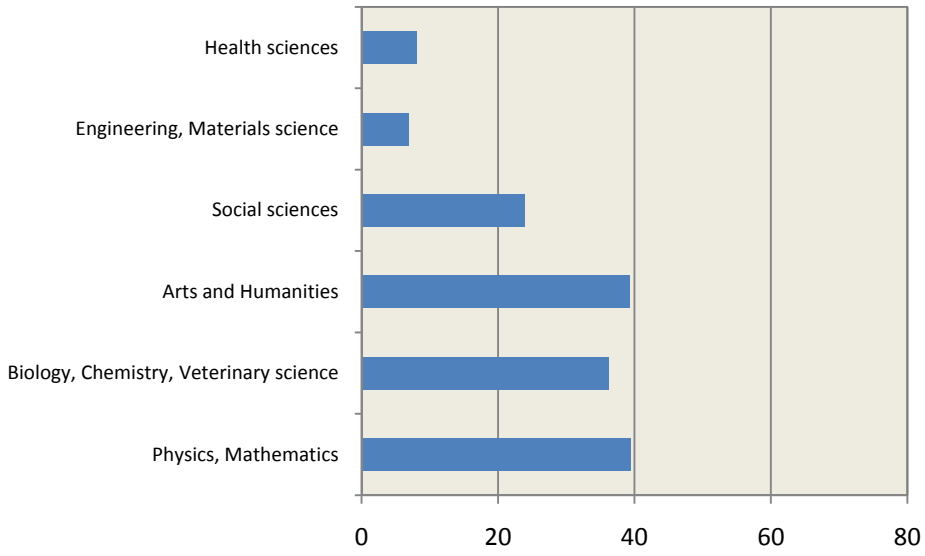


Exhibit 4b Applied research (% of respondents)

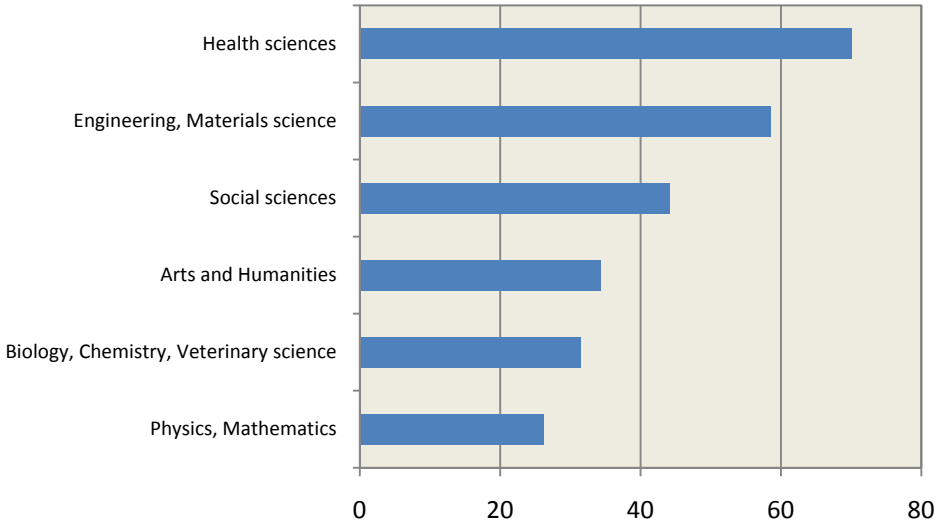
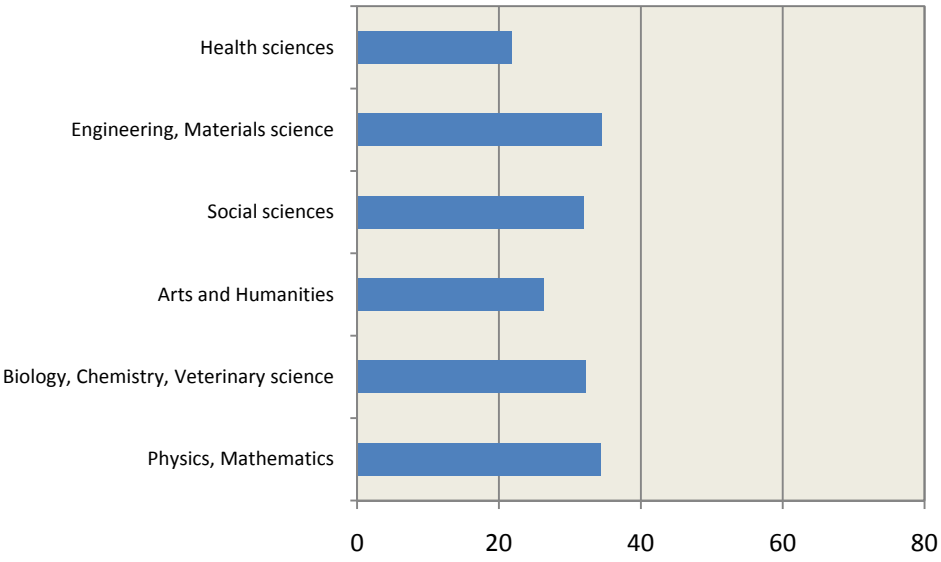


Exhibit 4c User-inspired basic research (% of respondents)



A comparison across these exhibits shows that the proportion of academics who consider themselves to be involved in basic research is highest in physics and mathematics, and in biology, chemistry, veterinary science, alongside arts and humanities. Those in health sciences, engineering and materials science and, to a lesser extent, the social sciences were much less likely to consider themselves as being concerned with purely basic research. In all cases less than 50% of academics felt their activities were primarily basic.

If we turn to applied research an almost exactly opposite picture appears. Those involved in physics, mathematics, biology, chemistry, veterinary science and the arts and humanities are the least likely to consider themselves involved in applied research whereas in the health sciences, engineering and materials science and the social sciences, in that order, a large proportion consider themselves as applied researchers. The proportion is well over two thirds in the case of health sciences and just

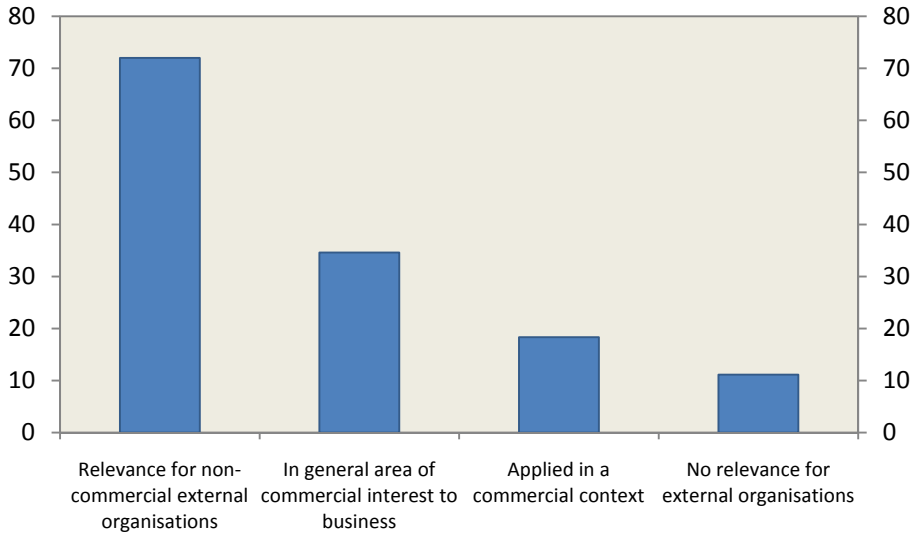
under 60% in the case of engineering and materials science. Variations in the proportions involved in user-inspired basic research are much less significant. There is much less variation in involvement in Pasteur's quadrant across the disciplines.

If we take applied research and user-inspired basic research together they form the dominant mode of research activity in all disciplines. Thus, even in the case of arts and humanities and physics and mathematics, less than 40% of the academics in those disciplines considered that their research was basic. In the discussions of the survey responses in the following sections, in addition to providing cross-cuts by discipline, age group and gender, we will also refer to cross-cuts in terms of these three characterisations of research.

Section 4. Commercialisation of Research

Current discussions of the application and impact of research focus very heavily on the STEM subjects. There is, however, a growing set of arguments which emphasise the importance of research carried out beyond those disciplines. We can use the data in the sample to illustrate a variety of commercialisation and application activities across the full range of disciplines and also in terms of the kind of research that individuals consider themselves to be carrying out. We ask our respondents to indicate if they were undertaking research whether it had been applied in a commercial context, was in a general area of commercial interest to business and/or industry, had relevance for non-commercial external organisations, including the public sector, or whether, in their view, it had no relevance for external organisations. Exhibit 5 shows the responses to this question.

Exhibit 5 Relevance of research (% of respondents)



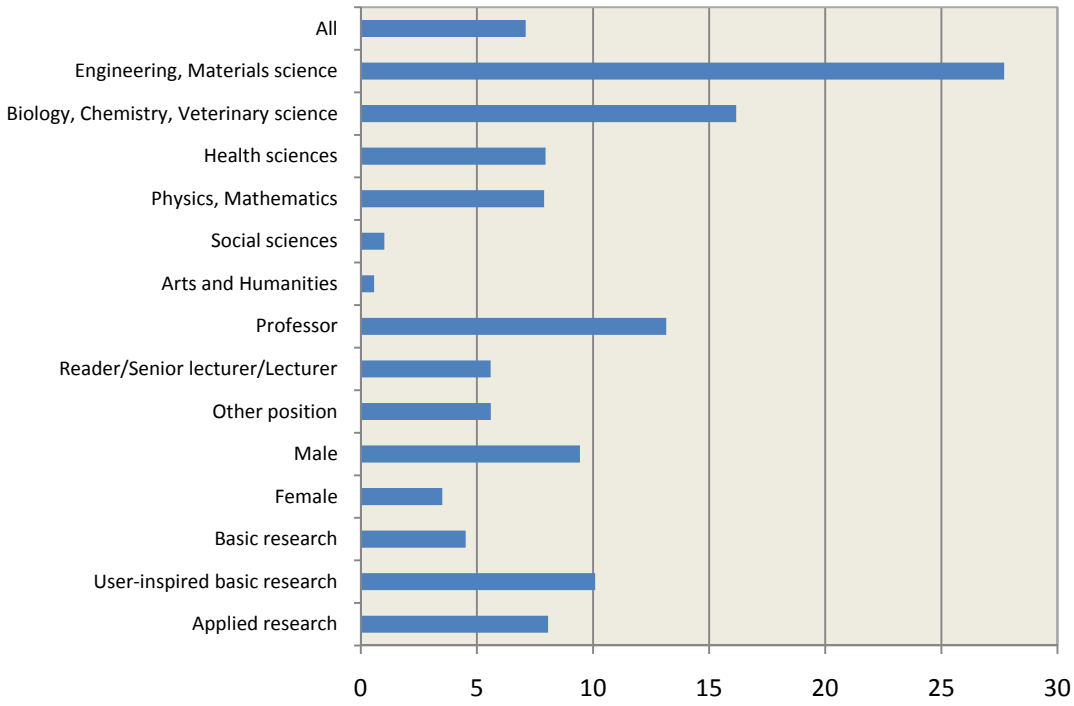
The first and perhaps most striking aspect is that over 70% of individuals considered that their research was of relevance for non-commercial external organisations. Over 34% considered their research to be in a general area of commercial interest to business and only 11% felt it had no relevance for external organisations.

A separate analysis shown in Annex A: Exhibit A3 reveals that less than 3% of those who considered that their research as applied, felt it had no relevance for external organisations. However, only 29% of those who were doing basic research felt it had no relevance to external organisations; 58% felt that it had relevance to non-commercial external organisations; and 22% considered that it was of general commercial interest to business. Thus even the minority of academics who conduct basic research consider that their work is of applied and commercial relevance in a substantial proportion

of cases. The same analysis shows that the arts and humanities on the one hand, and physics and mathematics on the other, contained academics who were most likely to believe that their research was not of relevance for external organisations with 21.4% and 18.7% respectively indicating this to be the case. As might be expected, academics in engineering and materials science were most likely to believe that their work had been applied in a commercial context and to be in the general area of interest to business.

A more direct indication of commercial involvement is the extent to which academics are involved in patenting activity. Although the importance of this varies significantly across industries and patenting and licensing income is a relatively small, though fast growing proportion of the external income of universities, it is an interesting measure. As might be expected, academics in engineering and materials science were the most likely to have taken out a patent in the last three years, with over a quarter of academics in those disciplines reporting this. They were followed by over 15% in biology, chemistry and veterinary science. Exhibit 6 also shows how this activity varies by academic position, gender and the nature of research.

Exhibit 6 Taken out a patent in the last three years (% of respondents)



For academics in general, user-inspired basic researchers were most likely to have taken out a patent. The fact that this proportion is somewhat higher than applied researchers might indicate that the latter were working on the areas in which the intellectual property was less novel and patentable. Even so just under 4% of basic researchers also report having taken out patents which emphasises that it is a mistake to think of basic research as not having any direct commercial applications. Males and professors were much more likely to be involved in patenting which is a reflection of the seniority of the individuals involved and the likelihood of being involved in substantial research projects and the somewhat older average age in seniority of male academics in the dataset. A very similar pattern emerges in Exhibits 7 and 8 which examine whether licenced

research outputs have been made to a company in the last three years and whether or not the academics had been involved in a spin-out company in the last three years.

Exhibit 7 Licensed research outputs to a company in the last three years (% of respondents)

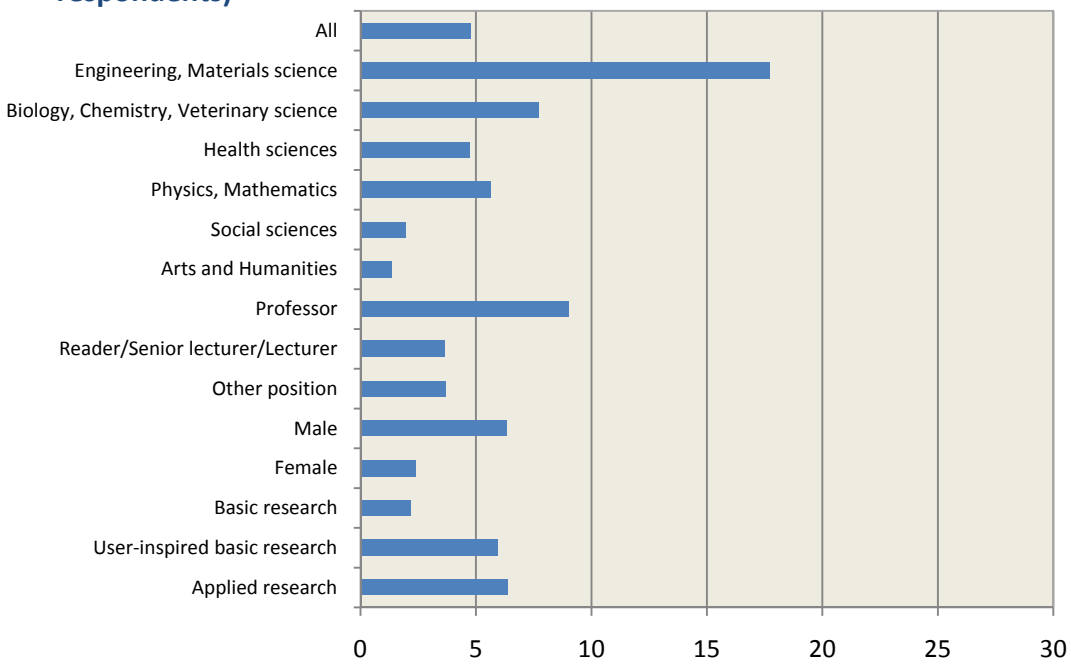
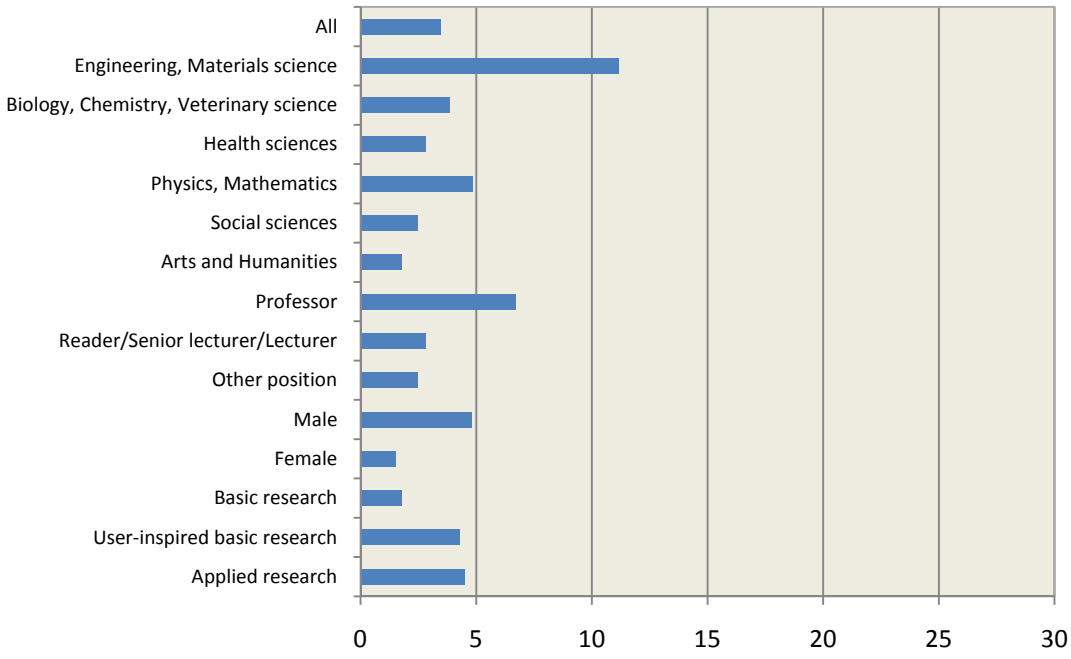


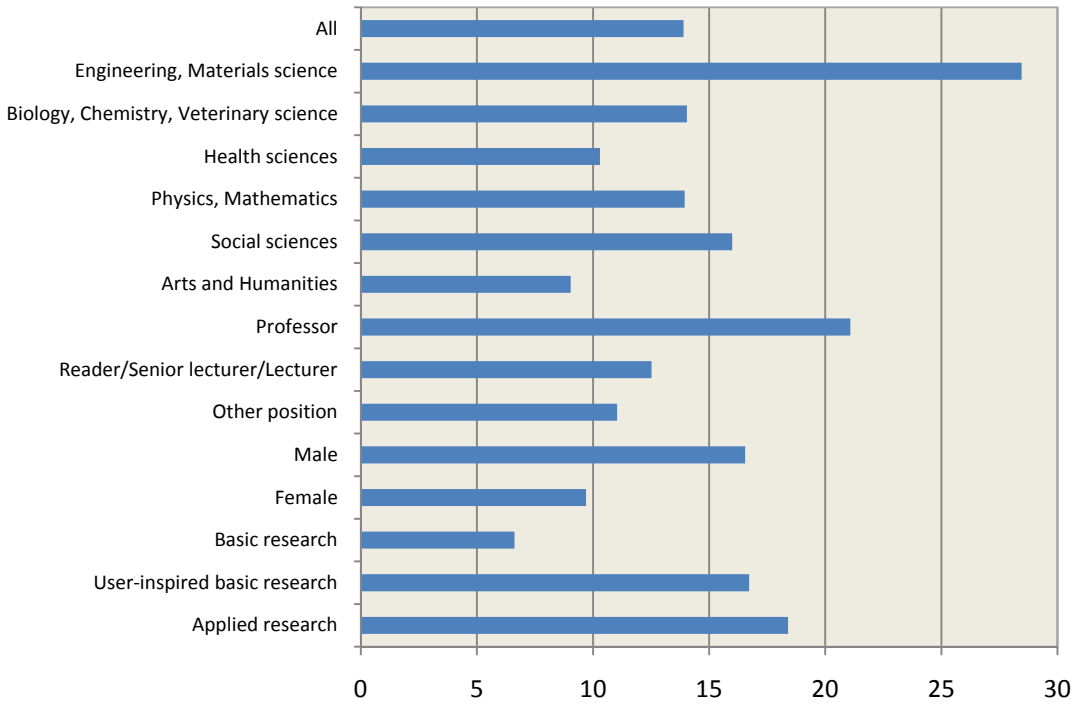
Exhibit 8 Formed a spin-out company in the last three years (% of respondents)



Both of these exhibits show that while the social sciences and arts and humanities are low in terms of activity, such activity nonetheless occurs.

By far the most common form of externalising activity based on research is the formation or running of a consultancy linked to research in the last three years. Here the level of activity is consistently high. It is relatively speaking the most important form of activity for social scientists. Although such activity is once again dominant in engineering and materials science, in this case it is followed by the social sciences. Just under 10% of academics in arts and humanities report such activity. The patterns of consultancy in terms of gender, seniority and the basic applied continuum are the same as for the other indicators of external commercial involvement.

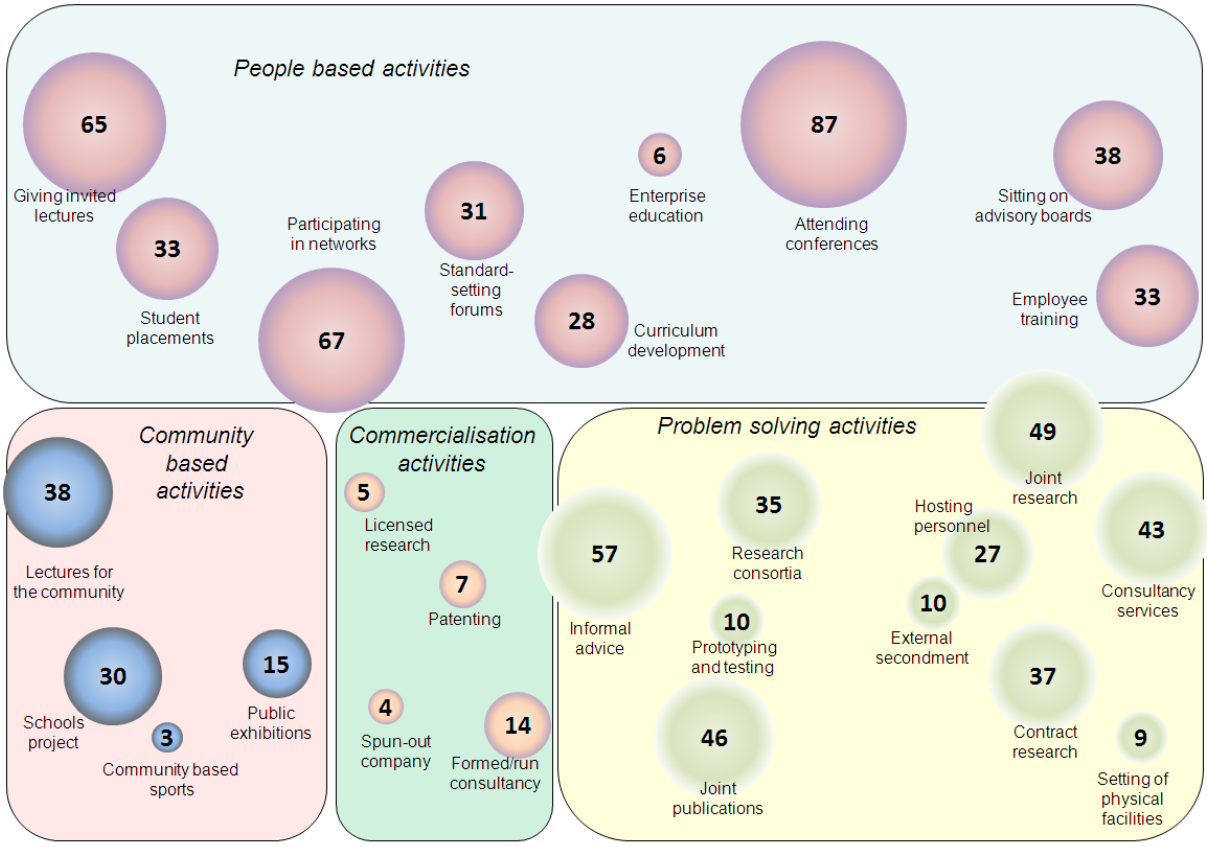
Exhibit 9 Formed or run a consultancy via research in the last three years (% of respondents)



Section 5. Modes of Interaction between Academics and External Organisations

There is increasing recognition that the modes of interaction between the university sector and external organisations are multi-faceted and nuanced. In seeking to identify the patterns of interaction exhibited by the academics in our sample, we grouped possible modes of interaction into three broad categories: people based, problem solving and community based.

Exhibit 10 Academic external interaction activity and commercialisation (% of respondents)



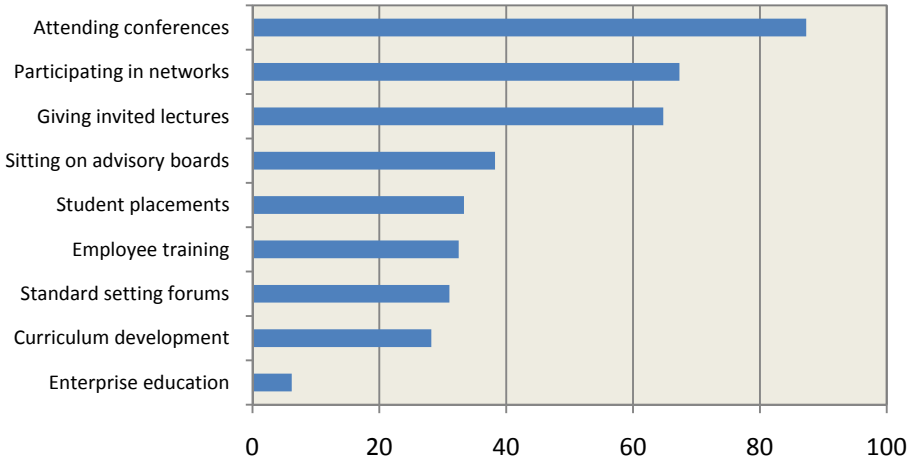
Source: Adapted with permission from Ulrichsen (2009)

Exhibit 10 shows the percentage of respondents reporting each type of interaction; the larger the balloon, the higher the percentage of respondents reporting that interaction. The exhibit also shows a fourth narrower group of knowledge exchange activities under the heading of *Commercialisation activities* (as discussed in Section 4). These include licensed research, patenting, spinning out of a company and the forming or running of a consultancy. It is at once apparent that these are amongst the least common forms of external knowledge exchange activity when taken alongside the much

wider and more frequently reported people based, problem solving and community based interactions. Many of the latter are aspects of what has been called the important, but neglected, "public space" role of universities (Cosh, Hughes and Lester, 2006). They represent in many cases the most common and fruitful way that universities can foster the development, through informal and people exchange activities, of a rich set of interactions which may lead to further and deeper patterns of collaborative research and teaching based activity.

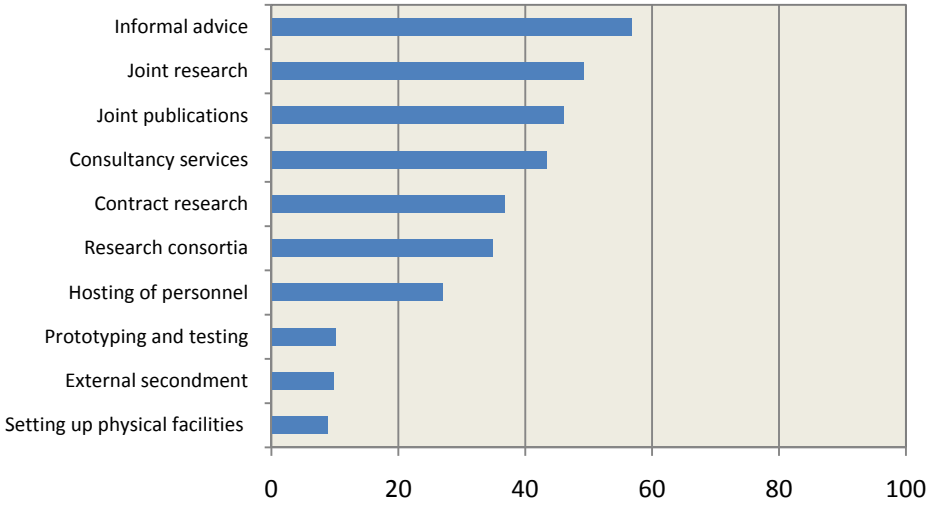
We can focus on the problem solving, people based and community based activities in a little more detail in Exhibits 11, 12 and 13. If we focus first on people based activities, we see that there is a very high level of interactions with external organisations through attendance of conferences, participating in networks, and giving invited lectures. Between 64% and 87% of academics are involved in this sort of interaction. This is followed by sitting on advisory boards, placing students with external organisations, and training employees for external organisations.

Exhibit 11 People based activities (% of respondents)



A further 31% of academics were involved in the important activity of standard setting forums which are a crucial mechanism for shaping and developing pathways of innovation activity. Curriculum development involved external interactions for 28% of academics. Enterprise education was a relatively specialised activity in which around 6% of academics were involved. This pattern indicates the significant extent to which the conventional modes of interaction in which academics are involved – such as disseminating the results of their research at conferences and the education of students and people exchange through placements - lie at the heart of external interactions by academics. A rich picture emerges in which public space activities involving the promotion of such interactions are clearly a significant part of academic activity involving outside organisations.

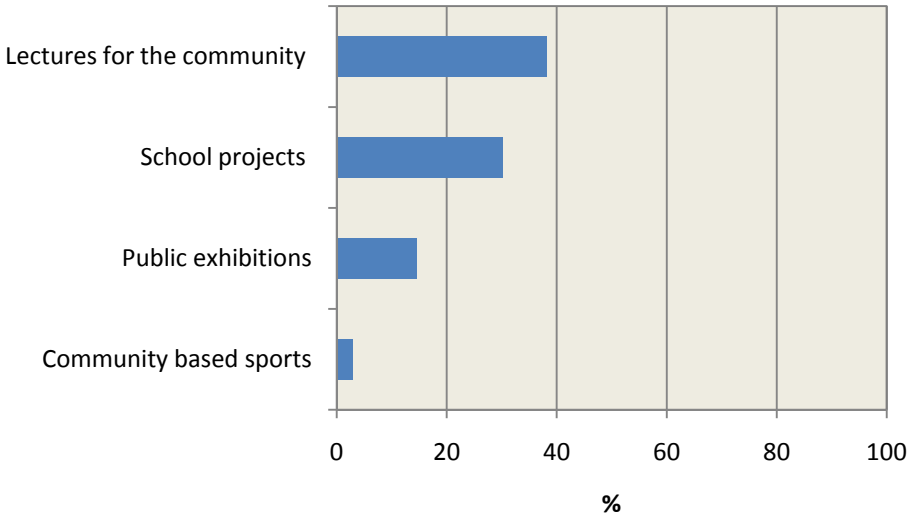
Exhibit 12 Problem solving activities (% of respondents)



The pattern of problem solving activities involving external organisations is shown in Exhibit 12. The most important mechanism is the provision of informal advice; this is reported in nearly 57% of the responses. Joint research and joint publications are also extremely common modes of problem solving interaction, followed by consultancy services and contract research. Hosting of personnel also occurs in a significant number of cases with 27% of academics involved in this form of people exchange. Prototyping and testing, external secondment and setting up physical facilities are relatively infrequently used. The role of informal advice is significant, since it reflects an important way in which contacts are established and may lead to further interactions involving either people based exchange and, or, further problem solving interactions.

Finally, if we turn to community based activities as shown in Exhibit 13, community based sports is clearly a specialised activity related to a small number of HEIs with such specialised activities.

Exhibit 13 Community based activities (% of respondents)



There is, however, clearly a substantial interaction between universities and both the community in the wider sense, such as through the provision of public lectures, and involvement in school projects and, to a lesser extent, by the mechanism of public exhibitions.

Taken as a whole, these results suggest that there is a substantial degree of connectedness between the UK university sector and external organisations. The ivory tower is indeed a myth.

Patterns of interaction do, however, vary across disciplines in the UK university sector. We can investigate this by looking at the extent to which individual academics are involved in one or more kinds of activity within each of our categories. We define a highly interactive academic in the people domain as one who is involved in six or more out of a possible nine modes of interaction. High interaction in the problem solving domain is being involved in six or more out of a possible ten modes of interaction and high interaction in the community based domain is based on being involved in two or more out of the possible four modes of interaction. We also consider an all interaction intensity individual as being one who interacts in twelve or more out of the total of twenty-three possible modes of interaction. If we identify highly interactive academics by discipline a number of interesting patterns emerge. Thus Exhibit 14a is based on the proportion of academics in each discipline who were highly interactive in the people based domain. This reveals that in the social sciences, in engineering and materials sciences and in health sciences around a quarter of academics had a high interaction intensity and were involved in multiple modes of activity.

Exhibit 14 Highly intensive interactions (% of respondents)

Exhibit 14a People based

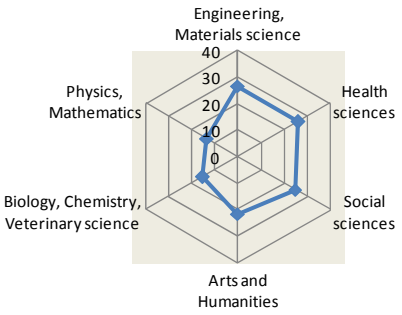


Exhibit 14b Problem solving

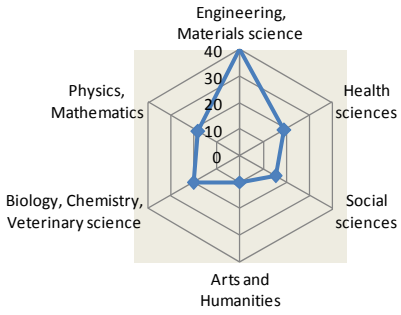


Exhibit 14c Community based

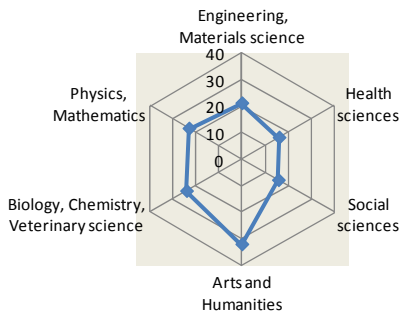
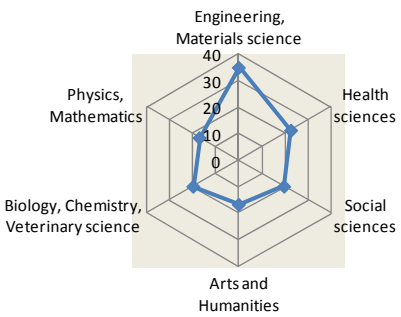


Exhibit 14d All interactions



The proportions were lowest in physics and mathematics and biology, chemistry and the veterinary sciences. In the problem solving domain the pattern was somewhat different. In this case

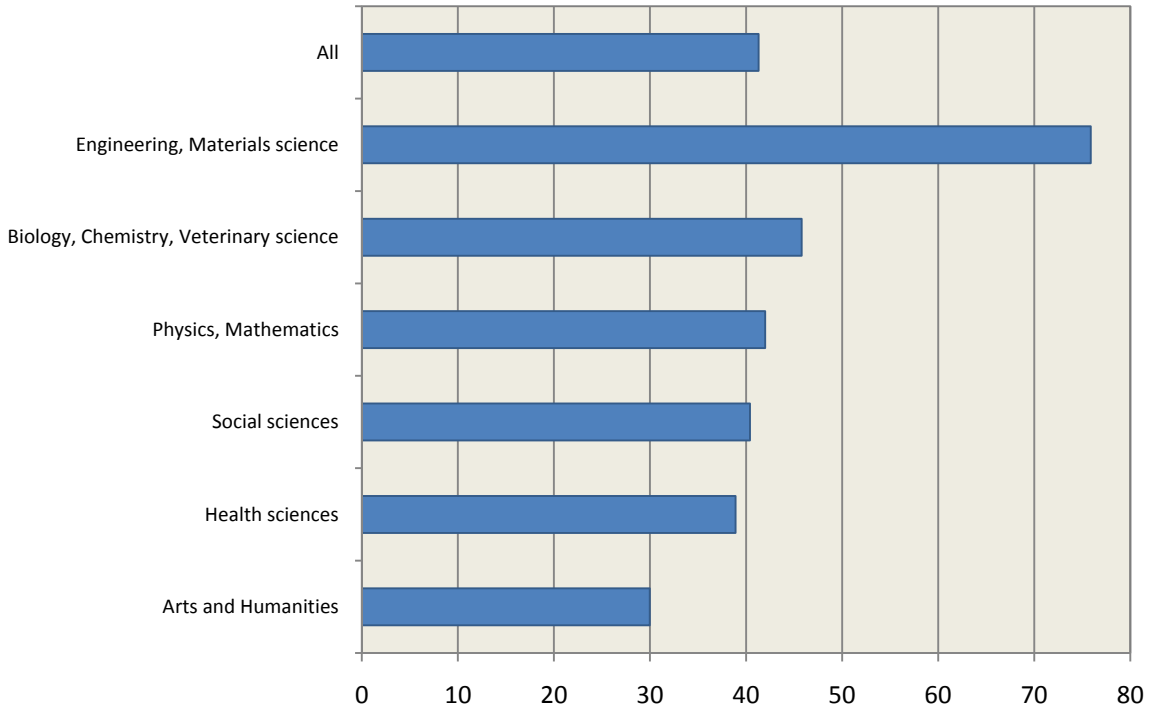
engineering and materials science was once again characterised by a higher proportion of highly interactive individuals, and in this case they were twice as likely to have highly interactive individuals as any other discipline. This emphasises the importance in this domain of multiple interactions which is the case for 40% of the academics reporting from this discipline. Health sciences and biology, chemistry and veterinary science were next with about 20% of highly interactive individuals with arts and humanities, at 10%, having the lowest intensive involvement. In terms of community based interaction, the arts and humanities were the dominant discipline, followed by biology, chemistry and veterinary science and mathematics and physics. Engineering and health and social sciences had fewer highly interactive individuals.

Taken as a whole it appears that academics in engineering and materials science are more likely to be highly interactive across multiple domains. The varied patterns of intensity by discipline across the domains of interaction across the other disciplines means that there intensity evens out. Thus, when all interactions are concerned, it is engineering and materials science which looks an outlier with the others typically containing around 20% of highly interactive individuals; arts and humanities and mathematics and physics performing slightly worse on this indicator than the other disciplines.

Section 6. Partners: Interacting with the Private, Public and the Third Sectors

There has been an increasing focus on how universities, particularly academics in science and engineering, interact with businesses to improve corporate innovation and competitiveness. The evidence from the survey of academics indicates that whilst such forms of interactions are important, there is a high degree of interaction from disciplines outside of the science base. In addition it shows that academics are highly engaged with the public and third sectors.

Exhibit 15 Activities with private sector companies (% of respondents)

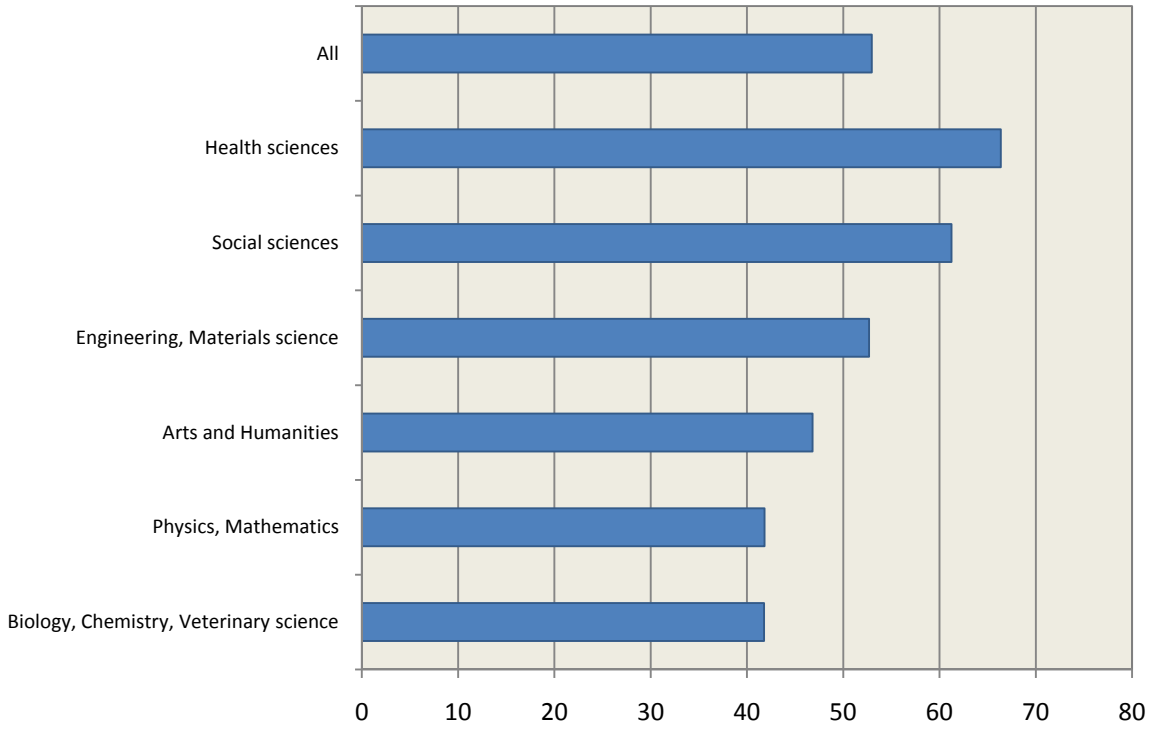


As shown in Exhibit 15, more than 40 % of academics from all disciplines are interacting with private sector businesses. And, perhaps in line with conventional wisdom, more than three-quarters of academics from engineering interact with the private sector. But there is also a high level of interaction with other disciplines outside the science base including social sciences (40%) and the arts and humanities (30%). This strengthens the evidence from case study research which shows the importance of a range of disciplines: for instance Abreu et al., 2009 show that the subject domain of the academic research and the technology central to the company's business may not be necessarily related and that businesses draw expertise from a range of disciplines.

That said, academics from different disciplines vary in the intensity with which they engage with different business sectors. As shown in Annex A: Exhibit A7, engineers and materials scientists are

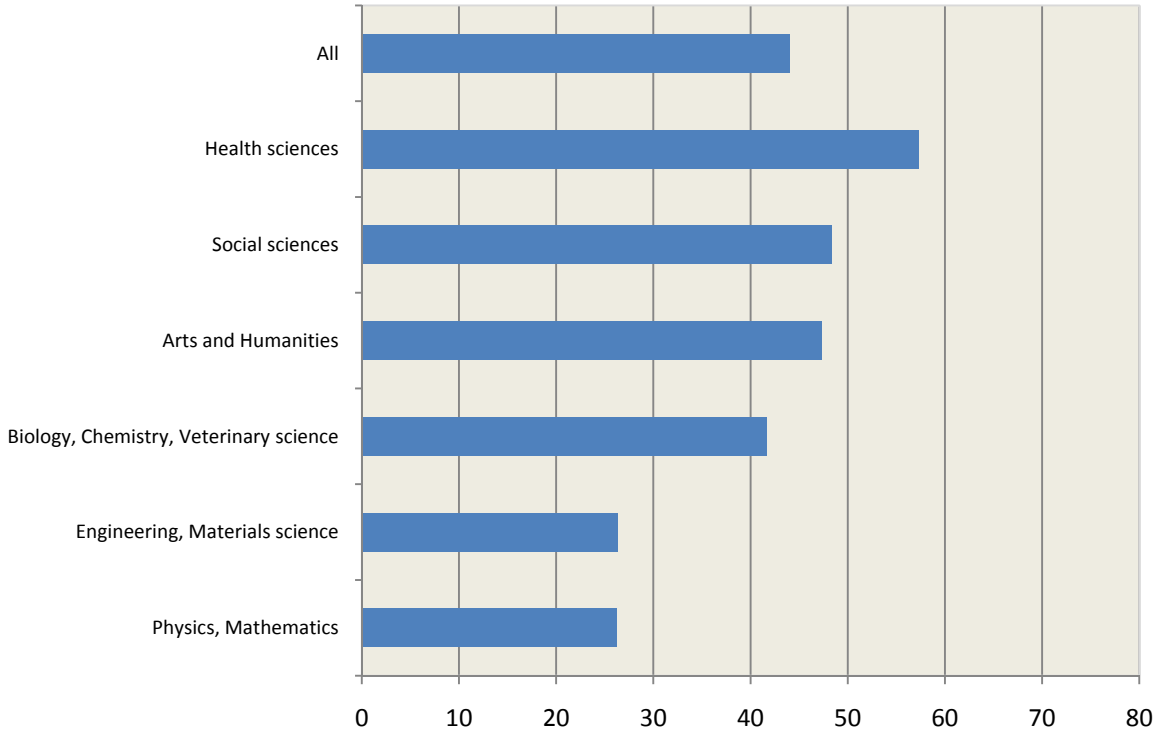
most likely to engage with the utilities and transport sector (56% of academics from this discipline); health scientists are most likely to engage with the private health care sector (66%); biologists and chemists are most likely to engage with the manufacturing sector (44%); and mathematics and physics (35%) and social scientists (39%) are most likely to engage with real estate and business services. The Royal Society (2009) has argued that STEM subjects have a significant impact on the service sector (which is approximately three quarters of the UK economy). The evidence from the survey of academics supports this argument – but also indicates that it is partial and incomplete. The survey shows that businesses – both manufacturing and services – also have significant interactions with non-STEM subjects such as the social sciences and the arts and humanities.

Exhibit 16 Activities with public sector organisations (% of respondents)



The focus on how academics interact with businesses, often overshadows the degree of interaction with the public and third (charities, voluntary organisations and social enterprises) sectors. As shown in Exhibit 16, 53% of academics interact with the public sector, 12% more than those who interact with the private sector. The discipline with the highest interaction is health sciences (66% of academics) probably reflecting interactions with the National Health Service. The degree of interaction from the social sciences is also high with 61% of academics interacting with the public sector. As shown in Annex A: Exhibit A8, the intensity of interactions is highest with UK Government departments compared to other partners. But Exhibit A8 also shows that there is a high number of international connections with 31% of academics engaging with overseas government departments or international organisations and agencies. A further point to stress is that nearly one-fifth of academics are interacting with Regional Development Agencies.

Exhibit 17 Engaged in activities with charitable or voluntary organisations in the last three years (% of respondents)

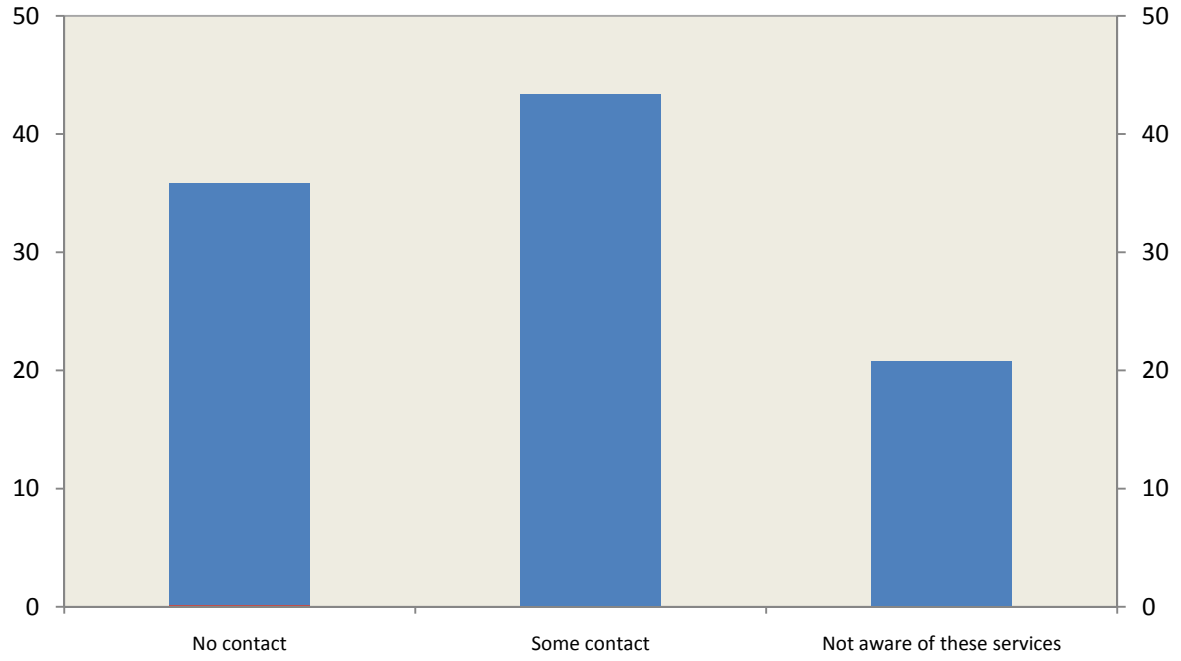


The degree of interaction with the third sector is shown in Exhibit 17. Overall, 44% of academics engage with the third sector - slightly higher than the level of engagement with the private sector. Furthermore, the disciplines with particularly high levels of engagement are different to those who have high engagement with the business sector. Those sectors with high degrees of engagement with the third sector include health sciences (57%), social sciences (48%), and the arts and humanities (47%). In comparison, only 26% of academics from engineering and materials sciences engage with the third sector – approximately one-third of the degree of engagement that the discipline has with the private sector.

Section 7. Creating Partnerships: How Interactions are developed

The development of effective partnerships is crucial if knowledge exchange is to be effective and provide benefits to all partners. Recent research has identified the importance of intermediaries or 'boundary spanners' who facilitate and manage contractual and relational interactions (Abreu et al., 2008; Goddard, 2009).

Exhibit 18 Frequency of contact with institution's knowledge/technology transfer office/consultancy services in the last three years (% of respondents)

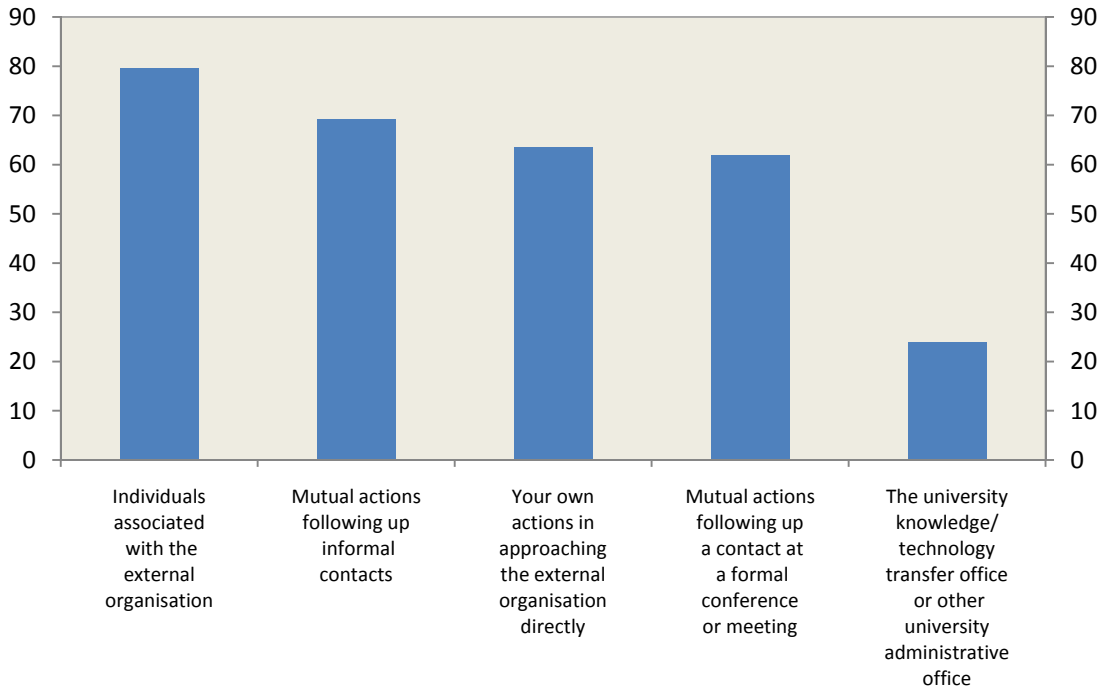


One of the main organisations that act as an intermediary is a University's technology transfer office (TTO). Exhibit 18 shows that 43% of academics had some contact with their TTO (or related organisation) in the past three years, whereas 36% had no contact and 21% were unaware that these types of services were available. As shown in Annex A: Exhibit A9 there is significant variation by discipline with the highest level of contact being by engineers (67%) and biologists and chemists (51%). The lowest level of contact is by: the social sciences (43%); academics from mathematics (42%); and the arts and humanities (36%). A lack of awareness of the services of a TTO was highest in the arts and humanities (27%) and in health sciences (25%). There are also significant variations by position, age and research activity. Simply, older and more senior academics are likely to know about, and use, their TTO (*see* Annex A: Exhibit A9). Furthermore, academics undertaking basic research (35%) are less likely to have contact with their TTO compared to those undertaking user-inspired basic research (49%) or applied research (49%).

In addition to managing relationships, intermediaries, or boundary spanners, often play an important role in **initiating** interactions.

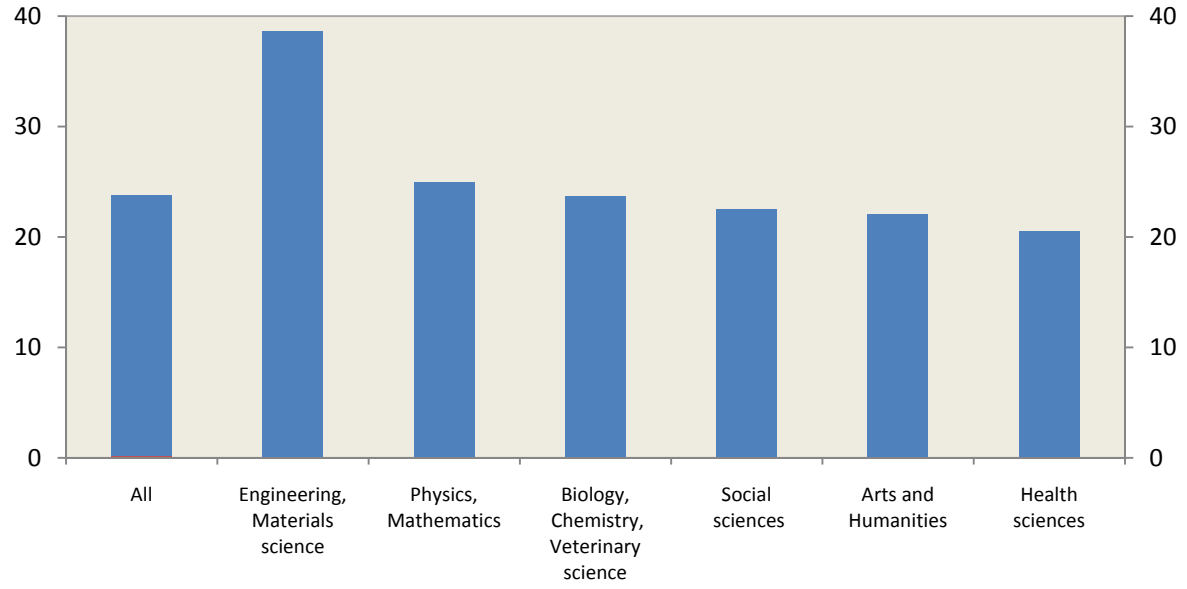
As shown in Exhibit 19, the most frequently cited initiator were individuals associated with the external organisation (80%) and the least frequently cited initiator was the TTO (24%) (note that respondents could identify multiple initiators). Furthermore, the initiatives of academics and mutual interactions are also important means of initiating relationships. This evidence suggests a number of important characteristics of the knowledge exchange process. First, the boundary spanners from external organisations may be more important than those based in the university. And, as far as the private sector is concerned, such boundary spanners are more likely to be found in big businesses compared to smaller businesses (CBR Business Survey, 2009). Second, the relative minor importance of TTOs probably reflects that many of the interactions discussed above are informal and people based and do not require the contractual and transactional inputs from a TTO.

Exhibit 19 Ways in which external activities were initiated (% of respondents)



Where a TTO is likely to have a greater role is where interactions require a significant legal or contractual component. Exhibit 20 shows how the use of the TTO to initiate relationships varies by discipline. Engineering is the discipline that has the highest propensity to have external activities initiated by the TTO – and, as discussed above, academics from this discipline are the most likely to engage in patenting, licensing and generating spin-outs compared to academics from other disciplines.

Exhibit 20 External activities initiated by university knowledge/technology transfer office (% of respondents)



Section 8. The Motivations and Impacts of Knowledge Exchange

To understand why academics engage and interact with external organisations we asked them to score a range of motives on a scale from 1 to 5 - where 5 is very important and 1 is unimportant (the scores reported below refer to the mean score for the relevant group).

Exhibit 21 Motivations for activities with external organisations (mean score)

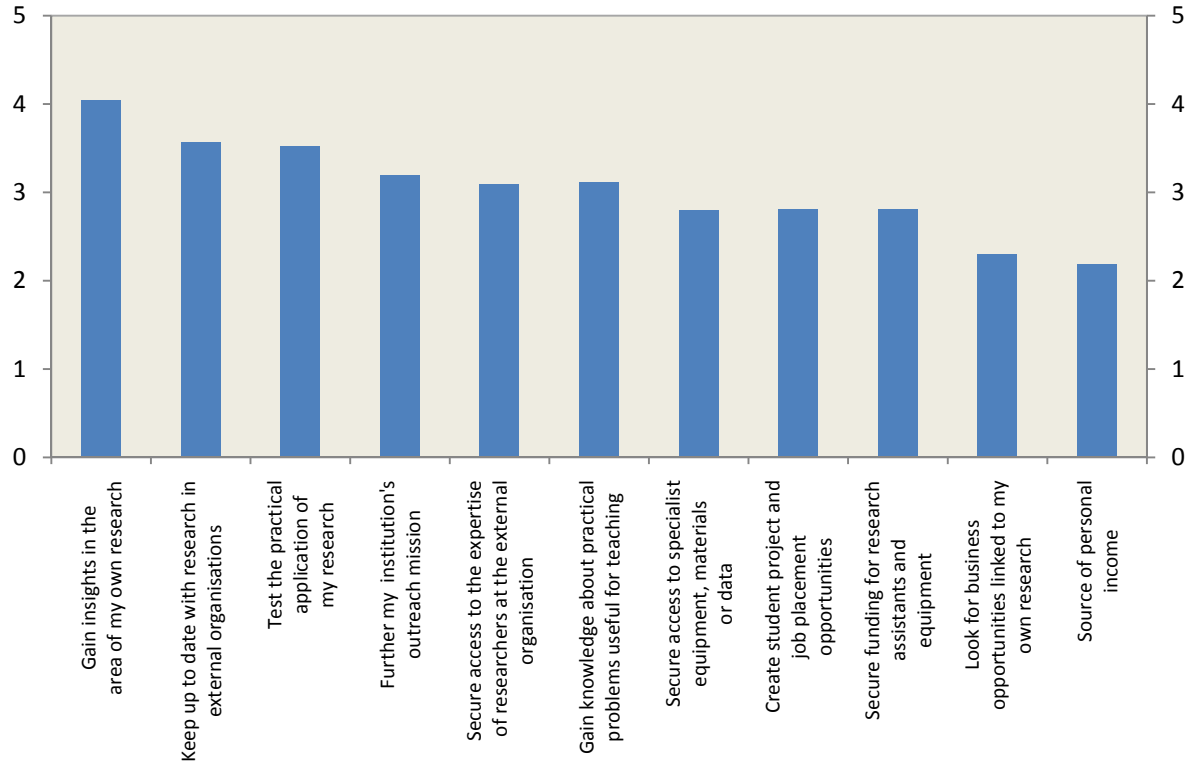


Exhibit 21 shows that the main motivations to engage with external organisations were concerned with developing the research activities of academics such as: gaining insights in the area of the academic's research (4.0); keeping up to date with research in external organisations (3.6); and testing the practical application of research (3.5). Conversely, the motivations that had the lowest rank were concerned with financial or commercial gain such as: personal income (2.2) and business opportunities (2.3). There are some variations by discipline and by research activity as shown in Annex A: Exhibit A11. In general, engineers rank all motivations higher than academics from other disciplines – from helping their research to pecuniary benefits. Furthermore, those engaged in applied or user-inspired basic research are more likely to stress that engagement with external organisations benefits their research compared to those academics engaged in basic research.

As well as asking about motivations we also asked about impacts (where applicable). And with similar results – not only were academics primarily motivated to engage with others to help their research but these motivations were realised as the interactions did help their research.

Exhibit 22 Impact of external activities on research (% of respondents)

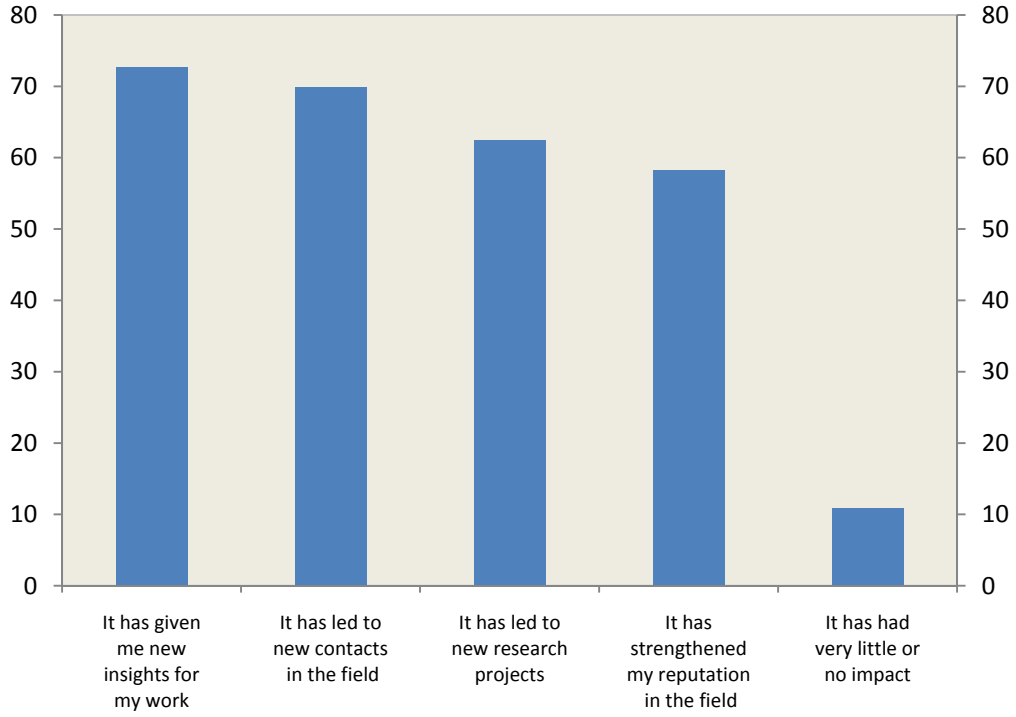
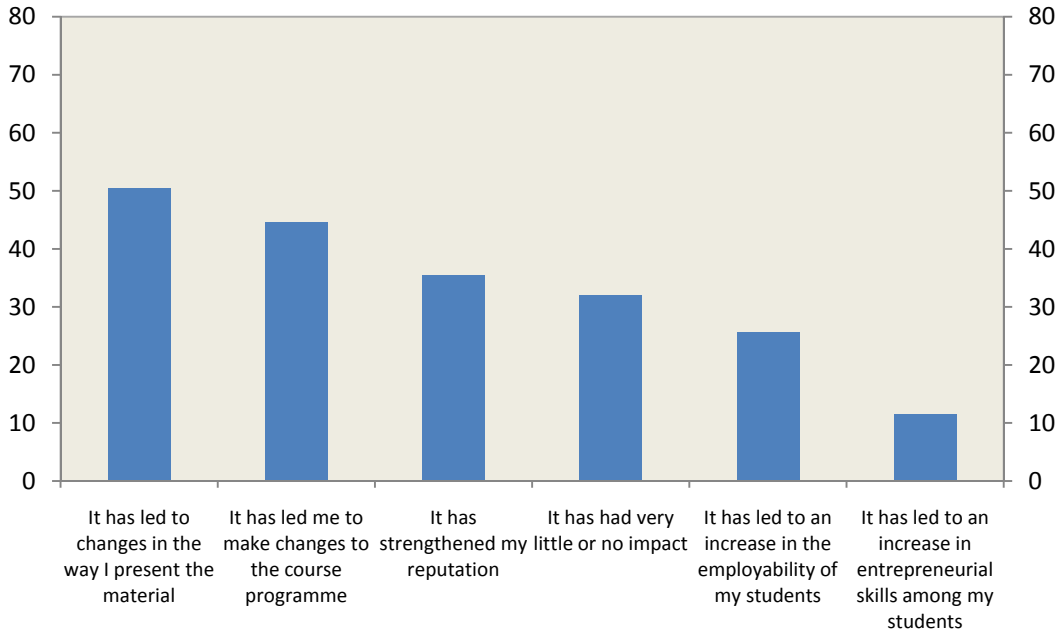


Exhibit 22 shows that 73% of academics who engage with external organisation believe that it has given them new insights into their research work; 70% believe it led to new contacts in the field; 62% believe it led to new research projects; and only 11% consider that it had very little or no impact. These results broadly apply across all disciplines (*see* Annex A: Exhibit A12), although the positive impact on research is strongest in engineering and materials science. Furthermore, the benefits to research are stronger for the academics engaged in user-inspired or applied research compared to those engaged in basic research.

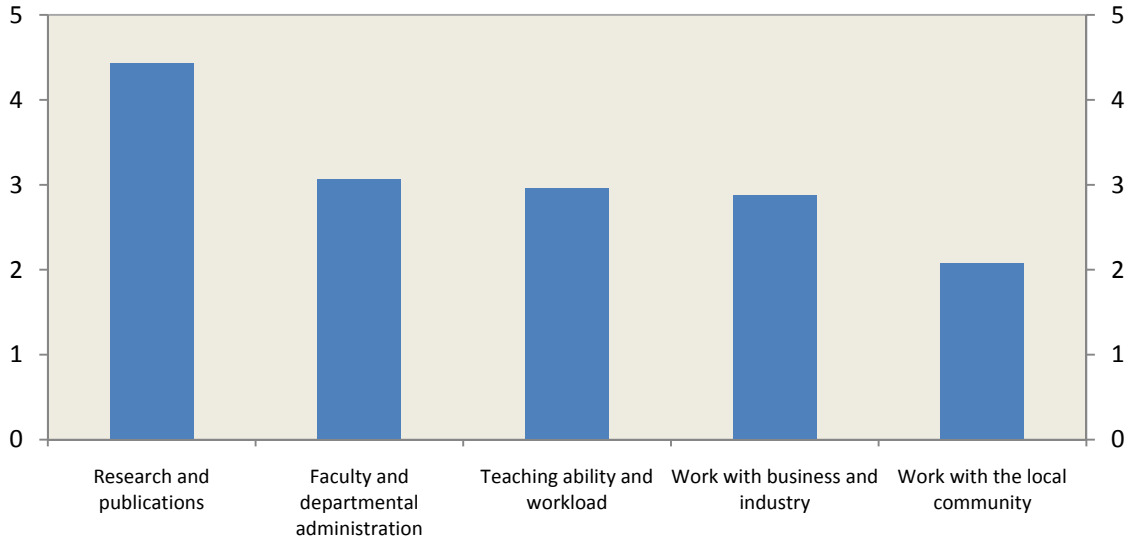
Exhibit 23 Impact of external activities on teaching (% of respondents)



External engagement also provided, where applicable, important positive impacts on teaching, although not to the same extent as the positive impacts on research. As shown in Exhibit 23, 50% of academics that are engaged with external organisations state that it has led to changes in the way they present teaching material and it has led 45% to make changes to their course programmes. There are also notable differences across discipline, as shown in Annex A: Exhibit A13, the strongest impact on teaching are most apparent for academics in the arts and humanities and in the social sciences.

Overall the survey shows that engagement with external organisations strengthens the two core missions of academics – research and teaching. This suggests that the notion of a separate 'third mission' or 'third stream' may be a misnomer as engagement with others, through knowledge exchange, is centrally linked and intertwined with the core missions of academics. But where engagement with others is more peripheral is in the promotion process. The academics in the survey were asked which factors were important in their institution with regard to career advancement and promotion (a scoring system was used with a scale from 1 to 5 - where 5 is very important and 1 is unimportant - the scores reported below refer to the mean score for the relevant group).

Exhibit 24 Weight given by institution, with regard to career advancement and promotion, various criteria (mean score)

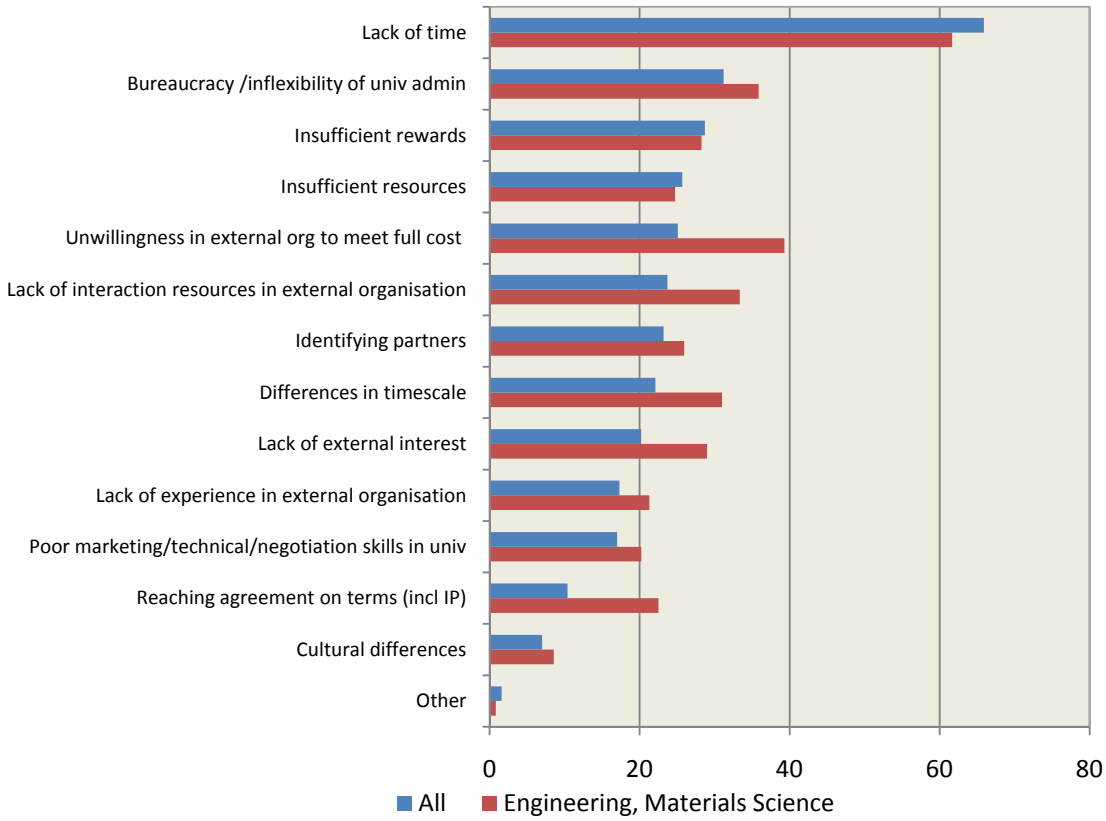


As shown in Exhibit 24 research and publications, not surprisingly, is considered the most important factor (4.4) – and this is consistent across disciplines (*see* Annex A, Exhibit A14). Surprisingly, and somewhat disconcertingly, administrative duties (3.1) rate higher than teaching ability (3.0). It should be added that academics under 40 years of age consider that teaching ability is more important than administration for career advancement, whereas it is the opposite for those who are 40 or older (see Annex A: Exhibit A14). The factors which are considered to have lowest impact on promotion are engagement with the community (2.1) and engagement with business (2.9). So overall, although academics have a high degree of engagement with external organisations, in general, they consider that it will not have a powerful direct impact on their career; although, it may have an indirect effect through strengthening the most important factor – their research.

Section 9. Constraints

Although there is a high degree of interaction between academics and external organisations there are also a range of factors that constrain such interactions. It is commonly argued that there are cultural barriers that limit interactions because universities are different to business. For instance the Lambert Report stated that: 'companies and universities are not natural partners: their cultures and their missions are different' (Lambert, 2003, p.15). It is also argued that disputes over intellectual property (IP) are an important barrier that has been becoming increasingly problematic (Bruneel et al. 2009).

Exhibit 25 Constraints on interactions with external organisations (% of respondents)



As shown in Exhibit 25, these constraints are, in general, **not** considered to be important constraints – only 7% of academics consider cultural differences a constraint and only 10 % consider reaching agreement about IP (and related issues) as a constraint. The issue of cultural differences seems to be largely an artefact as far as academics are concerned – it is considered to be low across all disciplines and even in mathematics and physics (the discipline where it is the highest) only 9% of academics cite it as a problem. The issue of intellectual property is more complex, with the relatively low number of academics considering it a problem probably reflecting that most interactions do not involve IP issues. It may be more important for those interactions that do involve IP and other

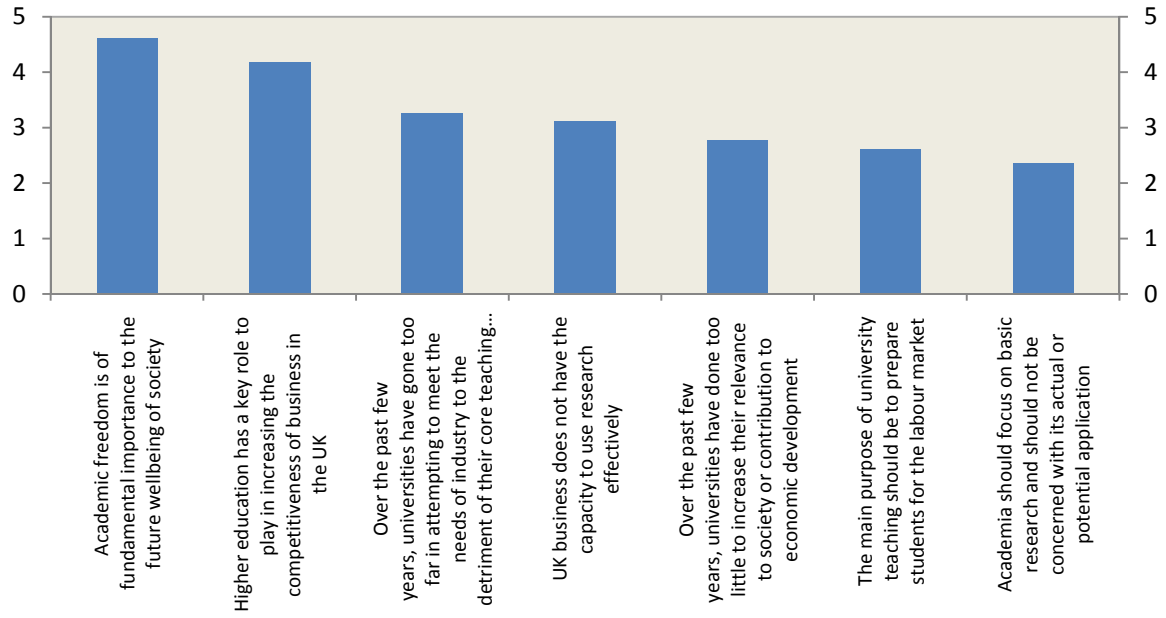
related contractual issues, and this will vary by discipline. For instance, as shown in Exhibit 25, more than a quarter of academics from engineering and materials (the discipline with the highest propensity to generate patents, licences, and spin-outs) consider that IP and related issues are a constraint.

Overall, the most important constraints are a lack of time (66%), bureaucracy (32%) and insufficient rewards (29%). The incidence of constraints does vary by discipline. As shown in Annex A: Exhibit A15 many constraints are higher in engineering and materials compared to other disciplines - such as cost, lack of resources in the partner organisation and time scales. Furthermore, the problem of time is most apparent in the arts and humanities (71%). The problem of bureaucracy is most apparent in engineering and materials (36%) – the discipline that is most likely to use a University's TTO. A lack of resources to help engagement is highest in the arts and humanities (29%) – perhaps reflecting that this discipline has been relatively marginalised in terms of third stream and knowledge exchange support.

Section 10. The Role of the Academy: The Perspective of Academics

How academics perceive the role of universities in society and the economy may significantly influence if, and how, they interact with external organisations. To gain insights into the attitudes of academics we asked them to indicate the importance of a range of factors using a scale from 1 to 5 - where 5 is very important and 1 is unimportant (the scores reported below refer to the mean score for the relevant group).

Exhibit 26 Extent to which agree with statements about relationships with external organisations (mean score)



As shown in Exhibit 26, the most important belief is that academic freedom is of fundamental importance to the future wellbeing of society – with an average score of 4.6 with consistently high scores across all disciplines (*see* Annex A: Exhibit A16a). Furthermore, in general, academics believe that higher education has a key role to play in increasing the competitiveness of business in the UK (4.2); but that recently universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles (3.3); and that UK business does not have the capacity to use academic research effectively (3.1).

Although the importance of academic freedom is rated consistently highly across all disciplines there are variations in the responses to other factors (see Exhibit A16). Engineers and materials scientists (4.5) are more likely to agree that higher education has a key role to play in increasing the competitiveness of business in the UK, particularly compared to academics from the arts and humanities (4.0). Similarly, engineers and materials scientists (3.0) are more likely to agree that the

main purpose of university teaching should be to prepare students for the labour market compared to those from the arts and humanities (2.3). Conversely, academics from the arts and humanities (3.5) are more likely to agree that universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles compared to engineers and materials scientists (3.0). In general, academics do not agree that they should focus on basic research (and that they should not be concerned with the actual or potential application of their research) – but the average score of 2.4 is close to the mid-point of the scale. There are two disciplines where the scores are just above the mid-point – the arts and humanities (2.6) and physics and mathematics (2.7) - suggesting that academics in these disciplines give a greater emphasis to the importance of basic research (as noted above these two disciplines have the largest proportion of academics engaged in basic research). Similarly, an analysis of responses according to the type of research being undertaken indicates that academics undertaking basic research tend to agree that academics should focus on basic research (3.1) whereas those that are doing applied research do not (1.8) (*See* Annex A: Exhibit A16b).

Section 11. Variations in Interaction by Type of Institution and by Region

In this section we look at the variations in the activities and views of academics across different types of universities and by regions. For our regional analysis we divided the sample into responses from each of the 9 regions of England, and the devolved administrations of Scotland, Wales and Northern Ireland. In the case of universities we adopted a simple classification of UK higher education institutions into four groups. The first is the self-defined Russell Group; the second is the older universities (excluding Russell Group members) which we define as those which were established before 1992. Our remaining two groups are younger universities established post-1992 and a group of specialist institutions which focus in particular on the media and the creative arts. The latter emerged as a distinctive grouping in the parallel study carried out by PACEC and the Centre for Business Research (CBR) into the impact of third stream funding (HEFCE, 2009). This is a small, but distinctive group of institutions.

The pattern of commercialisation activities across the institutions is shown in Exhibit 27. This shows there is very little difference across the four groups in the extent to which individual academics formed or run a consultancy based on research. For the sample as a whole, 13.9% did this and most of the groups tended to have a narrow range of variation around that average. The next most frequent activity, taking out a patent, reveals a distinction between the Russell Group and older universities taken together versus the younger universities and specialist institutions. The latter two are less likely to have been involved in this kind of activity. Moreover, the Russell Group itself has a much higher rate of activity than the older universities as a group. A similar pattern holds in relation to the licensing of research outputs to a company and to a lesser degree in terms of forming a spin-out company. The fact that the Russell Group universities have a high level of activity on each of these dimensions suggests that there is not a simple distinction between those institutions focusing on basic research and those which might be expected to be more focused on applied research.

Exhibit 27 Commercialisation activity by institution (% of respondents)

	Taken out a patent	Licensed research outputs to a company	Formed a spin-out company	Formed or run a consultancy via your research	Total respon-dents
All Institutions	7.1	4.8	3.5	13.9	19,029
Russell Group	9.7	5.6	3.9	13.1	8,098
Older universities (est pre-1992)	6.4	4.8	3.2	14.2	5,554
Younger universities (est post-1992)	3.9	3.5	3.4	14.9	4,871
Specialist institutions	4.9	3.6	2.6	12.0	506

On the basis of our classification we are able to compare the extent to which academics in the different types of institutions are engaged in people based and problem solving activities, as well as a number of other characteristics of those interactions, including how they are mediated, the geographical spread of their interaction activities, and their patterns of promotion and reward, as well as a number of motivational issues.

Exhibits 28a and 28b explore variations in people based and problem solving activities by two of our four groups of institutions. We present results for the Russell Group and younger universities as the two most distinctive groups whilst presenting results for all of the groups in Exhibits A18 and A19 (*see* Annex A). Exhibit 28a shows that the Russell Group universities are similar to the younger universities, except in relation to employee training, student placements and curriculum development. For each of these interactions the Russell Group universities are less likely to have academics involved. This reflects the importance of this kind of teaching related interaction in younger universities. Somewhat surprisingly, the Russell Group are also somewhat less likely to have academics involved in standard setting forums and network participation. If we turn to Exhibit 28b, which shows problem solving activities, the pattern of engagement is more similar, although academics from the Russell Group universities are more likely to be involved in joint research, joint publications and other research collaborations. Otherwise the pattern is very similar between the two groups. Taken together these two exhibits suggest a relative specialisation in terms of people based and teaching activities on the one hand in which the younger universities specialise, and research oriented activities in which the Russell Group are relatively more specialised.

Exhibit 28a People based activities by institution (% of respondents)

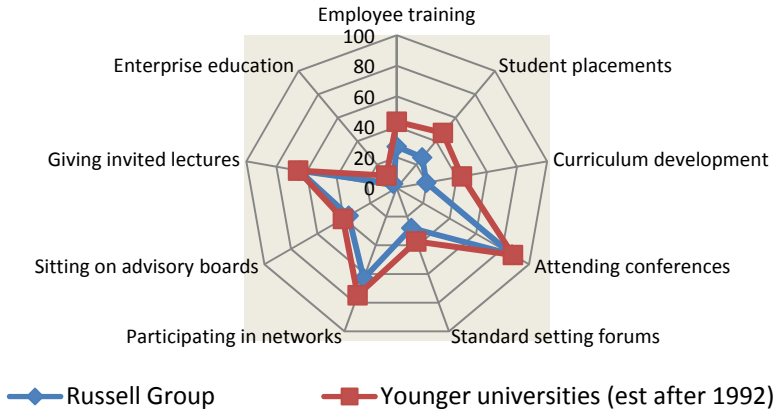
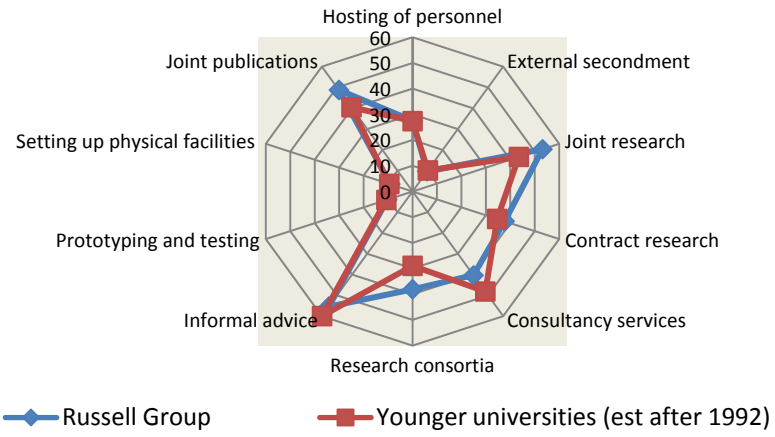


Exhibit 28b Problem solving activities by institution (% of respondents)



The geographical distribution of interactions is also of importance in relation to debates about the role of institutions in regional development in the United Kingdom and the apparent tensions between this and the need to establish international connections and pursue the highest levels of research. In Exhibits 29a and 29b respectively we look at people based interactions that are regionally orientated and those that are internationally orientated. Exhibit 29a reveals a clear distinction between the Russell Group and younger universities in terms of regional specialisation by academics. On all dimensions younger universities have a higher proportion of academics involved in regionally based external interactions based around people. On the other hand, when we look at Exhibit 29b academics from the Russell Group are more likely to be engaged in internationally orientated people based interactions. It is therefore important to bear in mind in the design of policy that universities have different strengths and that they will have different impacts on local and regional development. For instance, universities with a strong regional orientation may focus on the development of regional skills and connectivity with regional businesses. Whereas universities with an international orientation, may help attract international investment in R&D and may attract other economic actors that wish to access the UK science and knowledge base. These should be seen as complementary and not conflicting impacts. The differential pattern seen in terms of people based interactions are also apparent in terms of problem based interactions, see Exhibits 30a and 30b, except that with the latter the differences are somewhat smaller. Nonetheless the pattern remains clear.

Exhibit 29a Regional people based activities by institution (% of those respondents engaged in each activity)

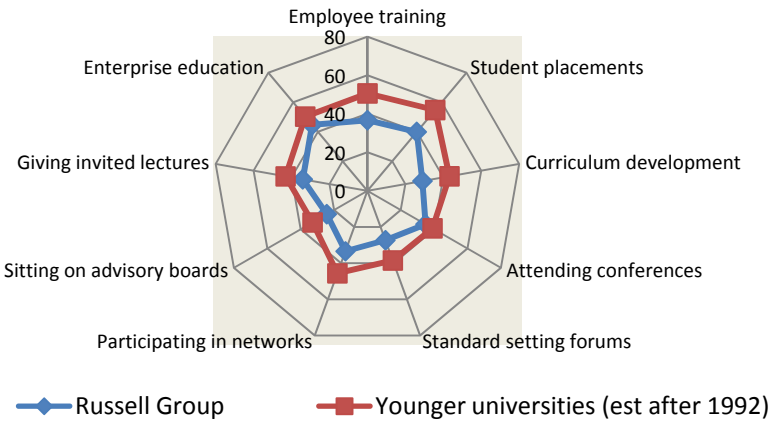


Exhibit 29 b International people based activities by institution (% of those respondents engaged in each activity)

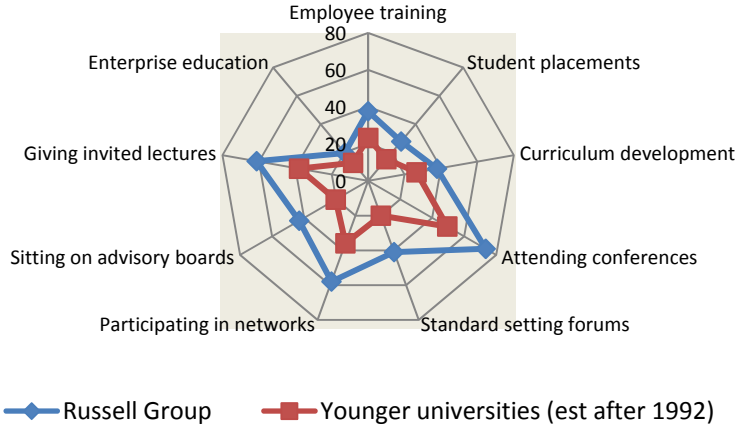


Exhibit 30a Regional problem solving activities by institution (% of those respondents engaged in each activity)

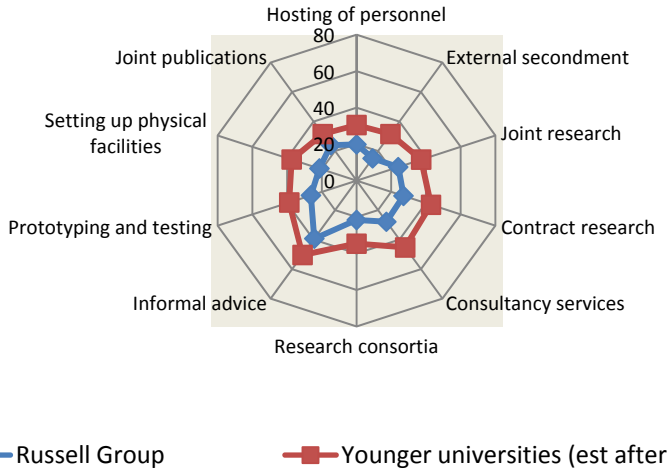
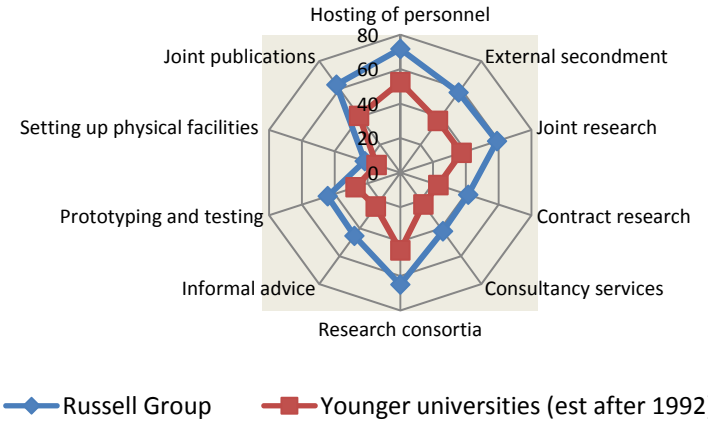
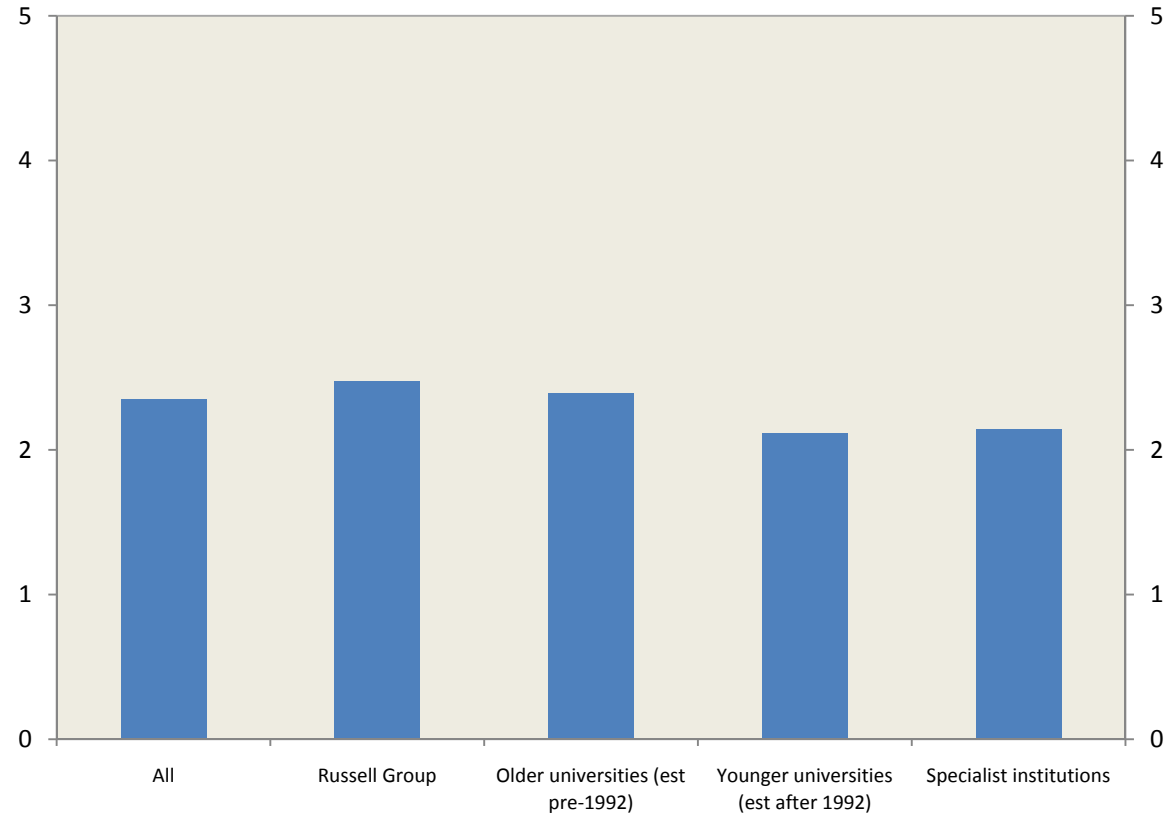


Exhibit 30b International problem solving activities by institution (% of those respondents engaged in each activity)



We are also able to explore differences in cultural attitudes across the different groupings of universities. Exhibit 31 reveals that, in general, the level of support of the statement that academia should focus on basic research and should not be concerned with actual or potential application vary little across the grouping. Although, as might be expected from the earlier discussion of interactions, academics from the Russell Group were more likely to be in support of the statement than were academics from the older universities and younger university groups. The differences are, however, quite small.

Exhibit 31 Extent to which agree with the statement 'Academia should focus on basic research and should not be concerned with its actual or potential application' (mean score)



In view of the importance attached to the initiation and mediation of various forms of knowledge exchange between the universities and external organisations, it is interesting to look at the extent to which activities with external organisations are initiated by the university knowledge or technology transfer offices in these different types of institutions. Exhibit 32 shows the extent to which this pattern varied across the university groupings. This reveals a very interesting pattern: academics in Russell Group institutions are much less likely to have their interactions initiated by the university technology transfer office, with the role played by this type of institution being highest in the younger universities. The specialist institutions are in an intermediate position. This may reflect the intensity required to develop the kinds of regional and people based activities in which younger universities are, as we have seen, more likely to be involved. It may also reflect a much greater strategic concern with knowledge exchange in relation to university missions in institutions with previously deep rooted connections with local industrial bases. Finally, it may reflect the extent to which the impact of focused third stream funding, based on successive government enhancements to the Higher Education Innovation Fund stream of activity, have had a proportionately greater impact in resource terms in the younger university group compared to the Russell Group and older universities (HEFCE, 2009).

Exhibit 32 Activities with external organisations initiated by the university knowledge/technology transfer office or other university administrative office (% of respondents)

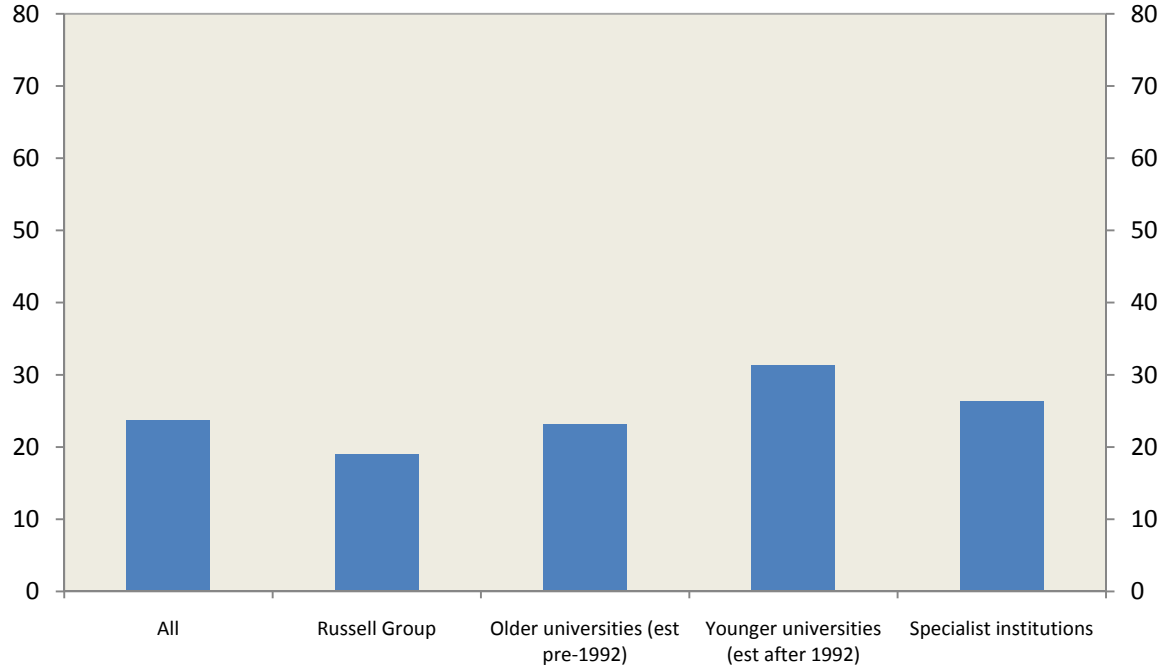
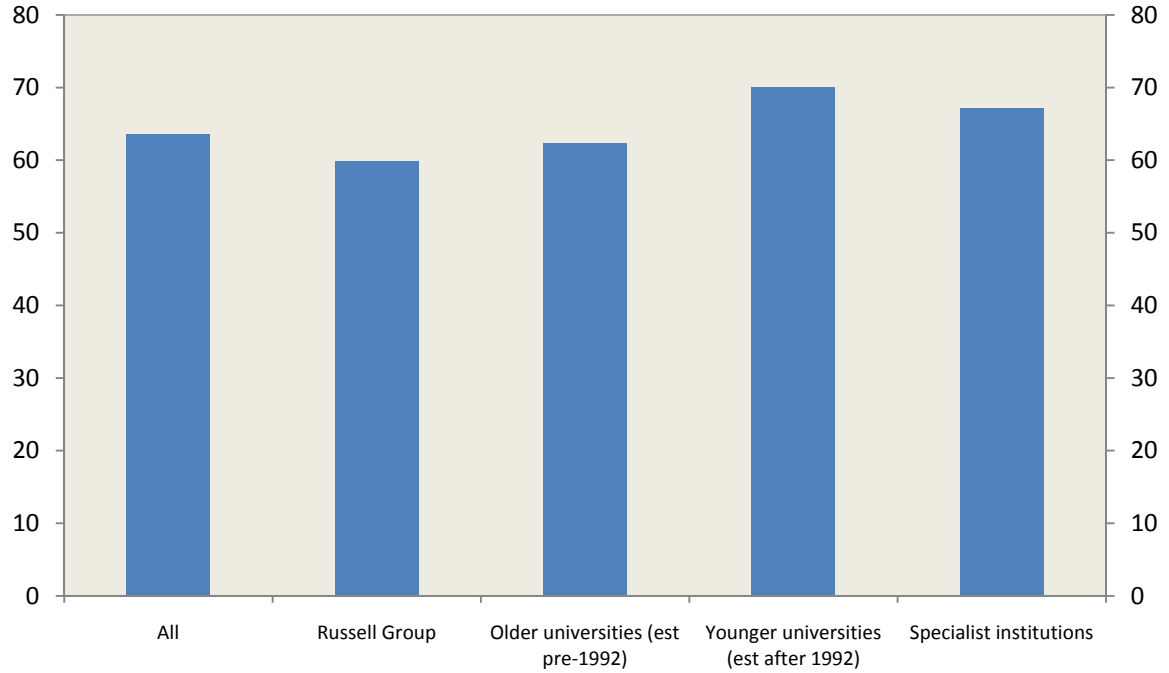


Exhibit 33 Activities with external organisations initiated by own actions in approaching the external organisation directly (% of respondents)



The contrasting use of technology transfer offices is, however, not the whole of the story, since, as Exhibit 33 shows, it is also the case that academics in younger universities were more likely to have approached external organisations on their own initiative compared with academics in the Russell

Group and older universities. Taken together Exhibits 32 and 33 suggest that younger universities contain academics who are more likely to have individually actively initiated interactions with external organisations and also to have a more proactive knowledge exchange technology transfer office. The patterns of behaviour shown in Exhibits 32 and 33 can also be a reflection of the extent to which the institutions themselves incentivise members of academic staff as well as the motivations of individual academics themselves.

Exhibit 34 Weight given by institution to research and publications with regard to career advancement and promotion (mean score)

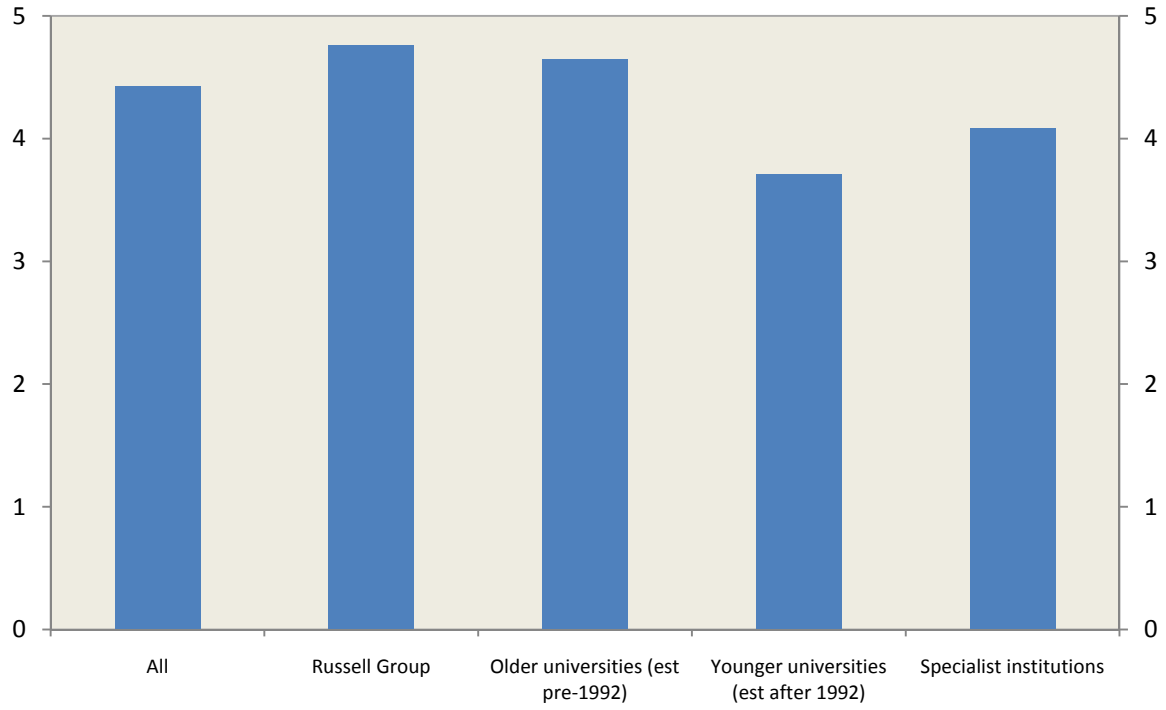
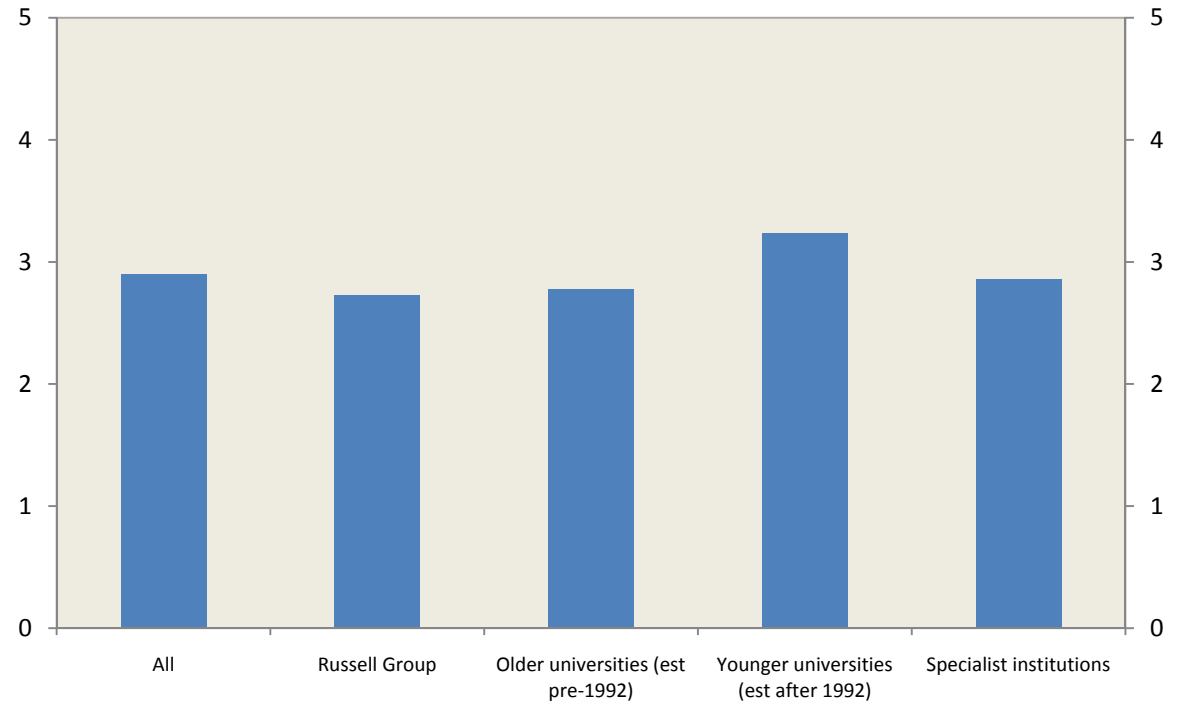
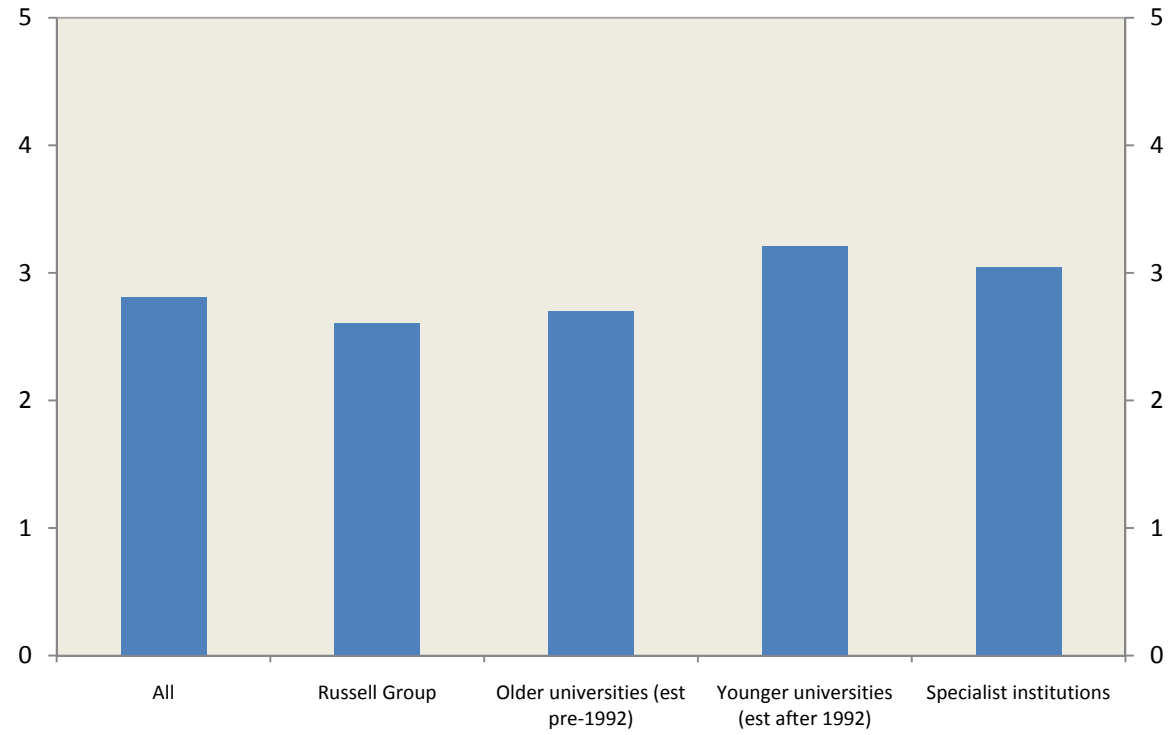


Exhibit 35 Weight given by institution to work with business and industry with regard to career advancement and promotion (mean score)



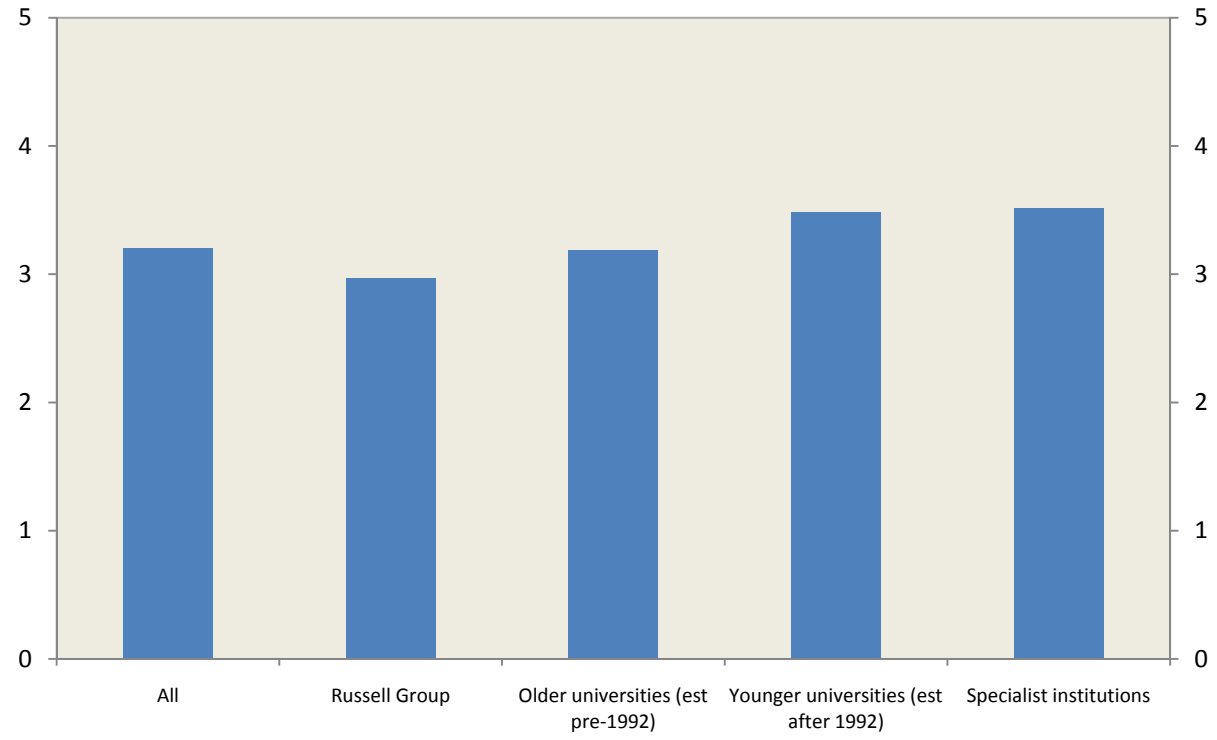
Exhibits 34 and 35 look in turn at how academics in each group of institutions rate research and publications on the one hand, and the work with business and industry on the other, in relation to career advancement and promotion. There is little difference between the Russell Group and older universities on either of these criteria. Both place much more weight on research and publications and much less weight on interactions with business and industry in relation to career advancement and promotion. It is interesting to note that even in the younger universities the weight attached to work with businesses and industry is lower than the weight given to research and publications. Given the extent to which younger institutions appear to have differentiated patterns of interactions with external organisations, then the use, in the past, of a single research assessment exercise which emphasised the importance of research and publications could be regarded as an inadequate method of evaluation for such institutions. In discussions about the introduction of the new research excellence framework (REF) close attention needs to be paid to the extent to which it is both desirable to have a differentiated institutional structure within the overall pattern of HEIs and what this might imply for the use of single sets of research excellence framework criteria across all institutions.

Exhibit 36 Motivations for activities with external organisations: Create student project and job placement opportunities (mean score)



We were able to explore the variety of motivations for academics interacting with external organisations in terms of research oriented and outreach oriented activities. Exhibit 36 shows that, consistent with our previous findings, the younger universities and to some degree the specialist institutions were much more likely to be interacting with external organisations to help the development of projects and job placement opportunities for students. This reflects a relative focus on people based activities in these types of institutions. Furthermore, as shown in Exhibit 37, younger universities and specialist institutions were more likely to be interacting with external organisations because of its general contribution to the outreach mission of their institutions.

Exhibit 37 Motivations for activities with external organisations: Further my institution's outreach mission (mean score)



Given the relative importance of people and teaching based interactions in younger institutions, it is interesting to ask about the impact that such involvement has had on the amount and type of teaching done across the different institutional groups. Exhibit 38 reveals that the younger universities are by far the most likely to report that interactions with external organisations stimulated improvements in course programmes, reputation, the presentation of materials, and employability of students. In this respect they are typically followed by the specialist institutions. The reported positive impacts on teaching are consistently lowest amongst academics from the Russell Group. In the latter case, 43% indicated that interactions with external organisations had had very little or no impact on their teaching. They were also the least likely to say that such interactions had had an impact in increasing entrepreneurial skills amongst students; whilst specialist institutions and younger universities recorded the highest proportion of academics showing a positive impact in this area. In general, however, it should be noted that increases in entrepreneurial skills were amongst the least frequently reported impacts as a result of interaction with external organisations.

Exhibit 38 Impact of external activities on teaching by institutional type (% of respondents)

	It has led me to make changes to the course programme	It has strengthened my reputation	It has led to changes in the way I present the material	It has led to an increase in the employability of my students	It has led to an increase in entrepreneurial skills among my students	It has had very little or no impact	Total respondents
All Institutions	44.5	35.4	50.4	25.5	11.4	31.9	12,977
Russell Group	34.2	27.3	41.8	17.0	7.2	43.1	4,944
Older universities (est pre-1992)	42.4	34.7	49.5	22.6	10.0	33.6	3,722
Younger universities (est post-1992)	59.8	45.7	61.5	38.9	17.2	16.9	3,920
Specialist institutions	41.4	41.2	56.8	26.9	18.4	25.6	391

Exhibit 39 Constraints on interactions with external organisations by institutional type (% of respondents)

	Lack of time to fulfil all university roles	Bureaucracy and inflexibility of administrators in your institution	Insufficient resources devoted by your institution to activities with external organisations	Poor marketing, technical or negotiation skills of administrators in your institution	Difficulty in reaching agreement with external organisation on terms of the interaction (such as IP rights)	Total respondents
All Institutions	65.9	31.2	25.7	17.0	10.4	16,629
Russell Group	60.3	26.0	19.3	11.8	12.2	6,813
Older universities (est pre-1992)	65.4	29.2	24.4	15.5	10.1	4,806
Younger universities (est post-1992)	74.7	41.6	36.5	26.5	8.2	4,542
Specialist institutions	66.5	26.3	26.5	15.4	8.5	468

Finally, in view of the degree of policy interest in increasing and improving the quality of interactions, it is interesting to look at the factors which have constrained interactions with external organisations across our institutional groupings. Exhibit 39 shows that lack of time is overwhelmingly the most important constraint and that this applies across all university groupings. In the case of younger universities the lack of time was cited as a constraint by 75% of academics. It is important to note the wide range of constraints which academics in younger universities identify as these academics have relatively high rates of interaction with external organisations especially at regional levels. Academics from younger universities report the greatest problems arising from the bureaucracy and inflexibility of administrators; a lack of resources devoted by their institutions to support interactions; and poor marketing, technical or negotiating skills. This suggests both that constraints are perhaps more likely to be revealed the more active individual academics are in trying to promote external relationships. Furthermore it may reflect the extent to which the relatively high degree of individual involvement with external organisations is outstripping the resources available within these institutions to support such interactions. This is an important issue for consideration in discussing the future involvement of support for third stream mission activities.

Exhibit 40 reveals the extent of variations in intensive interactions across the UK regions and the devolved administrations. As shown in Exhibit 40, there are significant variations in the intensity of knowledge exchange across the regions of the UK. Northern Ireland is the part of the UK which consistently has the highest level of academics engaged in (intensive) interactions – including people based, problem based and community interactions. But there are a number of caveats that should be emphasised. First, regional variations may reflect the different types of universities and different concentration of disciplines across the regions (and devolved authorities) of the UK. Second, although the intensity of knowledge exchange varies across regions so might the location of the partners. As discussed above, many academics are collaborating with partners outside their region and often outside the UK. When evaluating the local or regional impacts of universities it is important not just to consider the extent of external interactions but the nature of these interactions and the location of partners.

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Exhibit 40 High intensity interaction by region (% of respondents)

Region	People based interaction	Problem solving interaction	Community based interaction	All interactions	Total respondents
Northern Ireland	30.5	22.4	26.5	28.1	633
Wales	24.6	19.2	25.3	23.2	1,135
North East	23.6	18.3	24.4	22.8	980
Yorkshire and the Humber	23.5	17.7	21.2	20.3	1,913
West Midlands	23.1	17.3	21.4	19.8	1,325
North West	23.1	16.8	23.0	20.5	2,041
Scotland	22.0	19.9	22.9	21.4	2,997
East of England	21.5	19.1	22.6	21.6	1,675
South West	20.8	16.7	24.6	19.6	1,275
London	20.0	17.0	19.0	18.9	3,984
South East	19.1	16.0	22.1	18.1	2,661
East Midlands	18.3	15.0	21.8	16.7	1,438
All (%)	21.7	17.7	22.2	20.2	
All (N)	4,775	3,849	4,711	4,461	22,057

Note: The table is ranked on People based interactions.

Definition of 'high interaction'
People based: A score of 6 or more out of a possible 9.
Problem solving: A score of 6 or more out of a possible 10.
Community based: A score of 2 or more out of a possible 4.
All interactions: A score of 12 or more out of a possible 23.

Section 12. Concluding Remarks

Academics in the UK are engaged in a wide range of interactions with a wide range of partners. And such interactions include academics from all disciplines not just those from the STEM disciplines. Although there is a high degree of formal technology transfer through patents, licences and spin-outs this is only one part of a wide knowledge exchange spectrum. The evidence from the survey indicates the numerous mechanisms through which academics are engaging with society. These include a range of people based, problem solving and community orientated activities. The importance of diversity is also apparent: although we have only considered a simple categorisation of universities in this report it is apparent from this, and other work we have undertaken, that different universities have different strengths and different heritages and this is reflected in their different knowledge exchange activities. And this also has a spatial dimension – the knowledge exchange activities of academics may be with local, regional, national or international partners – all may be important, but such activities may differ in their intensity and where their impact is realised. Furthermore, it is important to emphasise the importance of diversity within universities – one of the core strengths of the higher education sector in the UK is that most individual universities comprise academics from different backgrounds, different disciplines and different approaches - and this itself creates a stimulating platform for knowledge exchange.

Although the evidence from the survey shows that academics are engaged in a wide range of knowledge exchange activities it also suggests some areas for caution. There has been a recent shift in focus with academics being increasingly urged to ensure that their research has impact. The survey suggests that in many cases it is having impact but it also indicates that the major constraint on interactions is a lack of time. There may be little capacity left within the university system for a greater level of interaction between academics and external organisations – especially if the system has to bear the impact of cuts in public expenditure in the near future. Simply, too much pressure may be placed on universities, or the academics within them, to engage with others and achieve economic impact. Furthermore, such pressure could undermine some of the core strengths of many universities in particular if it leads to less basic research. As noted in the discussion of Stokes's quadrants, there is considerable movement between the quadrants and that basic research can ultimately lead, often with a long time lag, to a range of important applications. For instance, Niels Bohr, the Nobel Prize winning Danish physicist, whose pursuit of fundamental understanding in atomic physics characterises the basic research quadrant, was also later to work on the Manhattan Project in World War II. There were also fundamental changes in economic growth and well being driven by the subsequent exploitation of his fundamental insights many of which were largely unpredictable at the time.

Annex A: Tables

Exhibit A1 Activity and management responsibility by age and gender (% of respondents)

	Research	Teaching	Administrative activities	Outreach activities	Other activities	Total respondents	Management responsibility	Total respondents
All	93.1	85.4	63.2	35.7	2.4	22,170	47.4	*22,008*
Age groups								
Under 30	97.0	61.6	33.5	20.5	0.9	1,321	10.6	*1,316*
30-39	97.0	80.2	55.0	30.1	1.9	5,886	32.6	*5,860*
40-49	93.4	90.1	70.4	38.8	2.7	6,358	55.4	*6,309*
50 and over	89.7	89.1	68.3	39.5	2.7	8,358	57.5	*8,291*
Gender								
Male	94.3	86.4	65.1	36.6	2.2	13,028	51.8	*12,944*
Female	91.5	83.8	60.4	34.3	2.7	8,692	40.9	*8,633*

Questions:

Please indicate whether you participate in the following activities:

- Teaching
- Research
- Administrative activities
- Outreach activities
- Other (please specify)

Do you have management responsibility within your institution?

- Yes
- No

Exhibit A2 Stokes's Quadrants by discipline (% of respondents)

Disciplines	Basic research	User-inspired basic research	Applied research	Total respondents
Physics, Mathematics	39.4	34.4	26.2	*2,640*
Biology, Chemistry, Veterinary science	36.2	32.2	31.5	*3,089*
Arts and Humanities	39.4	26.3	34.4	*4,152*
Social sciences	24.0	31.9	44.1	*5,388*
Engineering, Materials science	6.9	34.5	58.6	*1,483*
Health sciences	8.2	21.7	70.1	*3,170*
All (%)	27.4	29.7	43.0	
All (N)	5,450	5,910	8,562	*19,922*

Question:
If undertaking research, which of the following statements most closely describes it?

Basic research: theoretical, empirical or experimental work, undertaken primarily to acquire new knowledge about the underlying foundation of phenomena or observable facts, without any particular application or use in view.
User-inspired basic research: theoretical, empirical or experimental work, undertaken primarily to acquire new knowledge about the underlying foundation of phenomena or observable facts, but also inspired by considerations of use.
Applied research: original investigation undertaken in order to acquire new knowledge directed towards an individual, group or societal need or use.
(None of the above apply to my research)

The table excludes those that ticked 'None of the above apply to my research'.

Exhibit A3 Reference of research by discipline, age, gender and Stokes's quadrants (% of respondents)

	Relevance for non-commercial external organisations	In general area of commercial interest to business	Applied in a commercial context	No relevance for external organisations	Total respondents
All	72.0	34.6	18.3	11.1	*20,425*
Disciplines					
Arts and Humanities	72.7	11.9	10.6	21.4	*4,487*
Biology, Chemistry, Veterinary science	64.9	46.5	21.8	11.4	*3,086*
Engineering, Materials science	45.8	77.9	46.9	1.6	*1,490*
Health sciences	86.1	24.2	13.0	4.7	*3,213*
Physics, Mathematics	58.4	45.4	21.5	18.7	*2,639*
Social sciences	80.9	35.6	16.6	5.2	*5,471*
Age group					
Under 30	66.0	34.3	11.3	15.1	*1,270*
30-39	69.0	36.5	14.9	13.0	*5,655*
40-49	73.1	35.8	19.4	10.0	*5,883*
50 and over	74.4	32.4	21.3	9.9	*7,424*
Gender					
Male	68.4	40.6	22.9	11.3	*12,183*
Female	77.8	25.4	11.4	10.7	*7,862*
Stokes's quadrants					
Basic research	58.0	22.1	8.8	29.0	*5,373*
User-inspired basic research	74.8	43.4	19.7	4.8	*5,893*
Applied research	79.9	37.7	23.9	2.8	*8,538*

Question:
If undertaking research, which of the following statements apply to it? Please indicate all that apply.
It has been applied in a commercial context
It is in a general area of commercial interest to business and/or industry
It has relevance for non-commercial external organisations (including the public sector)
It has no relevance for external organisations

Exhibit A4 Commercialisation activity in the last three years by various categories (% of respondents)

	Taken out a patent	Licensed research outputs to a company	Formed a spin-out company	Formed or run a consultancy via your research	Total respondents
All	7.1	4.8	3.5	13.9	*19,029*
Disciplines					
Arts and Humanities	0.6	1.4	1.8	9.0	*4,210*
Biology, Chemistry, Veterinary science	16.2	7.7	3.9	14.0	*2,815*
Engineering, Materials science	27.7	17.7	11.2	28.5	*1,368*
Health sciences	8.0	4.7	2.8	10.3	*3,154*
Physics, Mathematics	7.9	5.7	4.9	13.9	*2,419*
Social sciences	1.0	2.0	2.5	16.0	*5,025*
Position					
Professor	13.2	9.0	6.7	21.1	*3,816*
Reader/Senior lecturer/Lecturer	5.6	3.7	2.8	12.5	*10,053*
Other position	5.6	3.7	2.5	11.0	*5,054*
Age group					
Under 30	3.1	2.0	1.1	7.7	*1,141*
30-39	6.3	4.2	2.3	12.4	*5,151*
40-49	8.4	5.2	4.0	15.3	*5,533*
50 and over	7.4	5.2	4.3	14.7	*7,101*
Gender					
Male	9.4	6.3	4.8	16.5	*11,295*
Female	3.5	2.4	1.5	9.7	*7,474*
Stokes's quadrants					
Basic research	4.5	2.2	1.8	6.6	*4,626*
User-inspired basic research	10.1	6.0	4.3	16.7	*5,164*
Applied research	8.1	6.4	4.5	18.4	*7,490*

Question:

How frequently if at all have you participated in any of the following in the past three years?

Taken out a patent

Licensed research outputs to a company

Formed a spin-out company

Formed or run a consultancy via your research

Exhibit A5 People based, problem solving and community based activities (% of respondents)

People based activities	%
Enterprise education	6.2
Curriculum development	28.2
Standard setting forums	31.0
Employee training	32.5
Student placements	33.3
Sitting on advisory boards	38.2
Giving invited lectures	64.8
Participating in networks	67.3
Attending conferences	87.3
Problem solving activities	
Setting up physical facilities	9.0
External secondment	9.9
Prototyping and testing	10.2
Hosting of personnel	27.0
Research consortia	34.8
Contract research	36.8
Consultancy services	43.4
Joint publications	46.1
Joint research	49.2
Informal advice	56.9
Community based activities	
Community based sports	2.9
Public exhibitions	14.6
School projects	30.3
Lectures for the community	38.2

Questions:
Have you engaged in the following people based activities with external organisations within the past three years?
Have you engaged in the following problem solving activities with external organisations within the past three years?
Have you engaged in the following community based activities with external organisations within the past three years?

Exhibit A6 Highly intensive interactions by discipline (% of respondents)

	People based interaction	Problem solving interaction	Community based interaction	All interactions	Total respondents
Disciplines					
Engineering, Materials science	26.7	40.1	21.1	35.0	*1,563*
Health sciences	26.4	19.3	16.3	22.6	*3,606*
Social sciences	24.7	15.4	16.0	19.6	*5,877*
Arts and Humanities	21.7	10.1	32.2	16.7	*4,982*
Biology, Chemistry, Veterinary science	15.4	20.4	24.2	19.7	*3,201*
Physics, Mathematics	13.5	18.2	23.1	17.0	*2,787*
All (%)	21.7	17.7	22.2	20.2	
All (N)	4,763	3,842	4,705	4,452	*22,016*

Definition of 'high interaction'
People based: A score of 6 or more out of a possible 9.
Problem solving: A score of 6 or more out of a possible 10.
Community based: A score of 2 or more out of a possible 4.
All interactions: A score of 12 or more out of a possible 23.

Exhibit A7 Activities with private sector companies by discipline and industrial sector (% of respondents)

	All	Engineering, Materials science	Biology, Chemistry, Veterinary science	Physics, Mathematics	Social sciences	Health sciences	Arts and Humanities
Activities with private sector companies							
%	41.3	75.9	45.8	42.0	40.4	38.9	30.0
Total respondents	*21,937*	*1,555*	*3,186*	*2,779*	*5,849*	*3,583*	*4,944*
If yes, industrial sectors where companies were based:							
Agriculture, fisheries, mining	11.6	9.5	38.4	17.0	8.2	2.6	2.4
Manufacturing	27.1	35.7	43.5	19.9	22.5	31.6	20.1
Electricity, gas, water supply, transport equipment, transport, storage, telecomms	20.9	56.0	7.9	29.8	22.6	3.2	8.4
Construction	10.3	20.7	3.5	7.9	16.2	1.7	5.4
Wholesale, retail trade, hotels, restaurants	6.8	2.9	3.4	4.1	13.1	2.0	6.4
Financial intermediation	7.4	1.4	1.5	7.7	16.9	1.7	3.7
Real estate, business services, other service activities	25.2	13.4	18.0	34.5	39.0	13.0	17.1
Education (private sector)	15.2	5.8	7.5	9.2	15.7	12.4	31.8
Health (private sector)	16.0	10.4	17.4	6.2	9.5	65.5	5.1
Cultural and recreational activities	14.5	3.4	6.7	5.6	11.5	3.7	45.1
Other (not specified)	0.6	0.3	0.6	1.0	0.8	0.2	0.3
Total respondents	*7,433*	*936*	*941*	*1,006*	*2,251*	*887*	*1,398*

Question:

Have you undertaken activities with private sector companies in the last three years?

If yes, in which industrial sectors were these companies based? Please indicate all that apply.

Exhibit A8 Activities with public sector organisations by discipline and public sector organisation (% of respondents)

	All	Health sciences	Social sciences	Engineering, Materials science	Arts and Humanities	Physics, Mathematics	Biology, Chemistry, Veterinary science
Activities with public sector organisations							
%	53.0	66.4	61.2	52.7	46.8	41.8	41.8
Total respondents	*21,838*	*3,574*	*5,831*	*1,549*	*4,909*	*2,762*	*3,172*
If yes, agency or department dealt with:							
UK Government department	62.0	79.3	61.0	66.3	53.5	51.6	54.5
Regional Development Agencies	18.7	7.4	24.3	27.1	20.3	17.6	16.7
All overseas government departments, EU, UN, World Bank or other international organisation	28.6	19.5	31.9	39.4	21.2	37.6	34.1
All UK non governmental agencies	24.3	19.5	23.7	15.6	31.8	24.5	26.7
All overseas non governmental agencies	2.2	1.1	2.6	1.2	2.0	4.0	2.3
Total respondents	*11,442*	*2,358*	*3,523*	*807*	*2,264*	*1,147*	*1,314*

Question:

Have you undertaken activities with any public sector organisations in the past three years?

If yes, which agencies or departments have you dealt with? Please indicate all that apply.

Exhibit A9 Frequency of contact with institution's Knowledge or Technology Transfer Office (TTO) or consultancy services office within the past three years by various categories (% of respondents)

	No contact	Some contact	Not aware of these services	Total respondents
All	35.8	43.4	20.8	*21,773*
Disciplines				
Arts and Humanities	36.7	36.0	27.3	*4,915*
Biology, Chemistry, Veterinary science	33.7	50.9	15.4	*3,169*
Engineering, Materials science	25.0	66.7	8.3	*1,550*
Health sciences	36.1	38.9	25.1	*3,546*
Physics, Mathematics	41.2	42.0	16.8	*2,749*
Social sciences	36.5	42.6	20.9	*5,803*
Position				
Professor	30.7	59.5	9.7	*4,319*
Reader/Senior lecturer/Lecturer	35.3	43.7	20.9	*11,594*
Other position	40.6	30.6	28.8	*5,795*
Age group				
Under 30	38.0	21.1	40.9	*1,301*
30-39	37.7	36.4	25.9	*5,821*
40-49	33.3	47.9	18.8	*6,310*
50 and over	36.1	48.2	15.7	*8,280*
Gender				
Male	35.3	47.9	16.7	*12,924*
Female	36.6	36.5	26.9	*8,582*
Stokes's quadrants				
Basic research	42.6	34.8	22.6	*5,352*
User-inspired basic research	33.9	48.5	17.5	*5,840*
Applied research	32.0	49.1	18.8	*8,452*

Question:
How often have you been in contact with your institution's Knowledge or Technology Transfer Office (TTO) or consultancy services office within the past three years?
(4) Frequently (7+ times)
(3) Occasionally (3-6 times)
(2) Rarely (1-2 times)
(1) No contact
(5) Not aware of these services

Exhibit A10 Way in which activities with external organisations were initiated by discipline (% of respondents)

	Individuals associated with the external organisation	Mutual actions following up informal contacts	Your own actions in approaching the external organisation directly	Mutual actions following up a contact at a formal conference or meeting	The university knowledge/ technology transfer office or other university administrative office	Total respondents
All Disciplines	79.6	69.2	63.5	61.9	23.8	*15,257*
Arts and Humanities	81.1	71.0	63.6	60.4	22.0	*3,143*
Biology, Chemistry, Veterinary science	78.2	65.6	60.9	59.1	23.7	*2,124*
Engineering, Materials science	83.2	72.3	70.5	71.7	38.6	*1,223*
Health sciences	79.2	67.0	61.6	62.9	20.5	*2,744*
Physics, Mathematics	75.5	67.5	57.6	59.4	25.0	*1,673*
Social sciences	80.1	70.7	66.2	61.9	22.5	*4,321*

Question:
If you have participated in activities with external organisations over the past three years, have these been initiated by the following?
The university knowledge / technology transfer office, or other university administrative office
Individuals associated with the external organisation
Your own actions in approaching the external organisation directly
Mutual actions following up a contact at a formal conference or meeting
Mutual actions following up informal contacts

Exhibit A11 Motivations for participating in activities with external organisations by discipline and Stokes's quadrants (score is 1-5 where 5 is very important)(mean score)

	Gain insights in the area of my own research	Keep up to date with research in external organisations	Test the practical application of my research	Further my institution's outreach mission	Secure access to the expertise of researchers at the external organisation	Gain knowledge about practical problems useful for teaching	Secure access to specialist equipment, materials or data	Create student project and job placement opportunities	Secure funding for research assistants and equipment	Look for business opportunities linked to my own research	Source of personal income	Total respondents
All Disciplines	4.0	3.6	3.5	3.2	3.1	3.1	2.8	2.8	2.8	2.3	2.2	*15,631*
Arts and Humanities	3.9	3.5	3.2	3.4	2.9	3.4	2.5	2.9	2.3	2.0	2.1	*3,250*
Biology, Chemistry, Veterinary science	4.0	3.5	3.6	3.0	3.3	2.6	3.1	2.9	3.4	2.6	2.0	*2,128*
Engineering, Materials science	4.2	3.9	4.1	3.2	3.5	3.2	3.3	3.3	3.8	3.1	2.5	*1,283*
Health sciences	4.0	3.6	3.6	3.1	3.3	3.0	2.9	2.7	3.0	2.2	2.0	*2,731*
Physics, Mathematics	3.9	3.5	3.6	3.1	3.2	2.9	2.9	2.9	3.1	2.5	2.2	*1,716*
Social sciences	4.2	3.6	3.5	3.1	2.8	3.3	2.6	2.6	2.4	2.1	2.3	*4,493*
Stokes's quadrants												
Basic research	3.7	3.2	2.9	3.0	2.9	2.6	2.6	2.6	2.5	1.9	2.1	*2,933*
User-inspired basic research	4.2	3.6	3.7	3.1	3.1	3.0	2.9	2.7	2.9	2.3	2.2	*4,432*
Applied research	4.2	3.8	3.8	3.3	3.2	3.2	2.9	2.9	3.0	2.5	2.2	*7,052*

Question:

If you have participated in activities with external organisations, which of the following were your motivations and objectives (please indicate the importance of each statement)?

Test the practical application of my research
Gain insights in the area of my own research
Keep up to date with research in external organisations
Secure access to specialist equipment, materials or data
Secure access to the expertise of researchers at the external organisation
Gain knowledge about practical problems useful for teaching
Create student project and job placement opportunities
Source of personal income
Secure funding for research assistants and equipment
Look for business opportunities linked to my own research
Further my institution's outreach mission

Exhibit A12 Impact of external activities on research by discipline and Stokes's quadrants (% of respondents)

	It has given me new insights for my work	It has led to new contacts in the field	It has led to new research projects	It has strengthened my reputation in the field	It has had very little or no impact	Total respondents
All	72.7	69.9	62.4	58.2	10.9	*14,708*
Disciplines						
Arts and Humanities	73.2	69.7	53.5	58.4	13.4	*2,967*
Biology, Chemistry, Veterinary science	64.9	66.1	66.5	54.5	11.7	*2,080*
Engineering, Materials science	77.3	76.3	74.5	64.9	5.7	*1,226*
Health sciences	71.0	69.8	67.1	59.5	9.6	*2,517*
Physics, Mathematics	67.6	66.3	63.7	53.9	13.6	*1,621*
Social sciences	77.9	71.5	59.8	58.7	10.0	*4,264*
Stokes's quadrants						
Basic research	58.9	56.7	47.1	45.6	21.9	*2,886*
User-inspired basic research	74.2	70.0	63.8	58.4	9.6	*4,404*
Applied research	77.8	75.6	68.8	63.4	6.9	*7,046*

Question:
In the last three years, what impact has your involvement in activities with external organisations had on the amount and kind of research that you do? Please indicate all that apply.

It has led to new research projects
It has strengthened my reputation in the field
It has given me new insights for my work
It has led to new contacts in the field
It has had very little or no impact
Not applicable

Exhibit A13 Impact of external activities on teaching by discipline (% of respondents)

	It has led me to make changes to the course programme	It has strengthened my reputation	It has led to changes in the way I present the material	It has led to an increase in the employability of my students	It has led to an increase in entrepreneurial skills among my students	It has had very little or no impact	Total respondents
All Disciplines	44.5	35.4	50.4	25.5	11.4	31.9	*12,977*
Arts and Humanities	51.2	42.0	55.1	28.7	15.2	24.4	*2,922*
Biology, Chemistry, Veterinary science	30.2	21.8	35.5	20.4	7.7	48.8	*1,658*
Engineering, Materials science	44.7	31.6	52.2	32.7	16.1	29.9	*949*
Health sciences	41.4	38.1	49.0	19.2	5.6	35.1	*2,229*
Physics, Mathematics	37.3	23.0	42.2	26.5	11.4	42.5	*1,312*
Social sciences	49.8	39.9	56.4	26.9	12.1	25.4	*3,887*

Question:

In the last three years, what impact has your involvement in activities with external organisations had on the amount and kind of research that you do? Please indicate all that apply.

It has led to new research projects
It has strengthened my reputation in the field
It has given me new insights for my work
It has led to new contacts in the field
It has had very little or no impact
Not applicable

Exhibit A14 Weight given by institution with regard to career advancement and promotion by various categories (score is 1-5 where 5 is the highest)(mean score)

	Research and publications	Faculty and departmental administration	Teaching ability and workload	Work with business and industry	Work with the local community	Total respondents
All	4.4	3.1	3.0	2.9	2.1	*21,669*
Disciplines						
Arts and Humanities	4.3	3.3	3.0	2.8	2.2	*4,898*
Biology, Chemistry, Veterinary science	4.5	2.9	2.9	2.9	1.9	*3,156*
Engineering, Materials science	4.4	2.8	2.9	3.3	2.0	*1,528*
Health sciences	4.5	3.0	2.9	3.0	2.3	*3,541*
Physics, Mathematics	4.5	2.9	3.0	2.8	1.9	*2,743*
Social sciences	4.4	3.1	2.9	2.8	2.0	*5,763*
Position						
Professor	4.6	3.0	3.0	2.8	2.0	*4,296*
Reader/Senior lecturer/Lecturer	4.3	3.1	2.8	2.9	2.1	*11,590*
Other position	4.5	3.1	3.2	2.9	2.2	*5,682*
Age group						
Under 30	4.5	3.0	3.4	2.9	2.2	*1,293*
30-39	4.5	3.0	3.1	2.8	2.0	*5,795*
40-49	4.4	3.1	2.9	2.9	2.1	*6,276*
50 and over	4.4	3.1	2.9	2.9	2.1	*8,202*
Gender						
Male	4.4	3.0	2.9	2.8	2.0	*12,833*
Female	4.5	3.1	3.0	3.0	2.2	*8,535*

Question:
With regard to career advancement and promotion, how much weight do you believe your institution gives to the following criteria (on a score of 5-1, where 5 is the highest)?

Teaching ability and workload
Faculty and departmental administration
Research and publications
Work with business and industry
Work with the local community

Exhibit A15 Constraints of interaction with external organisations by discipline (% of respondents)

	All	Arts and Humanities	Biology, Chemistry, Veterinary science	Engineering, Materials science	Health sciences	Physics, Mathematics	Social sciences
Total respondents	*16,629*	*3,528*	*2,280*	*1,310*	*2,953*	*1,812*	*4,711*
Lack of time to fulfil all university roles	65.9	71.2	61.4	61.7	62.6	62.5	68.7
Bureaucracy and inflexibility of administrators in your institution	31.2	30.1	29.6	35.9	30.1	26.3	34.0
Insufficient rewards from interaction	28.7	30.2	28.2	28.2	23.9	28.5	31.0
Insufficient resources devoted by your institution to activities with external organisations	25.7	29.3	22.1	24.7	24.3	19.1	28.3
Unwillingness in the external organisation to meet the full cost of the interaction	25.1	20.4	31.1	39.3	23.8	26.9	21.9
Lack of resources in the external organisation to manage the interaction	23.7	22.1	22.7	33.4	23.3	23.4	23.0
Difficulty in identifying partners	23.2	21.2	29.1	26.0	20.8	28.2	20.7
Differences in timescale	22.1	19.7	16.4	31.0	19.8	25.1	24.6
Lack of interest by external organisations	20.2	16.7	24.2	29.0	16.6	24.5	18.9
Lack of experience in the external organisation for interacting with academics	17.3	16.0	14.6	21.3	17.0	16.9	18.8
Poor marketing, technical or negotiation skills of administrators in your institution	17.0	17.2	16.3	20.2	15.1	15.1	18.1
Difficulty in reaching agreement with external organisation on terms of the interaction such as IP	10.4	5.9	14.2	22.5	11.2	13.8	6.6
Cultural differences	7.0	7.1	4.7	8.5	6.4	8.8	7.2
Other	1.6	1.6	1.3	0.8	1.7	2.3	1.6

=Low in each row =High in each row

Question:

Have the following factors constrained or prevented your interactions with external organisations over the past three years? Please indicate all that apply.

Lack of time to fulfil all university roles
Insufficient rewards from interaction
Difficulty in identifying partners
Lack of interest by external organisations
Cultural differences
Differences in timescale
Lack of resources in the external organisation to manage the interaction
Lack of experience in the external organisation for interacting with academics
Unwillingness in the external organisation to meet the full cost of the interaction
Bureaucracy and inflexibility of administrators in your institution
Poor marketing, technical or negotiation skills of administrators in your institution
Insufficient resources devoted by your institution to activities with external organisations
Difficulty in reaching agreement with external organisation on terms of the interaction (such as intellectual property rights)
Other (please specify
None of the above

Exhibit A16a Extent to which agree with statements about relationships with external organisations by discipline (score is 1-5 where 5 is the highest) (mean score)

	All	Arts and Humanities	Biology, Chemistry, Veterinary science	Engineering, Materials science	Health sciences	Physics, Mathematics	Social sciences
Total respondents	*21,853*	*4,935*	*3,186*	*1,546*	*3,574*	*2,764*	*5,807*
Academic freedom is of fundamental importance to the future wellbeing of society	4.6	(4.7)	4.6	4.5	[4.4]	4.7	4.6
Higher education has a key role to play in increasing the competitiveness of business in the UK	4.2	[4.0]	4.3	(4.5)	4.2	4.4	4.1
Over the past few years, universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles	3.3	(3.5)	3.2	[3.0]	3.1	3.3	3.2
UK business does not have the capacity to use research effectively	3.1	3.1	3.1	(3.2)	[3.0]	(3.2)	3.1
Over the past few years, universities have done too little to increase their relevance to society or contribution to economic development	2.8	[2.6]	2.7	2.8	(2.9)	2.7	2.8
The main purpose of university teaching should be to prepare students for the labour market	2.6	[2.3]	2.7	(3.0)	2.8	2.5	2.6
Academia should focus on basic research and should not be concerned with its actual or potential application	2.4	2.6	2.5	2.2	[1.8]	(2.7)	2.2

[ ] =Low in each row ( ) =High in each row

Question:

The following are statements about relationships between higher education institutions and external organisations. To what extent do you agree or disagree with them?
Academia should focus on basic research and should not be concerned with its actual or potential application
Academic freedom is of fundamental importance to the future wellbeing of society
Higher education has a key role to play in increasing the competitiveness of business in the UK
The main purpose of university teaching should be to prepare students for the labour market
UK business does not have the capacity to use research effectively
Over the past few years, universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles
Over the past few years universities have done too little to increase their relevance to society or contribution to economic development

Exhibit A16b Extent to which agree with statements about relationships with external organisations by Stokes's Quadrants (score is 1-5 where 5 is the highest)(mean score)

	All	Basic research	User-inspired basic research	Applied research
Total respondents	*21,853*	*5,390*	*5,847*	*8,461*
Academic freedom is of fundamental importance to the future wellbeing of society	4.6	4.8	4.7	4.5
Higher education has a key role to play in increasing the competitiveness of business in the UK	4.2	4.1	4.2	4.2
Over the past few years, universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles	3.3	3.6	3.3	3.1
UK business does not have the capacity to use research effectively	3.1	3.1	3.1	3.1
Over the past few years, universities have done too little to increase their relevance to society or contribution to economic development	2.8	2.5	2.7	2.9
The main purpose of university teaching should be to prepare students for the labour market	2.6	2.3	2.6	2.7
Academia should focus on basic research and should not be concerned with its actual or potential application	2.4	3.1	2.4	1.8

Question:

The following are statements about relationships between higher education institutions and external organisations. To what extent do you agree or disagree with them?
Academia should focus on basic research and should not be concerned with its actual or potential application
Academic freedom is of fundamental importance to the future wellbeing of society
Higher education has a key role to play in increasing the competitiveness of business in the UK
The main purpose of university teaching should be to prepare students for the labour market
UK business does not have the capacity to use research effectively
Over the past few years, universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles
Over the past few years universities have done too little to increase their relevance to society or contribution to economic development

Exhibit A17 Activity and management responsibility by institution (% of respondents)

	Teaching	Research	Administrative activities	Outreach activities	Other activities	Total respondents	Management responsibility	Total respondents
All	85.4	93.1	63.2	35.7	2.4	22,170	47.4	*22,008*
Institutions								
Russell Group	80.1	97.1	60.1	33.0	3.5	9,233	47.5	*9,170*
Older universities (est pre-1992)	86.0	94.4	67.1	37.1	1.6	6,485	46.6	*6,431*
Younger universities (est post-1992)	92.7	86.0	64.8	38.3	1.6	5,866	47.3	*5,828*
Specialist institutions	87.9	89.1	54.3	34.0	2.7	586	54.6	*579*

Questions:

Please indicate whether you participate in the following activities:

- Teaching
- Research
- Administrative activities
- Outreach activities
- Other (please specify)

Do you have management responsibility within your institution?

- Yes
- No

Exhibit A18 People based activities by institution (% of respondents)

Activity	Russell Group	Older universities (est pre-1992)	Younger universities (est post-1992)	Specialist institutions
Employee training	27.1	30.4	43.4	34.9
Student placements	26.0	30.8	47.1	41.2
Curriculum development	19.7	26.4	43.4	31.2
Attending conferences	87.2	86.5	87.9	92.6
Standard setting forums	27.9	29.5	37.3	35.0
Participating in networks	63.1	66.2	74.9	71.3
Sitting on advisory boards	36.4	38.5	40.6	42.3
Giving invited lectures	64.7	63.8	65.6	67.9
Enterprise education	3.6	6.0	10.6	7.1
Mean	39.5	42.0	50.1	47.0

Question:

Have you engaged in the following **people based** activities with external organisations within the past three years?

Please indicate whether you have engaged in the activity, and where applicable indicate the **geographic location** of the organisations involved.

- Training company employees through teaching or personnel exchange
- Arranging in-course student projects or placements with external organisations, including Knowledge Transfer Partnerships (KTPs)
- Joint curriculum development with external organisations
- Attending conferences which have participation by individuals from external organisations
- Participating in standard setting forums involving external organisations
- Participating in networks involving external organisations
- Sitting on advisory boards of external organisations
- Giving invited lectures or participating in brainstorming sessions organised by external organisations
- Involvement with Enterprise Education

Exhibit A19 Problem solving activities by institution (% of respondents)

Activity	Russell Group	Older universities (est pre-1992)	Younger universities (est post-1992)	Specialist institutions
Hosting of personnel	27.5	25.7	27.4	31.4
External secondment	9.6	9.9	10.1	12.1
Joint research	53.1	48.3	43.5	54.4
Contract research	37.7	37.4	34.6	35.9
Consultancy services	40.4	43.3	48.1	47.2
Research consortia	38.1	34.9	29.0	39.1
Informal advice	55.4	55.7	59.9	63.5
Prototyping and testing	10.3	9.6	10.8	10.3
Setting up physical facilities	9.1	7.8	9.5	14.4
Joint publications	48.7	46.8	40.4	53.0
Mean	33.0	32.0	31.3	36.1

Question:

Have you engaged in the following **problem solving** activities with external organisations within the past three years?

Please indicate whether you have engaged in the activity, and where applicable indicate the **geographic location** of the organisations involved.

- Organising the hosting of personnel from external organisations on a short- or long-term basis
- Secondment on a short- or long-term basis to an external organisation
- Joint research with external organisations (original work undertaken by both parties)
- Contract research with external organisations (original work undertaken by academic partner only)
- Consultancy services (no original research undertaken)
- Participating in research consortia with external organisations
- Providing informal advice on a non-commercial basis
- Prototyping and testing for external organisations
- Setting up new physical facilities with funding from external organisations (such as labs, campus buildings etc.)
- Joint publications with individuals of external organisations

Exhibit A20 Community based activities by institution (% of respondents)

	Russell Group	Older universities (est pre-1992)	Younger universities (est post-1992)	Specialist institutions
Activity				
Lectures for the community	38.5	39.3	36.6	37.9
Community based sports	2.0	2.8	4.5	1.7
Public exhibitions	13.0	14.1	16.2	30.5
School projects	26.6	28.7	37.6	33.5
Mean	20.0	21.2	23.7	25.9

Question:

Have you engaged in the following **community based** activities with external organisations within the past three years? Please indicate whether you have engaged in the activity, and where applicable indicate the **geographic location** of the organisations involved.

- Giving public lectures for the community
- Providing community based sports
- Providing public exhibitions
- Involvement with school projects

Exhibit A21 Regional people based activities by institution (% of those respondents engaged in each activity)

	Russell Group	Older universities (est pre-1992)	Younger universities (est post-1992)	Specialist institutions
Activity				
Employee training	36.6	43.5	50.6	41.7
Student placements	39.9	49.2	54.7	40.8
Curriculum development	29.0	36.2	43.3	33.3
Attending conferences	34.8	36.2	39.0	40.4
Standard setting forums	27.4	30.9	38.5	33.7
Participating in networks	33.4	38.5	45.6	40.2
Sitting on advisory boards	24.4	28.9	32.9	30.3
Giving invited lectures	34.1	38.7	43.2	41.6
Enterprise education	44.7	51.7	50.3	51.4
Mean	33.8	39.3	44.2	39.3

Exhibit A22 Regional problem solving activities by institution (% of those respondents engaged in each activity)

Activity	Russell Group	Older universities (est pre-1992)	Younger universities (est post-1992)	Specialist institutions
Hosting of personnel	19.8	24.7	30.5	22.3
External secondment	15.0	21.3	31.5	6.3
Joint research	24.1	31.2	37.2	33.8
Contract research	27.1	33.3	42.9	26.5
Consultancy services	27.9	34.2	45.3	36.3
Research consortia	21.6	26.0	34.6	32.7
Informal advice	39.4	44.0	50.4	45.2
Prototyping and testing	26.3	31.5	38.8	34.0
Setting up physical facilities	21.4	26.4	37.4	27.6
Joint publications	24.0	26.8	31.5	31.9
Mean	24.6	29.9	38.0	29.7

Exhibit A23 International people based activities by institution (% of those respondents engaged in each activity)

	Russell Group	Older universities (est pre-1992)	Younger universities (est post-1992)	Specialist institutions
Activity				
Employee training	37.7	33.8	23.2	34.8
Student placements	27.8	23.0	15.3	31.7
Curriculum development	37.9	31.4	26.6	34.6
Attending conferences	73.5	66.1	49.4	65.3
Standard setting forums	41.0	36.4	20.0	39.9
Participating in networks	57.9	50.6	36.0	54.2
Sitting on advisory boards	43.0	33.8	20.3	36.2
Giving invited lectures	61.2	51.8	38.0	56.8
Enterprise education	19.7	15.9	12.7	17.1
Mean	44.4	38.1	26.8	41.2

Exhibit A24 International problem solving activities by institution (% of those respondents engaged in each activity)

	Russell Group	Older universities (est pre-1992)	Younger universities (est post-1992)	Specialist institutions
Activity				
Hosting of personnel	71.7	64.6	52.5	69.9
External secondment	57.5	47.5	37.1	68.3
Joint research	59.0	52.2	37.3	53.6
Contract research	41.4	35.6	23.2	50.3
Consultancy services	42.1	35.5	22.7	42.3
Research consortia	64.9	59.2	45.1	64.3
Informal advice	45.3	37.3	24.3	45.5
Prototyping and testing	44.3	34.1	27.3	44.0
Setting up physical facilities	21.6	21.6	14.5	27.6
Joint publications	63.0	56.7	40.8	58.0
Mean	51.1	44.4	32.5	52.4

Exhibit A25 Way in which external activities were initiated by institutions (% of respondents)

	The university knowledge/ technology transfer office or other university administrative office	Individuals associated with the external organisation	Your own actions in approaching the external organisation directly	Mutual actions following up a contact at a formal conference or meeting	Mutual actions following up informal contacts	Total respondents
All	23.8	79.6	63.5	61.9	69.2	*15,257*
Institutions						
Russell Group	19.0	79.5	59.8	60.4	67.2	*6,323*
Older universities (est pre-1992)	23.2	78.6	62.4	61.3	68.8	*4,385*
Younger universities (est post-1992)	31.4	80.3	70.0	64.5	72.2	*4,114*
Specialist institutions	26.4	85.0	67.1	65.4	72.7	*435*

Question:

If you have participated in activities with external organisations over the past three years, have these been initiated by the following?

The university knowledge / technology transfer office, or other university administrative office

Individuals associated with the external organisation

Your own actions in approaching the external organisation directly

Mutual actions following up a contact at a formal conference or meeting

Mutual actions following up informal contacts

Exhibit A26 Weight given by institution with regard to career advancement and promotion by institution (score is 1-5 where 5 is the highest)(% of respondents and mean score)

	Teaching ability and workload		Faculty and departmental administration		Research and publications		Work with business and industry		Work with the local community		Total respondents
	4 or 5 %	Mean score	4 or 5 %	Mean score	4 or 5 %	Mean score	4 or 5 %	Mean score	4 or 5 %	Mean score	
All Institutions	34.6	3.0	35.2	3.1	85.1	4.4	32.2	2.9	11.1	2.1	*21,669*
Russell Group	31.3	2.9	26.0	2.9	95.6	4.8	27.2	2.7	6.0	1.8	*8,991*
Older universities (est pre-1992)	32.4	2.9	31.2	3.0	92.6	4.6	27.8	2.8	8.2	2.0	*6,353*
Younger universities (est post-1992)	41.4	3.1	53.1	3.5	61.4	3.7	44.8	3.2	22.0	2.5	*5,756*
Specialist institutions	43.8	3.2	43.5	3.3	74.1	4.1	32.7	2.9	13.1	2.2	*569*

Question:

With regard to career advancement and promotion, how much weight do you believe your institution gives to the following criteria (on a score of 5-1, where 5 is the highest)?

Teaching ability and workload

Faculty and departmental administration

Research and publications

Work with business and industry

Work with the local community

Exhibit A27 Motivations of respondents to activities with external organisations by institution (score is 1-5 where 5 is very important)(% of respondents and mean score)

	Create student project and job placement opportunities		Source of personal income		Secure funding for research assistants and equipment		Look for business opportunities linked to my own research		Further my institution's outreach mission		Total respondents
	4 or 5 %	Mean score	4 or 5 %	Mean score	4 or 5 %	Mean score	4 or 5 %	Mean score	4 or 5 %	Mean score	
All Institutions	37.3	2.8	21.9	2.2	39.1	2.8	23.8	2.3	49.3	3.2	*15,631*
Russell Group	30.5	2.6	22.6	2.2	43.8	2.9	21.7	2.2	41.9	3.0	*6,423*
Older universities (est pre-1992)	34.1	2.7	22.3	2.2	40.5	2.8	24.3	2.3	49.0	3.2	*4,514*
Younger universities (est post-1992)	49.9	3.2	20.1	2.2	30.5	2.6	26.4	2.4	59.7	3.5	*4,253*
Specialist institutions	46.5	3.0	24.2	2.3	37.7	2.9	23.0	2.4	59.0	3.5	*441*

Question:
If you have participated in activities with external organisations, which of the following were your motivations and objectives (please indicate the importance of each statement)? (scale is 1 to 5)

Test the practical application of my research
Gain insights in the area of my own research
Keep up to date with research in external organisations
Secure access to specialist equipment, materials or data
Create student project and job placement opportunities
Source of personal income
Secure funding for research assistants and equipment
Look for business opportunities linked to my own research
Further my institution's outreach mission

Exhibit A28 Impact of external activities on research by institution (% of respondents)

	It has led to new research projects	It has strengthened my reputation in the field	It has given me new insights for my work	It has led to new contacts in the field	It has had very little or no impact	Total respondents
All	62.4	58.2	72.7	69.9	10.9	*14,708*
Institutions						
Russell Group	63.3	57.5	70.4	68.6	11.1	*6,233*
Older universities (est pre-1992)	62.5	58.3	72.6	69.7	11.1	*4,298*
Younger universities (est post-1992)	60.2	58.4	76.2	71.6	10.7	*3,777*
Specialist institutions	67.0	64.3	76.8	76.8	7.8	*400*

Question:

In the last three years, what impact has your involvement in activities with external organisations had on the amount and kind of **research** that you do? Please indicate all that apply.

- It has led to new research projects
- It has strengthened my reputation in the field
- It has given me new insights for my work
- It has led to new contacts in the field
- It has had very little or no impact

Exhibit A29 Highly intensive interactions by region (% of respondents)

	People based interaction	Problem solving interaction	Community based interaction	All interactions	
	%	%	%	%	Total respondents
Region					
Northern Ireland	30.5	22.4	26.5	28.1	*633*
Wales	24.6	19.2	25.3	23.2	*1,135*
North East	23.6	18.3	24.4	22.8	*980*
Yorkshire and the Humber	23.5	17.7	21.2	20.3	*1,913*
West Midlands	23.1	17.3	21.4	19.8	*1,325*
North West	23.1	16.8	23.0	20.5	*2,041*
Scotland	22.0	19.9	22.9	21.4	*2,997*
East of England	21.5	19.1	22.6	21.6	*1,675*
South West	20.8	16.7	24.6	19.6	*1,275*
London	20.0	17.0	19.0	18.9	*3,984*
South East	19.1	16.0	22.1	18.1	*2,661*
East Midlands	18.3	15.0	21.8	16.7	*1,438*
All (%)	21.7	17.7	22.2	20.2	
All (N)	*4,775*	*3,849*	*4,711*	*4,461*	*22,057*

Definition of 'high interaction'
People based: A score of 6 or more out of a possible 9.
Problem solving: A score of 6 or more out of a possible 10.
Community based: A score of 2 or more out of a possible 4.
All interactions: A score of 12 or more out of a possible 23.

Annex B: The Survey Method, Tests of Significance and Response Bias

Introduction

In this Annex we describe the sampling frame, the process by which the survey was administered, the response rate and possible response biases. We also briefly discuss the use and interpretation of tests of statistical significance with the large sample sizes generated by the survey.

The Sampling Frame

The sampling frame is all academics active in teaching and/or research in the sample period in all disciplines in all UK higher education institutions. There is no publicly available database which provides contact details for this sampling frame. We therefore proceeded by compiling a list of all UK higher education institutions from data compiled by the Higher Education Statistical Agency (HESA), Universities, UK, the Higher Education Funding Councils of England, Wales, Scotland and the Northern Ireland Department for Employment and Learning. We then manually collected from the websites of all of these institutions a list of all academics listed on the websites in all departments and faculties. This email directory was the sampling frame to which we addressed a web based questionnaire. Difficulties with web access led to the exclusion of 4 smaller specialist HEIs from the sampling frame.

Prior to the administration of the survey instrument, we discussed with the appropriate bodies the Freedom of Information Act rules and web conventions relating to large-scale web based surveys. This led to the specific design of the covering letter accompanying the survey instrument which gave full details of the project with which the survey was associated, contact details of the research team and the research programme of which the survey was a part. It also included clear routes by which individuals could decline to participate or be prompted. It also guaranteed confidentiality in the treatment of all data collected.

The Survey Instrument

The survey instrument was designed in the light of previous research in this area and in parallel with a survey conducted as part of an evaluation commissioned by the Higher Education Funding Council of England (HEFCE) on the impact of third stream funding on university, culture and practice (HEFCE, 2009). This process allowed a significant amount of piloting before the conduct of the survey described here. It also drew on the findings of a suite of detailed case studies of university-industry interactions completed at an earlier stage of the project (Abreu et al., 2008)

The survey instrument was administered using the Qualtrics survey software suite. Because of the scale of the survey which was to be sent to over 126,000 academics identified in the sampling frame, the survey was conducted in a series of regional waves. After the completion of the first regional

wave an assessment was made of the functionality of the instrument and a small number of minor changes were made which involved closing a number of open codes.

Response Rates

The survey involved an initial web mailing followed two or three weeks later by a follow-up prompt. The first wave began in September 2008 and the final wave closed in June 2009. Exhibit B1 shows the response rate achieved.

Exhibit B1 Academic Survey Response

	Total	%
Total sample	126,120	
less:		
Failed email address	(220)	
Total surveyed sample	125,900	
Completed returns	22,465	17.8
of which:		
Without	12,283	9.8
After reminder	10,182	8.1
No response	101,932	81.0
Refused	1,503	1.2
Total surveyed sample	125,900	100.0
Out of scope*	295	
Total usable sample**	22,170	

*These respondents were excluded because their survey return indicated that they were not active in either teaching or research at their institutions in the survey period.
** Completed returns minus out of scope returns.

The table shows that of the total sampling frame of 126,120 academics, 220 could not be contacted because of failed email addresses. Of the total surveyed sample of 125,900, we achieved 22,465 returns for an overall response rate of 17.8%. Of this total, 9.8% replied without being prompted and 8.1% replied after the prompt had been sent. No responses were received in 81% of the cases, and a further 1.2% replied refusing to take part. Of the 22,465 returns a further 295 were deemed out of scope, because their returns indicated that they were not actively involved in either teaching or research. The final useable sample was therefore 22,170.

Test of Significance in Large Survey Samples

In this report we do not present standard tests of statistical significance. This is for simplicity of presentation. In each case, however, we have tested differences in responses across different cross-classifications of the data using appropriate parametric and non-parametric methods. All of the results reported in the main text are statistically significant at the 5% level or better.

Of more importance than statistical significance when there are very large sample sizes is the question of economic significance. With very large samples of several thousand observations the chance of obtaining statistically significant differences is high, even though the actual magnitude of the differences is extremely small. (See for example Kennedy, 2003, pp72ff). In the discussion in the

text therefore we refer to differences which are of a reasonable magnitude and are of economic importance.

The distinction between statistical and economic significance is particularly important when we analyse potential response biases in the dataset. Because the sample sizes are so large, even very small differences between those individuals who replied without prompting and those who required prompting are statistically significant.

Response Bias

The covering letter and survey instrument made it explicit that we were soliciting returns whether or not an individual had been involved in interactions with external organisations. Nevertheless it is possible in a survey which focuses on external interactions by academics that those individuals who do not take part in such activities may not reply. We could not compare non-respondents directly with respondents. However, we can compare those academics who replied without a reminder with those academics who required prompting to respond. On the assumption that the latter felt the survey to be less relevant to them, we might expect response biases to show up in differences between the two groups. A detailed analysis across variables relating to external interactions in the survey sample showed some differences that were statistically significant because of the large sample sizes, but the quantitative differences were very small.

Exhibit B2 Response Bias Analysis

(A) If undertaking research, which of the following most closely describes it? (%)

	Basic research	User-inspired basic research	Applied research
Without reminder	27	30	43
After reminder	28	29	43

(B) If undertaking research: It has been applied in a commercial context

	% ticked
Without reminder	19**
After reminder	18

(C) If undertaking research: It is in a general area of commercial interest to industry

	% ticked
Without reminder	35
After reminder	35

(D) If undertaking research: It has relevance for non-commercial external organisations

	% ticked
Without reminder	73**
After reminder	70

(E) If undertaking research: It has no relevance for external organisations

	% ticked
Without reminder	11**
After reminder	12

(F) Undertaken activities with private sector companies in last 3 years

	% ticked
Without reminder	43**
After reminder	40

(G) Undertaken activities with public sector organisation in last 3 years

	% ticked
Without reminder	56**
After reminder	50

(H) Engaged in activities with charitable or voluntary organisation in last 3 years

	% ticked
Without reminder	47**
After reminder	41

(I) Disagreement/agreement (1-5) with: Academia should focus on basic research and should not be concerned with its actual or potential application

	Mean	Median
Without reminder	2.34	2
After reminder	2.35	2

(J) Disagreement/agreement (1-5) with: Over the past few years, universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles

	Mean	Median
Without reminder	3.25	3
After reminder	3.26	3

Key: ** Statistically significant at the 5% level or better using the Mann-Whitney U test or Chi-Square test.

A selection of these comparisons is shown in Exhibit B2. These results suggest that there may be a small upward bias in our sample in the estimated level of interactions involving academics with external organisations in the UK. This effect is more marked for public sector and charitable interactions relative to private sector company interactions.

Senior staff are known to be more likely to interact with external organisations than junior staff. They may also therefore be more likely to reply. In addition faculties may be less likely to list junior research staff. In either event our sample may as a result overrepresent interactions. As a further check we therefore compared our sample with aggregate HESA statistics in terms of the positions held by respondents. We also compared characteristics by gender. In making this comparison it is important to bear in mind that the HESA statistics are known to underestimate the number of professors. We should expect some tendency for the HESA numbers to be lower than that based on self-reported status as in this survey, even if there was no response bias. Exhibit B3 shows the results of our comparison.

In terms of seniority the sample does indeed have a higher proportion of professors and senior staff. It is therefore likely that higher levels of interaction will be reported in the aggregate sample results. There is little difference in terms of gender balance.

Exhibit B3 Comparison with HESA by Position and Gender

	Academic staff					
	By grade and gender, HESA 2007/08 (%)			By position and gender, CBR/ESRC Survey 2008-09 (%)		
	Female	*Male*	*Total*	*Female*	*Male*	*Total*
Professors	2	9	11	4	15	19
Readers, senior lecturers and senior researchers	8	13	21	12	18	30
Lecturers, researchers and research/teaching assistants	24	27	51	20	22	42
Other grades	8	9	17	4	5	9
Total	42	58	100	40	60	100

Source: HESA Resources of Higher Education Institutions 2007/08, Table 12 and Centre for Business Research/ESRC Survey of Academics (2009)

We also compared the disciplinary spread of our respondents with HESA data. This comparison is not straightforward to make. First the HESA data are by cost centre categories which do not map directly onto university departmental or disciplinary groupings on websites or self-allocation to disciplines by academics. Second, within a cost centre grouping, university department, or research centre academics may be drawn from several disciplines. With these caveats in mind Exhibit 4 shows that the CBR sample is broadly representative of HESA cost centre data with the exceptions of medicine, dentistry and health where our sample is underrepresented and biosciences and physical science and administrative, business and social studies which are overrepresented. These differences must be borne in mind when interpreting the results reported in the main text. The implications for response bias are not straightforward to infer.

Exhibit B4 Comparison with HESA by discipline

Academic cost centres/Disciplines	Academic staff	
	HESA 2007/08 (%)	CBR/ESRC Survey 2008/09 (%)
Administrative, business & social studies	18	25
Agriculture, forestry & veterinary science	1	1
Architecture & planning	2	2
Biosciences & physical sciences	13	19
Design & creative arts	8	5
Education	9	6
Engineering	8	7
Humanities, language based studies & archaeology	10	12
Mathematics & IT	7	7
Medicine, dentistry & health	25	16
All	100	100

Source: HESA resources of Higher Education Institutions 2007/08, Table 12 and Centre for Business Research/ESRC Survey of Academics (2009)

Our final comparison is in terms of age. Here again HESA data are not available in the same age bands as those used in the survey. However, on the basis of a comparison with an interpolation of the HESA age bands Exhibit B5 shows that the sample has a lower proportion in the under 30 age group and a higher proportion aged over 50 than the HESA data.

Exhibit B5 Comparison with HESA by age

	Academic staff	
	HESA 2007/08 (%)*	CBR/ESRC survey 2008/09 (%)
Under 30	12	6
30-39	27	27
40-49	28	29
50 and over	33	38
All	100	100

* HESA's age distribution differs from the CBR in that the breaks are: 30 and under, 31-40, 41-50 and 51 and over. We therefore adjusted the HESA data to match the CBR groupings.

Source: HESA Resources of Higher Education Institutions 2007/08, Table 11 and Centre for Business Research/ESRC Survey of Academics (2009)

Other things being equal, this is likely, as with the response patterns by seniority, (to which it is related) to lead to a somewhat higher likelihood of interactions with external organisations.

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enquiries@ukirc.ac.uk
www.ukirc.ac.uk

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