The Evolution of the Infrastructure of the Knowledge Exchange System

PACEC

Public & Corporate
Economic Consultants

The Evolution of the Infrastructure of the Knowledge Exchange System

A report to HEFCE by PACEC and the Centre for Business Research, University of Cambridge

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Foreword

Some days I read that we at HEFCE are funding 1,000s of Intellectual Property (IP) managers. Who are managing around £56M in licensing income. I think- outrageous. But then I think of the diversity of our universities and colleges, of their subjects and of their partners in society and the economy. And then I think – hang on, are these all focussed so intently on Intellectual Property that they need 1,000s of specialist IP managers?

Clearly not – as this report from the Cambridge Centre for Business Research and PACEC consultants describes. The report tries to capture the wide range of engagements between higher education and societies and the economy – and the support in place for research translation, development of human capital, soft networks, provision of facilities and civic and community outreach. Such engagements generated at least £2.25Bn in total value for the economy and society in 2007-08.

Not that we at HEFCE or HEI leaders and managers should be complacent. HEFCE provides around 2% of its funds from Government to help HEIs support their engagements with the wider world. This complements project support from such as Research Councils and Regional Development Agencies. We all need to maximise efficiency and effectiveness, both in engagement work and in the underpinning research and teaching. Improving strategic and operational efficiency is critical. A key part of that is getting the right balances between academics and professional staffs, so that the academics feel supported in their creative roles and the institutions are comfortable with the financial, legal and other consequences of engagements. We hope that this report will help with this development process.'

David Sweeney

HEFCE Director, Research, Innovation and Skills

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"If we accept that in companies 'organisational design is the key to unlocking the opportunities of the 21st century' (Bryan and Joyce, 2007: 16), the same may be true of universities. If … internal organisational design changes could add between 30% and 60% to the profit per employee of companies with high proportions of 'thinking-intensive jobs', how much could universities add to their innovative capacity by further organisational change?"

- *Michael Shattock (2009: 7)*[1]

[1] Shattock (2009) *Entrepreneurialism in Universities and the Knowledge Economy: Diversification and Organisational Change in European Higher Education*, New York: Open University Press

1 Introduction

1.1.1 This paper is the first in a series that addresses the state of knowledge exchange (KE) in the English higher education (HE) sector. It builds upon a major evaluation of the impact of knowledge exchange funding undertaken by PACEC and the Centre for Business Research (CBR) at the University of Cambridge for HEFCE (PACEC/CBR, 2009).

1.1.2 This first paper aims to provide answers to two key research questions:

- What types of HEI infrastructure exist to support the knowledge exchange process?
- Why does the organisational structure of this infrastructure differ across HEIs?

1.1.3 The paper initially sets the scene by presenting evidence from our recent research on the scale and nature of KE activities undertaken by academics. It begins by highlighting an observed need for some form of support structure and a significant growth in the KE infrastructure over the period 2003-2008. Section two then presents, for the first time, the diverse set of types of HEI infrastructure supporting the KE process and the current structure of the system. Section three then discusses the key factors that shape the system and the heterogeneity which is found across the English HE sector. Conclusions from this are drawn in section four.

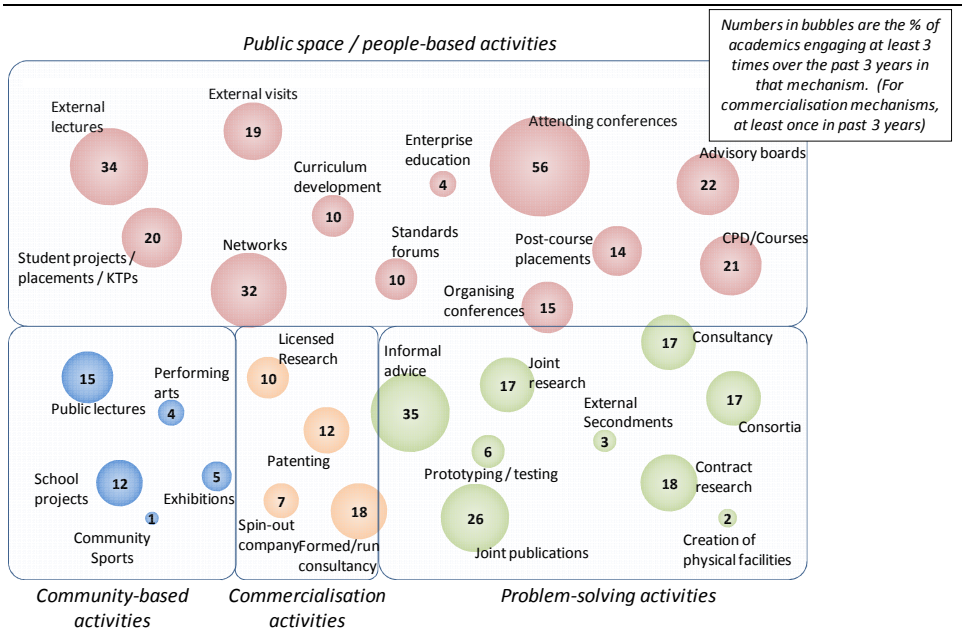
1.1.4 The analysis is based primarily on the evidence gathered through HEFCE (PACEC/CBR, 2009). This consisted of a survey of academics and external organisations, and case studies of thirty HEIs across five different clusters based primarily on differences in their research intensity. Additional interviews have been carried out with fifteen HEIs complemented by significant web-based research.

Academic participation in knowledge exchange

1.1.5 The past decade has seen a rapid expansion in knowledge exchange activity across a wide range of mechanisms that academics are engaged with (Figure 1.1). These activities fall within four distinct groups of activities. What is striking about the evidence shown in Figure 1.1 is the diversity of modes of engagement for KE and the fact that significant amount of activity occurs well beyond the traditional 'technology transfer' modes of engagement (licensing and spin-outs).

1.1.6 The mix and relative importance of different types of KE activities differs across HEIs as well as across academic disciplines (PACEC/CBR, 2009, p. 139-141). The PACEC/CBR survey of academics showed, for example, that engineers have an above average propensity to engage in activities such as joint research, contract research, consultancy, and prototype and testing activities while those in arts disciplines are more likely to organise student projects and undertake community based activities. Engineers are also much more likely to engage in the commercialisation activities of licensing, spin-outs and patenting.

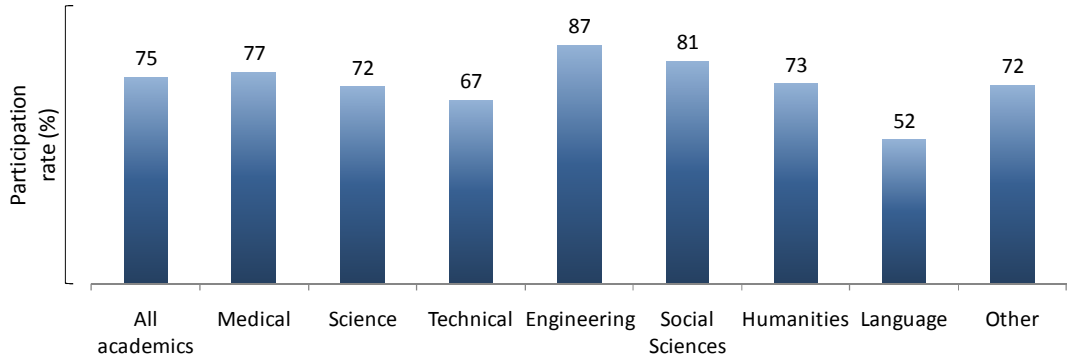
Figure 1.1 Academic engagement in knowledge exchange activities



Note: 'Attending conferences' and 'organising conferences' refer to conferences with external organisation participation
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

1.1.7 Not only is there a great diversity of modes of engagement by HEIs with external organisation, there is also high participation by academics with three-quarters of all academics having engaged in some form of KE activity at least three times over the last three years. This evidence in Figure 1.2 also emphasizes that KE is not limited to the science, technology, engineering and mathematics (STEM) disciplines, but is occurring across the breadth of disciplines, with the highest participation in engineering and the lowest in languages.

Figure 1.2 Academic participation rate in knowledge exchange by discipline (based on academics engaging in at least one mechanism at least three times in the past three years)

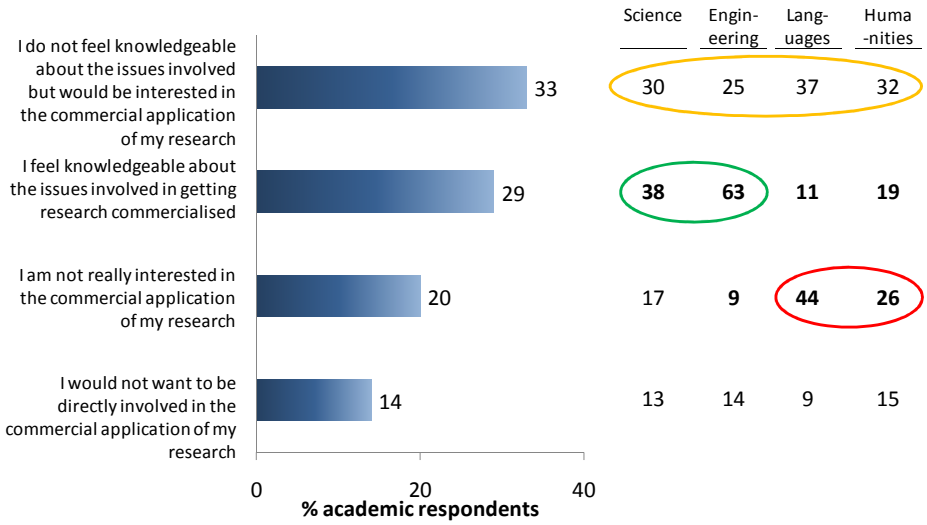


Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

A need for support for knowledge exchange

1.1.8 There is strong evidence that academics are not fully cognisant of all the issues surrounding the commercialisation of their research. Approximately one third of academics did not feel knowledgeable about the issues involved, but would be interested in the commercial application of their research (Figure 1.3).

Figure 1.3 The need for support for knowledge exchange



Note: A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the total (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

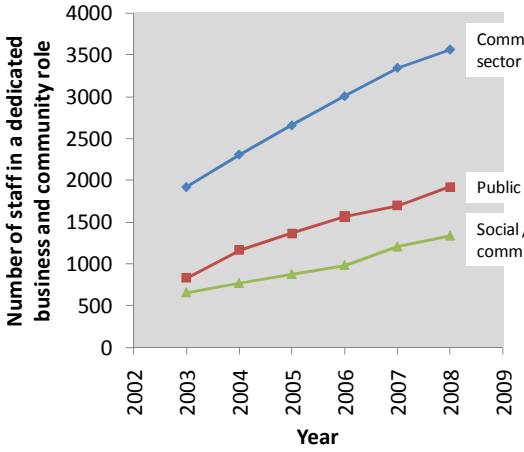
1.1.9 It is also important to note that the most important factor constraining academic engagement with external organisations is time (PACEC/CBR, 2009). This suggests a potentially important role for commercialisation and other KE support.

1.1.10 There are a number of different ways to satisfy the support needs of academic in their KE activities. These include improving the capabilities of academics to better engage themselves, developing internal capability and capacity, or fostering links with support providers external to the HEI (this could be private and public sector organisations or other HEIs, for example).

A growing system of knowledge exchange infrastructure

1.1.11 Over the past decade, the English HE sector has witnessed a very large growth in the scale of the infrastructure dedicated to supporting the KE process with the private and public sectors and with society and the community (proxied by the number of staff employed within HEIs in a dedicated KE role, Figure 1.4).

Figure 1.4 Number of knowledge exchange staff 2003-2008



	Number of staff, 2008	CAGR, 2003-2008 (%)	Average number of staff per HEI, 2008
Commercial sector	3,561	13	28
Public sector	1,920	18	15
Social / community	1,334	15	10

Source: HEBCI, PACEC/CBR analysis

1.1.12 The growth of the system of KE infrastructure has been greatly supported by HEFCE's KE funding programmes, notably HEROBC and HEIF (PACEC/CBR, 2009), which have invested approximately £700 million in constant 2003 prices over the period 2000/01-2007/08. The analysis of HEIF round 4 funding (PACEC, 2008) showed that approximately 50% of the allocated funding was to be spent on KE staff, with a further 15% on support for staff engagement and 2.5% for staff development and training.

1.1.13 Our case studies show that HEIs are developing a diversity of KE initiatives and mechanisms to strengthen and meet the needs of academics and other users. Meeting the KE support needs of academics has involved continuous experimentation with different initiatives. The infrastructure systems developed by HEIs are still in flux as they learn how to best match the system to their specific context and mission.

2 The Elements and Structure of the System of Knowledge Exchange Infrastructure

2.1.1 The system of KE infrastructure within an HEI can be conceptualised as a micro knowledge system consisting of:

- Knowledge exchange units (KEUs) providing different types of services in support of the KE activities of academics and others, to different types of internal or external customers; and
- Formal or informal interactions within the system, either between KE units, or between these and the users of their services. The frequency, density and nature of these interactions are an important part of the KE process.

2.1.2 This section documents the different types of knowledge exchange units and functions that constitute the overall KE system of an HEI. It also presents some tentative evidence on the effectiveness of this system by examining the constraints confronting academics in their KE engagements with external organisations.

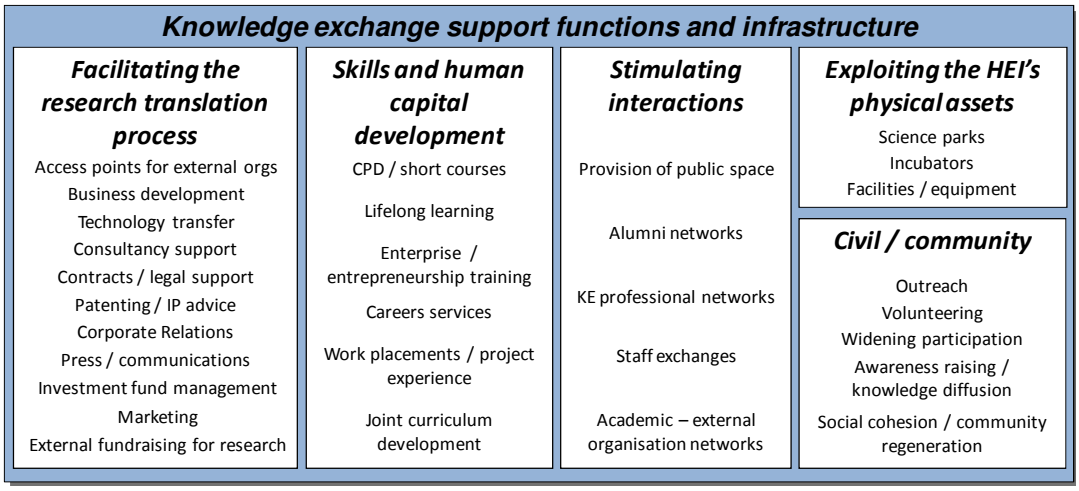
2.2 Types of Knowledge Exchange Infrastructure

Knowledge exchange functions and support infrastructure

2.2.1 The case study research identified a diverse range of KE functions that support the wide variety of mechanisms through which academics engage with external organisations to achieve economic and social impact. These functions are shown in Figure 2.1 and are grouped into five different categories as follows:

- Facilitating the translation of research through, for example, supporting the contract research process, consultancy activities and licensing / spin-outs through technology transfer;
- Facilitating the improvement of skills and human capital development of the academics, students and those external to the HEI through, for example, CPD, training for academics and students, providing entrepreneurship and employability training etc.;
- Facilitating the stimulation of interactions between those in the HEI and those in the economy and society through, for example, the development of networks, and holding events that bring academics and external organisations together to share ideas and knowledge;
- Facilitating the exploitation of the physical assets of the HEI through, for example, the development of science parks, incubators, design studios, hiring of specialist equipments, as well as museums, exhibition space etc.; and
- Providing support dedicated to exploiting the HEI capabilities to improve civil society and the community through, for example, outreach and volunteering, widening participation programmes etc.

Figure 2.1 Key elements of the system of knowledge exchange infrastructure



A detailed description of the specific functions is provided in a separate working paper[2]
Source: Web research, interviews with key stakeholders, PACEC/CBR analysis

2.3 The Organisational Structure of the Knowledge Exchange System

2.3.1 The case studies reveal wide differences across HEIs in the way in which KE support functions are organised and delivered. The different support functions are delivered through knowledge exchange units (cost centres responsible for delivering one or more functions). The organisational structure for delivering support functions differs across HEIs. At one end of the spectrum is the highly fragmented or modular structure characterised by a relatively large number of knowledge exchange units, each providing relatively specialised support functions. At the other end of the spectrum there are HEIs providing support functions through a relatively small number of knowledge exchange units each responsible for providing a portfolio of different support functions.

2.3.2 A number of HEIs are experiencing significant organisational change in how the support functions are grouped into different knowledge exchange units. Some HEIs with large units providing a range of functions are being broken up into more specialised units as the scale of KE activity has grown. Other HEIs are amalgamating previously fragmented units into large units to provide greater coherence to their support provision.

2.3.3 These differences and shifts in organisational structures reflect key differences in the KE strategies across the HE sector. Three strategic positions may be distinguished, follows:

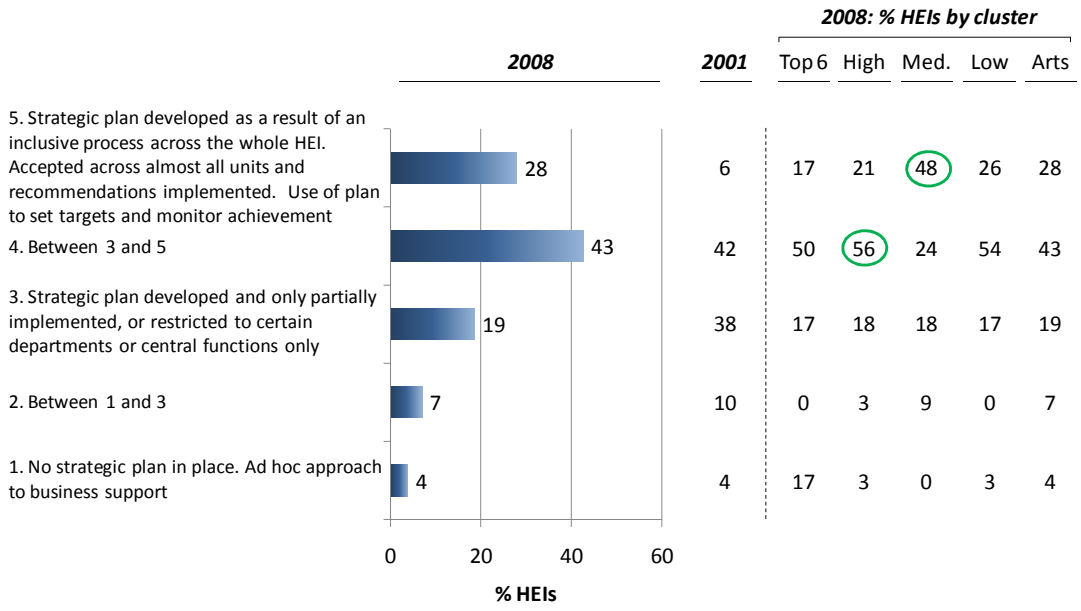
- Overarching strategy : covering all major aspects of knowledge exchange;
- Fragmented strategy : no overarching KE strategy but one or more dedicated sub-strategies covering distinct aspects of KE such as commercialisation,

[2] PACEC/CBR (2009) Understanding the Knowledge Exchange Infrastructure in the English Higher Education Sector, a working paper for HEFCE

continuing education etc. with varying degrees of integration of the different sub-strategies;

- Implicit strategy: No dedicated KE strategy but KE objectives are implicit or embedded within other strategies.

Figure 2.2 Strategic plan for knowledge exchange (% of HEIs)



Source: HEBCI, PACEC/CBR (2009)

2.3.4 Evidence on the breadth of KE strategies is provided through HEBCI (Figure 2.2) and shows that 28% of HEIs now have a strategic plan developed as an inclusive process and accepted by most units, compared with just 6% in 2001. Almost half of all HEIs in the medium research intensity cluster had a comprehensive strategy in place. Similarly, the share of HEIs with a strategic plan developed and only partially implemented, or restricted to certain departments or central functions only, has fallen from 38% in 2001 to 19% in 2007.

Interactions between infrastructural units

2.3.5 Interactions and knowledge flows between the different KEUs, in a complex system consisting of a diverse set of functions and KEUs, are likely to be important for the efficient and effective operation of the system. Knowledge can flow in a number of ways, including human interaction, reports, databases, and good practice guides. Whereas codified knowledge can be transmitted (although not necessarily effectively used) with limited human interaction, tacit knowledge requires much more contact between individuals. Interpersonal interactions between different parts of a system provide an essential mechanism for, amongst other things, sharing knowledge and ideas, improving the organisational design of the system, improving understanding of user needs and internal competences, and sharing opportunities, both at the strategic level and the operational level, and implementing actions following from codified

knowledge exchange. In addition interaction will facilitate coordination and collective action and the sharing of a common perspective.

2.3.6 Our case studies show that interactions within the KE system occur primarily for two reasons: interactions for the strategic development of the system and interactions for the delivery of services.

Interactions for the strategic development of the system

2.3.7 Interactions for the strategic development of the system help ensure that senior HEI managers have sufficient information about user needs, constraints, and priorities to create an efficient and effective system. They facilitate the rapid flow of information between the strategic decision makers and those responsible for delivering the service, as well as helping to minimise the duplication of effort, ensure that an integrated set of services are developed that meet the needs of users, and ensure that the system is responsive and adaptable to changes in demand.

2.3.8 Strategic interactions were identified in most case study HEIs and were both formal and informal for example:

- Formal interactions:
  - Fora such as management committees bringing together senior management from around the HEI and regularly scheduled meetings between KE unit management
  - Reporting lines create direct links between units and HEI senior management which facilitates knowledge flow vertically
- Informal interactions:
  - Social networks built up by senior management
  - Frequent ad-hoc interaction between senior management of the different parts of the system

Interactions for the delivery of knowledge exchange services

2.3.9 Operational interactions develop in the process of delivering the KE services to users to, for example, share knowledge about processes, improve technical understanding, understanding about customers, opportunities, and marketing. In addition, given the many points of access to the HEI for external organisations, it is highly likely that it may have to be referred to other parts of the system. Similarly, even if the external organisation has made initial contact with the right KEU, the HEI may find that interaction with other parts of the system can yield additional benefits (i.e. potential for cross-selling of KE services). A good understanding by each of the KEUs of the types of services provided by each part of the system and who is responsible for delivering them would greatly aid efficiency and effectiveness as well as potentially yielding additional benefits for the HEI.

2.3.10 Unlike strategic interactions, which were relatively widespread within the case study HEIs, the extent of operational interactions was much more varied. Some HEIs viewed such links as very important for their system of KE infrastructure and were taking active steps to ensure that structures were put in place to facilitate the

formation of these linkages, thus helping to build up a 'networked' organisational structure. At the other end of the spectrum is the 'silo' organisational structure where individual KEUs have few systematic connections to the rest of the system. In reality, most of the case study HEIs fell somewhere in between, with ad-hoc, spontaneous connections forming as a result of individuals and their personal relationships with others in the system.

2.3.11 In addition, while some formal interactions existed for operational reasons, the case studies revealed that most were informal, arising from social and personal networks of individual KE staff. Many were said to occur through common meeting grounds (e.g. the 'water-cooler' effect, or at events which bring people from different parts of the system together).

2.3.12 Many of the formal strategic interactions are permanent, embodied in standing committees meeting regularly. However, at the operational level, most interactions, particularly informal ones, appear to be transient, forming and re-forming in different ways for different types of projects. This emphasizes the necessity for strong social networks so that individuals can access different parts of the system as demands change.

2.4 Experimentation and the evolution of the system

2.4.1 Experimentation with different types of structures has occurred among all types of HEIs across the thirty case studies (PACEC/CBR, 2009). Indeed, it was difficult to find a KEU that had not undergone significant changes over the past decade. This was true of HEIs that have long experience in KE as well as HEIs only recently engaged in formalising their KE activities. The changes reflect both a learning process within the HEI as well as learning within the wider HE sector coupled with the sharing of experiences. The case studies suggest that HEFCE funding for KE has greatly facilitated this learning process by providing the necessary funds with the required flexibility for HEIs to experiment with different structural forms.

2.4.2 To secure major improvements in KE performance within an HEI and the system of KE support, a number of HEIs have successfully introduced 'change agents'. They are brought in to redesign the KE system, and recast the overall KE strategy. For example:

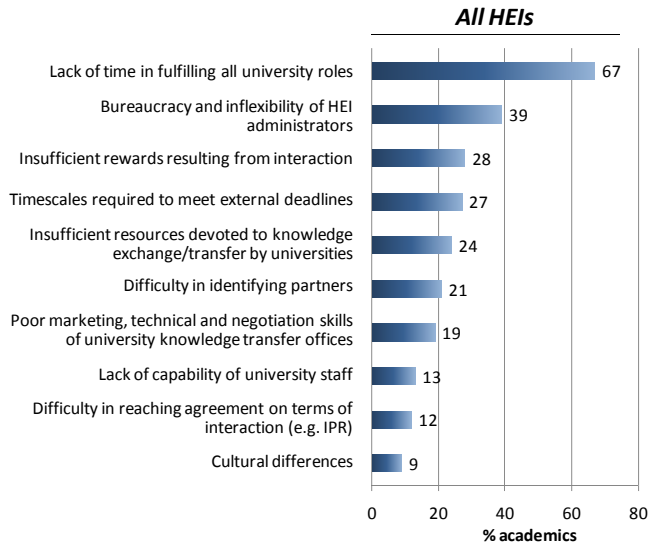
- This occurred in 2005 at UCL where the post of Vice-Provost for Enterprise was introduced to reform its KE performance in order to deliver a step change in their ability to translate UCL's capabilities into economic and social impact. Following internal and external reviews, this led to the introduction of an overarching strategy for enterprise which directly influenced the design and structure of the system of knowledge infrastructure.
- A similar exercise was recently undertaken by Kingston University, who brought in a dedicated 'change agent' at the senior level of HEI management to bring about a step change in KE performance. At Kingston, this has led to a large redesign of the system of KE infrastructure.

2.5 Efficiency and Effectiveness of the Knowledge Exchange System Infrastructure

2.5.1 While little data exists as yet on the effectiveness of individual units, the previous research did seek academic views on the key constraints facing the KE process (Figure 2.3). As users of the KE support infrastructure, their perceptions can provide powerful insights into potential areas of inefficiencies and ineffectiveness of the overall system. Key findings include:

- Bureaucracy and inflexibility of HEI administrators is seen as a constraint by 39% of academics, rising to over half of academics in low research intensity HEIs, but reducing to 31% in the top six research intensive HEIs;
- The lack of capability of university staff is a particular constraint for medium research intensive HEIs, while it is much less of a constraint for high research intensive HEIs;
- Difficulty in reaching agreements on the terms of interaction (e.g. intellectual property rights) is only a particular constraint for a small number of academics (just 12%), rising to 22% for those in the top six research intensive HEIs. In addition, an analysis of constraints by discipline showed that this constraint is dominated by academics in engineering disciplines (24%). This is likely a result of the type of mechanisms that engineers and academics in the top six research intensive HEIs engage in, that typically consist of a much greater legal or contractual component.

Figure 2.3 Key internal factors constraining the knowledge exchange process



	All HEIs	Top 6	High	Medium	Low	
Lack of time in fulfilling all university roles	67	69	**62**	65	**76**	83
Bureaucracy and inflexibility of HEI administrators	39	**31**	35	42	**53**	26
Insufficient rewards resulting from interaction	28	26	28	32	29	19
Timescales required to meet external deadlines	27	24	29	23	32	36
Insufficient resources devoted to knowledge exchange/transfer by universities	24	**12**	21	25	**39**	30
Difficulty in identifying partners	21	20	19	24	22	26
Poor marketing, technical and negotiation skills of university knowledge transfer offices	19	17	16	23	21	17
Lack of capability of university staff	13	7	**8**	**21**	19	13
Difficulty in reaching agreement on terms of interaction (e.g. IPR)	12	**22**	13	8	**4**	4
Cultural differences	9	**15**	10	5	6	13
Number of respondents:	*917*	*166*	*341*	*238*	*152*	*21*

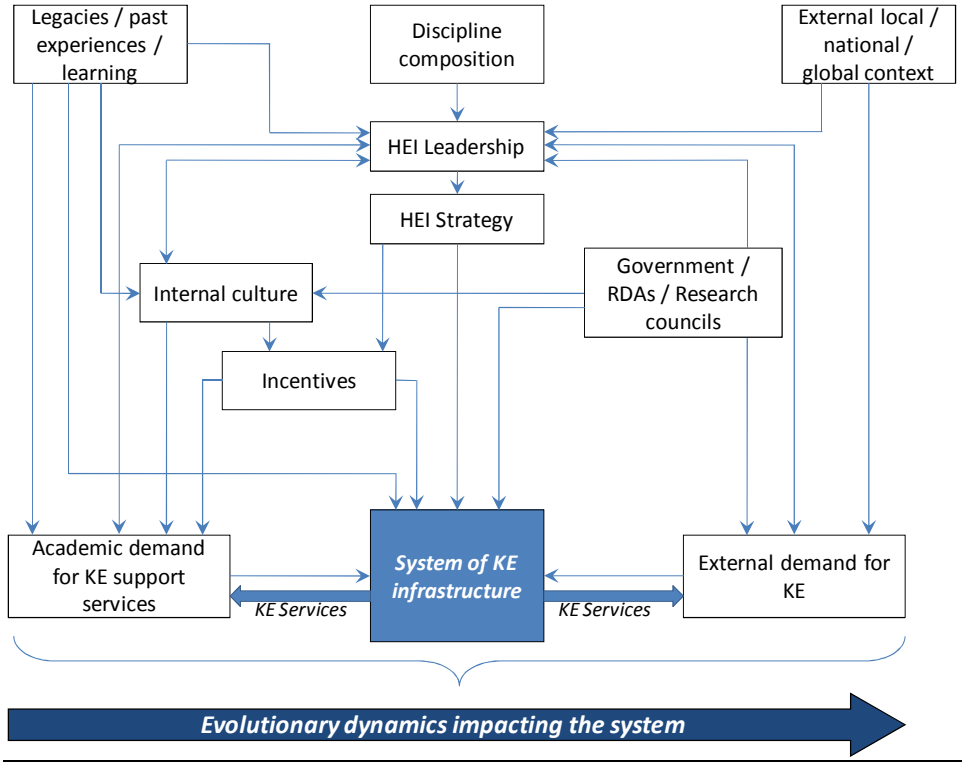
Note: A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the total (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

2.5.2 The data above provide only an indication of the effectiveness of the overall KE system. A separate working paper due in 2010 will explore the concepts of efficiency and effectiveness of the system of KE infrastructure in much greater detail.

3 Factors Shaping the System of Knowledge Exchange Infrastructure

3.1.1 The system of KE infrastructure is shaped by many different factors, internal and external to the HEI, which lead to different structures emerging across the HE sector. The key factors are summarised in Figure 3.1 and are the focus of this section.

Figure 3.1 The factors shaping the structure of the knowledge exchange system



Source: PACEC/CBR analysis

3.2 Internal context and culture

3.2.1 The internal context within HEIs differs substantially across the HE sector. Key differences include:

- Strategic missions vary from those that strive to be global leaders in research, to those whose key aim is more teaching focused to the rise of the 'entrepreneurial university'.
- The composition of academic disciplines differs greatly between HEIs with some offering a very broad range of subjects and others specialising in particular areas such as science and technology or the creative arts. Similarly, the quality of the research and teaching within the HEI varies substantially across the HE sector.
- The breadth and scale of mechanisms through which academics interact with the economy and society differs according to HEI type (PACEC/CBR, 2009, p. 139-141).

- HEIs have different levels of historical experience with KE and different current levels of academic capability to engage with external organisations
- HEIs have different geographical foci for their KE activities (Abreu et al., 2009, p. 46-47).

3.2.2 The culture, norms and values that exist within an institution, with regard to KE and its legitimacy as an activity for academics to pursue, will have a very large bearing on types of activities that thrive and hence the type of support academics may demand. PACEC/CBR (2009) showed that:

- There is now a supportive culture towards KE engagement at the senior management level in many HEIs.
- The majority of academics – approximately three-quarters of academics – believed that KE was considered a legitimate activity in their departments, with a modest change between 2001 and 2008.

3.2.3 Important drivers of cultural change include:

- Strong leadership actively embracing KE as an important activity for the HEI;
- Changing incentive structures including promotions and assessment criteria;
- Improved structures to help reduce the time burden of academics who wish to engage (e.g. establishment of funds to buy-out academic time);
- Increasing awareness of the benefits and value of KE and increased confidence to engage; and
- Infrastructural developments reducing the opportunity cost of engagement.

3.3 Leadership

3.3.1 Critical amongst the factors shaping the system of KE infrastructure is the leadership of the HEI. They determine both the strategic direction and design and implement the organisational structure subject to *expected* constraints. These constraints include:

- Internal context and existing capability and capacity of the institution
- Availability of funding
- Culture amongst academics towards different types of activities
- Past experiences of the HEI
- Government policy
- External demand for their outputs (broadly speaking, their outputs can be thought of as knowledge embodied in either people, including graduating students, academics, or codified in some form such as publications or reports).

3.3.2 The culture and beliefs of the leadership will therefore have a critical bearing on the strategies that are designed and how they are implemented, the wider culture that thrives in the overall organisation and the types of activities that flourish. Evidence provided by PACEC/CBR (2009) shows that:

- Strong support for KE as a core activity amongst most of the case study HEIs across all cluster types;
- A diversity exists within the HE sector in terms of the focus of HEI missions, strategic aims and the balance between research, teaching and KE;

- The prominence and importance attached to KE above and beyond the traditional mechanisms of publications and the teaching of students for the transmission of knowledge into external organisations differs across HEIs:
  - At one end of the spectrum, some HEIs continue to emphasize the importance of the traditional modes of knowledge transmission (publications and the teaching of students).
  - Other HEIs, while continuing to emphasize research and/or teaching excellence, are embracing alternative knowledge transmission mechanisms.

3.3.3 Cultural change at the leadership level has been driven by a number of factors including intensifying constraints faced by HEIs forcing them to seek income in addition to that received from government; government policies backed by resources made available by HEFCE and other funders; and increasing external demand for outsourced research and development, and training.

Incentives

3.3.4 The leadership of an HEI set incentives to help align the behaviour of academics and other staff with the strategic objectives of the institution. Over the past decade, there have been significant advances in the incentives for KE. PACEC/CBR (2009) showed that 74% of HEIs have improved their incentives for KE since 2001. The report identified a number of important incentive mechanisms including:

- Promotions and assessment criteria, impacting the types of academics that are recruited, retained and succeed within the HEI. They provide a very strong signal from the leadership of the values placed on different types of activities expected from academics;
- Celebration of successes to provide acknowledgement and recognition to academics for their efforts to deliver economic and social impacts;
- Financial incentives for intellectual property (IP) generation;
- Incentives for consultancy activities making it easier and more beneficial for academics to engage;
- Incentives to relieve the time pressures facing academics to allow them to engage in KE activities without compromising their research or teaching duties; and
- Bringing KE explicitly within the workload planning system.

3.4 Internal and external demand for knowledge exchange support

3.4.1 Knowledge exchange units should only exist if there is demand for their services by their users. Ultimately this means that the existence of a particular KEU is determined by the demand by external organisations for the KE outputs that it facilitates the production of.

3.4.2 The economy has witnessed a shift towards the outsourcing of research and development (R&D) by external organisations and towards the open innovation paradigm (e.g. Chesbrough, 2003). In addition to R&D, anecdotal evidence suggests that external organisations are also increasingly looking externally for training and staff development needs, as well as looking to cut costs of development through

leasing or renting equipment that is not likely to be fully utilised (e.g. test rigs, wind tunnels, digital design studios etc.). This creates the *potential* for HEIs to benefit from this increased trend towards outsourcing and open innovation. However, according to statistics on gross expenditure on R&D by business enterprise (Office of National Statistics), the amount of outsourcing to HEIs by businesses in the UK is still very low at 2.5% of their total R&D expenditure.

3.4.3 In turn, even if external demand for KE outputs exists, the academics responsible for delivering this output must be willing to engage with the unit (or, in some circumstances, mandated or incentivised to do so). Key factors influencing this internal academic demand include:

- Culture towards KE;
- Awareness of academics of the available support;
- The incentive structures ;
- Policies influencing the nature of the KE process (e.g. mandating that all licensing activity goes through a technology transfer office);
- Past experiences of academics with KE (i.e. do they have confidence to engage on their own);
- Perceived capabilities and capacity of the KEUs to provide the necessary support.

3.4.4 The PACEC/CBR survey of academics 2008 explored the extent to which academics have been in contact with the university's "knowledge or technology transfer office or consultancy services office" (i.e. one part of the overall KE infrastructure). The evidence is presented in Table 3.1.

Table 3.1 Engagement with knowledge transfer office, technology transfer office, or consultancy services office within the last three years (% academic respondents)

	All academics	Selected subjects				Selected positions	
		Engineering / Technology	Social sciences	Business / Finance	Humanities / Languages	Professor	Lecturer
No contact	45	**13**	**60**	**27**	**66**	**33**	**51**
Rarely (1-2 times)	22	**34**	17	24	15	24	23
Occasionally (3-11 times)	19	18	17	**31**	10	20	18
Frequently (12 or more times)	12	**34**	**4**	14	**5**	**21**	**6**
Not aware of these services	2	1	3	4	4	2	2
Number of respondents	967	85	99	48	135	347	418

Note: A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the total (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

3.4.5 The survey shows that the use of knowledge exchange offices varies significantly across disciplines, with engineers and technologies engaging most frequently (34%) compared with those in the social sciences (4%) and humanities/languages (5%). This is likely to be partly associated with the types of KE activities undertaken by the different academic disciplines, with those in engineering perhaps requiring a significantly larger proportion of contract, legal or IP support (Abreu et al., 2009).

3.4.6 In addition, the survey showed that

- Academics that use these offices frequently are also more likely to undertake KE through a larger number of mechanisms (those who do not engage with these offices undertake KE through approximately 5 mechanisms compared to 11 mechanisms for those who engage frequently).
- Compared with academics who do not engage with these offices, academics that frequently engage are more likely to undertake the following KE mechanisms[3]:
  - Patenting
  - Spin-outs
  - Licensing research
  - Prototyping and testing for external organisations
  - Enterprise education
  - Forming or running a consultancy
  - Participation in consortia involving external organisations
  - Provision of community based performance arts
  - Consultancy
  - Participation in standard setting fora
  - Contract research

3.5 The constraining effects of legacies

3.5.1 While past experiences with KE can provide valuable learning for organisational design, legacies, for example acting through institutional memory or through the historical power built up by individuals in areas, can also constrain the adaptation of the system of KE infrastructure to changing internal and external demands. For example, if the technology transfer office was historically ineffective, it is likely that, despite significant changes and improvements, academics may still associate it with its past operation. The unwillingness of academics to engage with it will constrain demand for its services thus making it more difficult for it to evolve, learn and improve.

[3] Based on the ratio of the share of academics who engage with the KE unit frequently undertaking a particular KE mechanism to the share of academics who do not engage with the KE unit undertaking the same KE mechanism

4 Conclusions

4.1.1 The knowledge exchange (KE) system is evolving to meet and growing need for KE support services. These needs are being driven by the increasing emphasis being given to KE by HEIs in their overall strategy development. Academics are engaging in KE in wide variety of ways and participation rates are high. Notwithstanding, they are demanding more information and support for the different modes of engagement which are emerging. Participation is taking place through a diverse set of mechanisms, well beyond the commercialisation mechanisms in science, technology, engineering and mathematics (STEM) subjects that have received much of the attention in the past. In addition, the *potential* market for HEI KE looks promising, with a shift towards outsourced research and development as well as training, although HEIs still need to work more closely with businesses and other external organisations to demonstrate the value added they can deliver.

4.1.2 To meet these needs of academics, HEIs, supported by government funding through HEROBC and HEIF, have responded by greatly expanding their capacity and capabilities with a diverse and imaginative set of initiatives and KE support functions. We have grouped these functions into five broad categories: support for the translation of all types of research; skills and human capital development; stimulating interactions between academics and external organisations; facilitating the exploitation of the physical assets of HEIs; and support for engaging with the community and society.

4.1.3 Organisational structures of HEIs have also adapted to this expansion of KE activity and again a striking feature is the diversity of response and the extent of HEI experimentation. For some HEIs the organisational response has been to increase the specialisation of knowledge exchange units (KEUs) through a process of 'vertical disintegration', for others to rationalise and consolidate to a smaller number of KEUs. These different organisation changes reflect the learning by HEIs of how to improve the support delivered and the shifting leadership priorities and objectives mediated by factors such as the availability of funding, government policy, subject composition, internal culture, the existing capability and capacity of academics and importantly, and the legacy of past engagement in KE.

4.1.4 Critical to the success of these organisational responses, and the overall efficiency and effectiveness of the KE system, is the need to ensure adequate interactions between different KEUs where they may be mutually beneficial and to the advantage of the system as a whole.

4.1.5 The overall system of KE infrastructure has witnessed a large amount of experimentation over the past decade as HEIs seek to improve their support to the KE process, as well as in response to the changing terms of different funding streams. However, academics still perceive important constraints with the overall system of infrastructure, particularly in lower research intensive HEIs, including bureaucracy and inflexibility of HEI administrators and a lack of capability of university staff. Difficulties with intellectual property agreements appear to be mainly confined to specific disciplines rather than being pervasive across all subject areas and all HEIs.

References

Bryan, L.L and Joyce, C.I. (2007) *Mobilising Minds*. London: McGraw-Hill

Chesbrough, H. (2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press

Abreu, M., Grinevich, V., Hughes, A. and Kitson, M. (2009, p. 46-47) *Knowledge Exchange between Academics and the Business, Public and Third Sectors*, a report by the UK~IRC

Shattock, M. (2009) *Entrepreneurialism in Universities and the Knowledge Economy: Diversification and Organizational Change in European Higher Education*, Society for Research into Higher Education & Open University Press

PACEC (2008) *Higher Education Innovation Fund Round Four Institutional Strategies: Overview and Commentary*, a report to HEFCE, report 2008/35

PACEC and Centre for Business Research (2009) *Evaluation of the Effectiveness and Role of HEFCE/OSI Third Stream Funding*, a report to HEFCE, report 2009/15