

# UK University–Industry Relations: Multiple Modes of Knowledge Exchange

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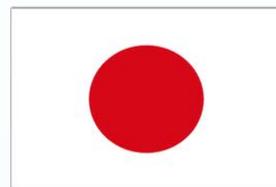
Technology Management for Innovation  
Faculty of Engineering  
University of Tokyo

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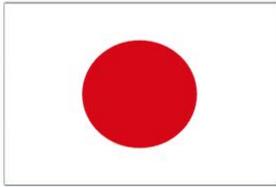
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  - Variety of interactions beyond IP / co-publication – well acknowledged
  - Questionnaires appear useful for obtaining clearer picture

# Key Indicator Snapshot



	UK	Japan	USA
GERD (2011)	39 627.15m	140 958.52m	415 193.00m
GERD/GDP Intensity	1.77%	3.26%	2.77%
% of GERD by HE Sector	27%	11%	15%
% of GERD by Industry	48.5%	75.3%	61.6%
% of HERD by Industry	4.11%	2.63%	5.21%

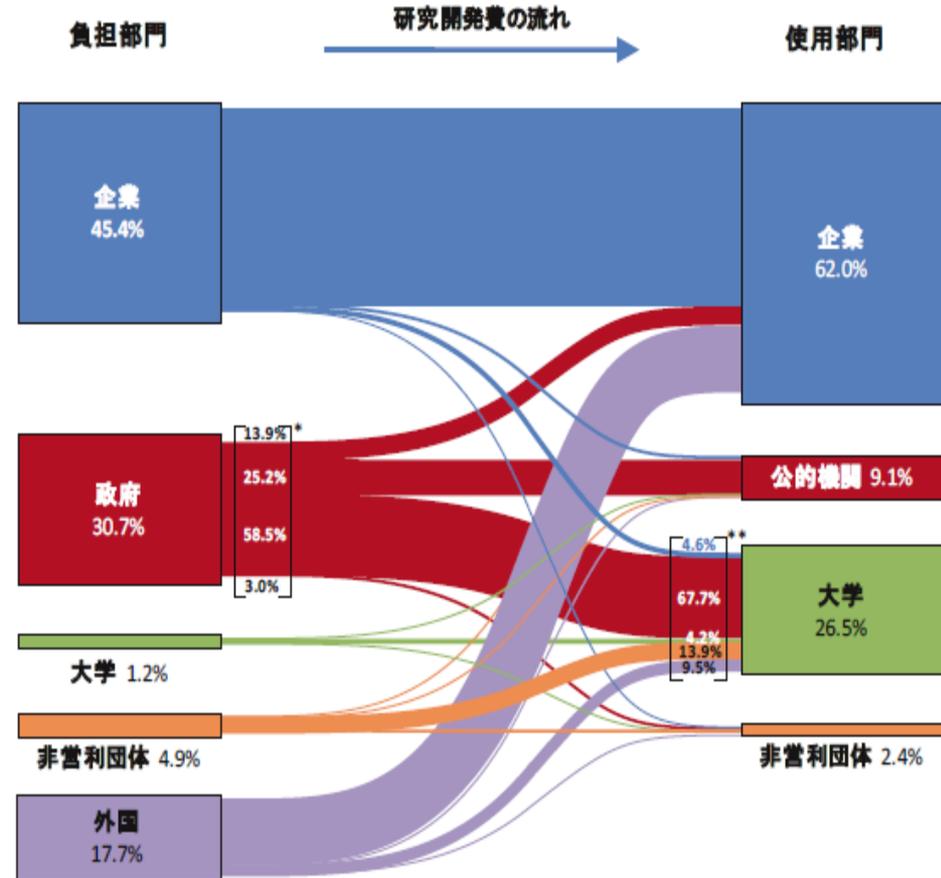
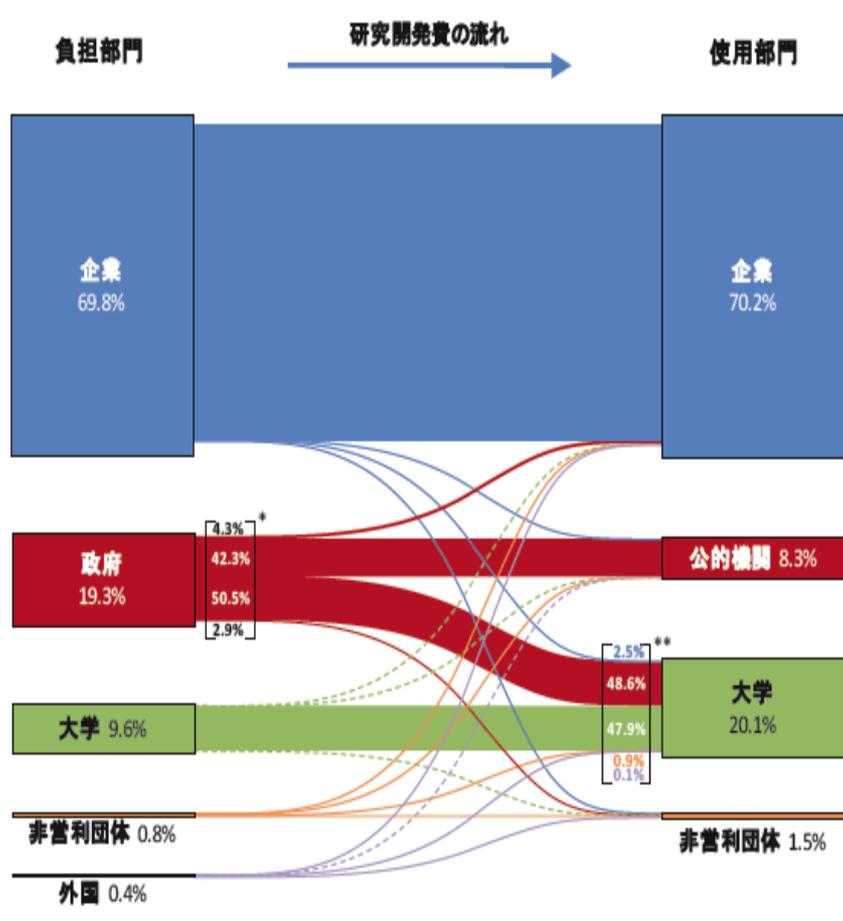


(A)日本(2010年度)

# R&D Expenditure Flows



(E)イギリス(2009年)

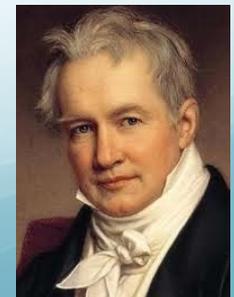


# Nature of Universities?

1. Teaching

1. Research

2. and ... Innovation



# Universities in the UK

165 Higher Education Institutions (HEIs)

115 Universities

– Quite a lot of diversity across the range of institutions

Informal groupings	Institutions
Russell Group	24 Top institutions: Oxford, Cambridge, UCL, Manchester, Bristol, Edinburgh, etc.
Pre-1992	Warwick, York, Surrey, Sussex, Lancaster, Essex, UEA, Loughborough, SOAS etc.
Post-1992	Many former polytechnics; former specialist colleges or institutes

# UIL Publication Trends

**413** results (1980–2011)

Perkmann et al., (2012)  
search of UIL articles.

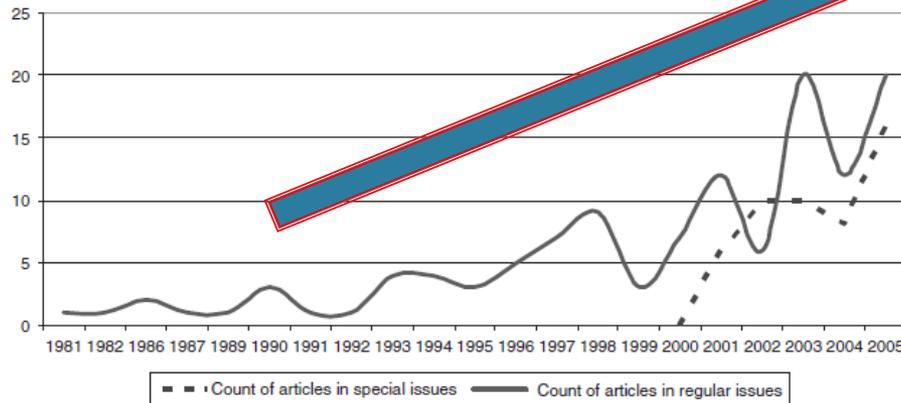


Figure 1 University entrepreneurship articles published per year in regular issues versus special issues, 1981–2005.

**173** articles (1981–2005)

Rothaermel et al. (2007)

Keyword search of databases (Proquest's  
ABI/Inform, Business Source Premier, and  
EconLit)

# (Some) Literature on Multi-Modal UIL

Benefits of publicly funded research are real and substantial – but come in a variety of forms: trained researchers; tacit knowledge; networks; instrumentation and methods etc.

*Salter and Martin (2001)*

Much of the literature on university–industry technology transfer has centred on intellectual property rights (IPR), academic spin– offs, licences and royalties.

*Patel and D'Este (2007)*

“the state of knowledge [on knowledge transfer] remains relatively fragmented and tentative”.

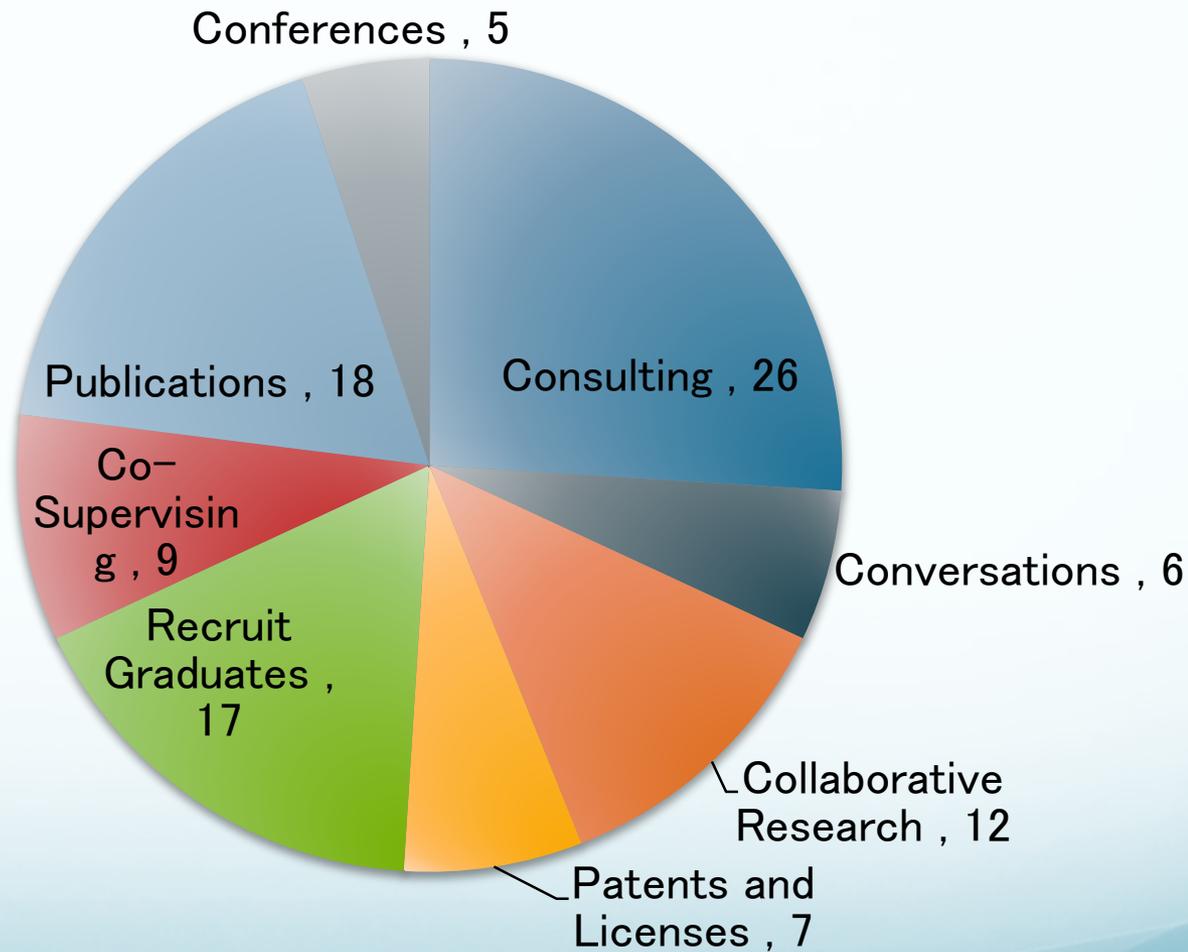
*Perkmann et al. (2012)*

Most coverage is on science, technology and mathematics disciplines.

*Hughes and Kitson (2012)*

# Putting Patents in Context

Interviews and  
Survey with faculty  
at MIT (n=68)



# External Sources of Knowledge for Innovation

60 interviews with 31 companies

	With Other Companies			With Public Sector Research		
	Bio	Ceramics	Parallel Computing	Bio	Ceramics	Parallel Computing
<b>Technical Product Innovation</b>	Formal	Formal (some tacit)	Formal (some tacit)			Formal and Tacit
<b>Research Equipment</b>	Tacit	Tacit	Formal and Tacit	Tacit	Tacit	

# Recent Studies on UK Multi-Modal UIL

- A lot of them have not been published as academic articles – if so, there is a delay of a few years
- Main data source:
  - Higher Education Business Community Interaction Study (HE-BCI)
- Studies and assessments by consultancies or as commissioned research:
  - PACEC studies on institutional changes & HEIF
  - Studies on academics – large scale survey (Abreau et al. 2010; Hughes 2009; Kitson 2012)
  - Studies on industry – EPSRC programmes (D’ Este 2004; Bruneel et al. 2009)

# Sources of Multi-Modal UIL: Funding System

# Supportive context

- “Now strong support for the third stream mission by senior management across all HEIs” (PACEC 2009)
- Why?
  - Policy support at government level
  - Funding support (HEIF)
  - Support within the institution (Vice Chancellor & Management)
    - Vice Provost for Enterprise (UCL)
    - Pro-Rector Enterprise (Imperial College)
- More academics now perceive a positive culture towards knowledge exchange than before.
  - 2001: 61%
  - 2008: 75%

# Higher Education Innovation Fund (HEIF)

- Dedicated pot of funds for “knowledge exchange”
- Began in 2001
  - 2011–2015: 150m per year (219億) (601m total) over 4 years
- Science and Investment Framework 2004–2014

	HEIF 4 (2008–11)	HEIF 2011–14
Number of Institutions receiving funds	129 (all)	99 English HEIs
Max / Min. funding per institute	Max: 1.9m Min: 100k	Max: 2.85m Min: 254k
Funding allocation method	Partly on income performance (HE-BCI data); capacity building	Solely on income (x2 for SMEs)

# HEIF: Institutional Strategies for Funding

- Universities submit institutional strategies to obtain funding
- Make changes to their strategies and plans over the four year funding period
- Previously project based, now institutions develop own strategies.
  - Diversity of approaches
  - Institutional Embeddedness
  - Build capacity in the institution – now more on performance

**Can use the funds across a range of activities**

# Types of UIL Activities

## *Knowledge exchange support functions and infrastructure*

### ***Facilitating the research exploitation process***

Access points for external orgs  
Business development  
Technology transfer  
Consultancy support  
Contracts / legal support  
Patenting / IP advice  
Corporate Relations  
Press / communications  
Investment funds  
Marketing  
External fundraising for research

### ***Skills and human capital development***

CPD / short courses  
Lifelong learning  
Careers services  
Work placements / project experience  
Joint curriculum development

### ***Social enterprise / entrepreneurship***

Social enterprise  
Enterprise and entrepreneurship training

### ***Stimulating interactions***

Provision of public space  
Alumni networks  
KE professional networks  
Staff exchanges  
Academic – external organisation networks

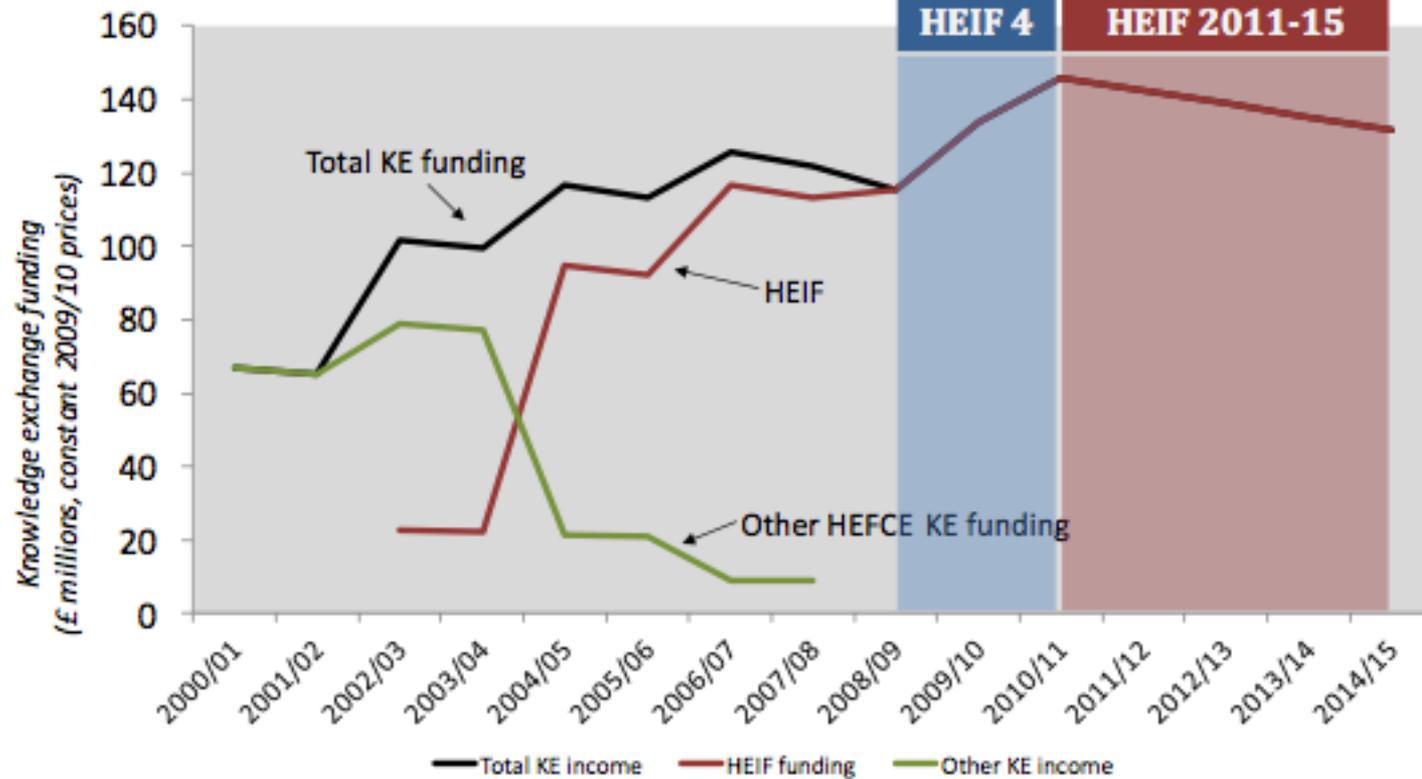
### ***Exploiting the physical assets of the HEI***

Science parks  
Incubators  
Facilities / equipment

### ***Supporting the community / public engagement***

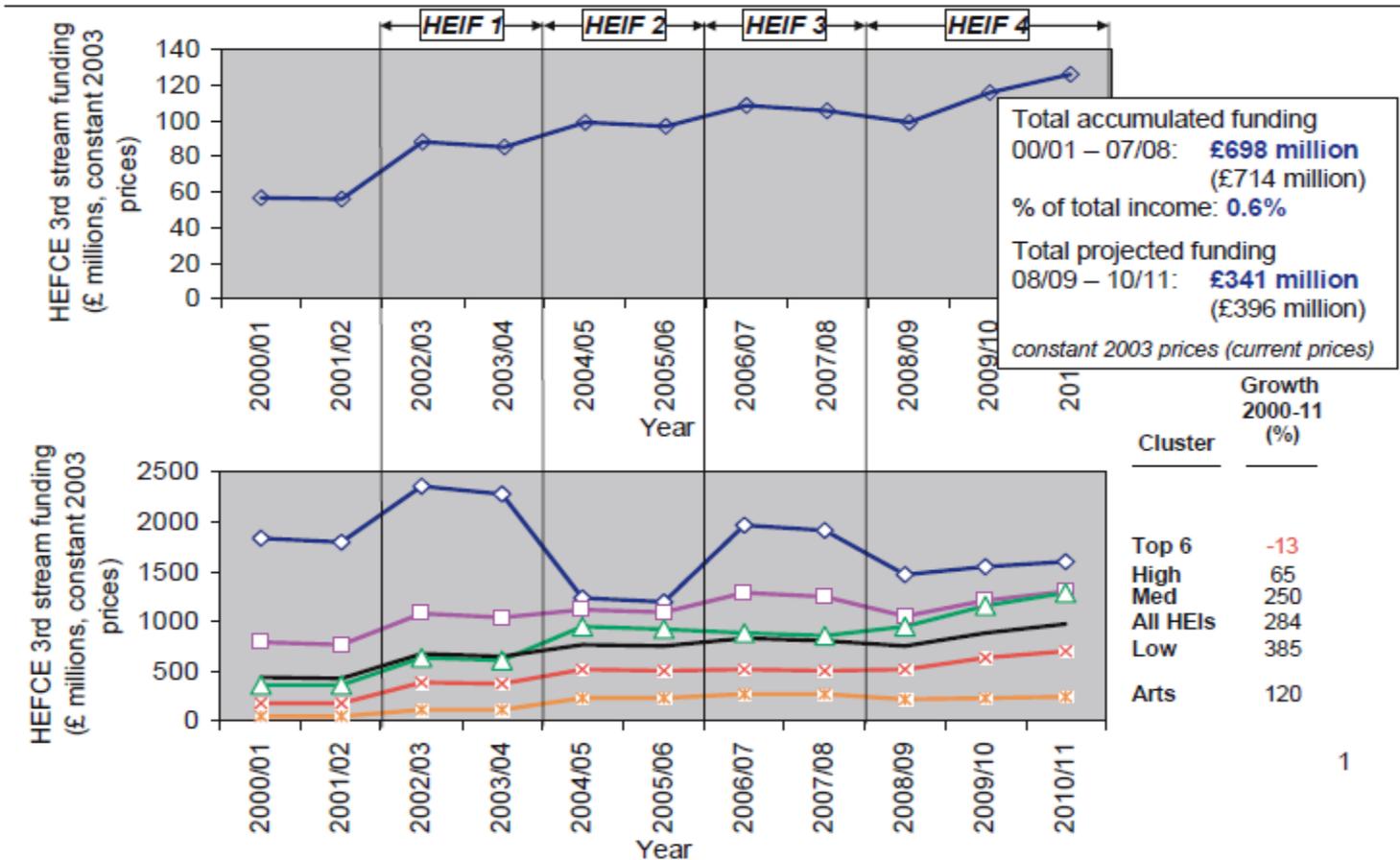
Outreach  
Volunteering  
Widening participation  
Awareness raising  
Involving public in research  
Social cohesion / community regeneration

# Evolution of HEIF Funding



# HEIF: Distributions

**Figure X1 Evolution of HEFCE third stream funding 2000/01 to 2010/11 (£ millions, constant 2003 prices)**



# HEIF Best Practice Examples from HEFCE

- Cranfield Univ. – Strategy
- Exeter Univ. – Open Innovation
- Hertfordshire Univ. – SME engagement
- Manchester Univ. – Student Employability
- Newcastle Univ. – Professors of Practice
- Oxford Univ. – linking research with practice
- Staffordshire Univ. – Local economic development

# Review of HEIF

- KE now finally looks to be permanently embedded within many HEIs
- “No one size fits all” – lots of variety and experimentation
- Allowed the universities to take a longer term perspective
  - rather than one-off projects
- *Still some barriers noted on Univ. / industry sides ... but that is another talk...*

# Data Availability on Multi-Modal UIL

# Data on UIL: HE-BCI

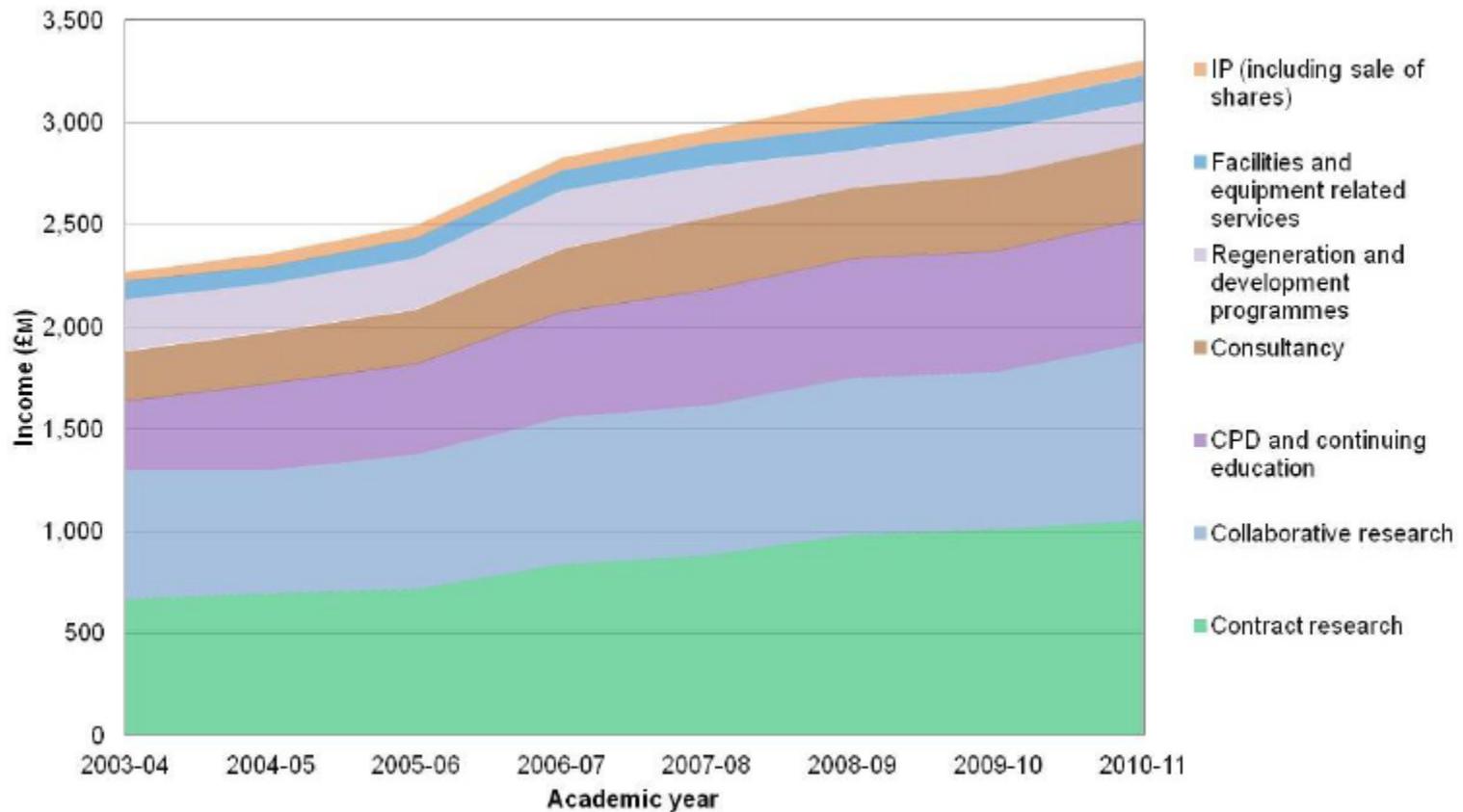
- Annual survey since 1999
  - Now implemented by the Higher Education Statistics Authority (HESA)
  - Survey to all HEIs in the UK
  - Data made available in report
  - Possible to obtain dataset from HESA (but at cost)



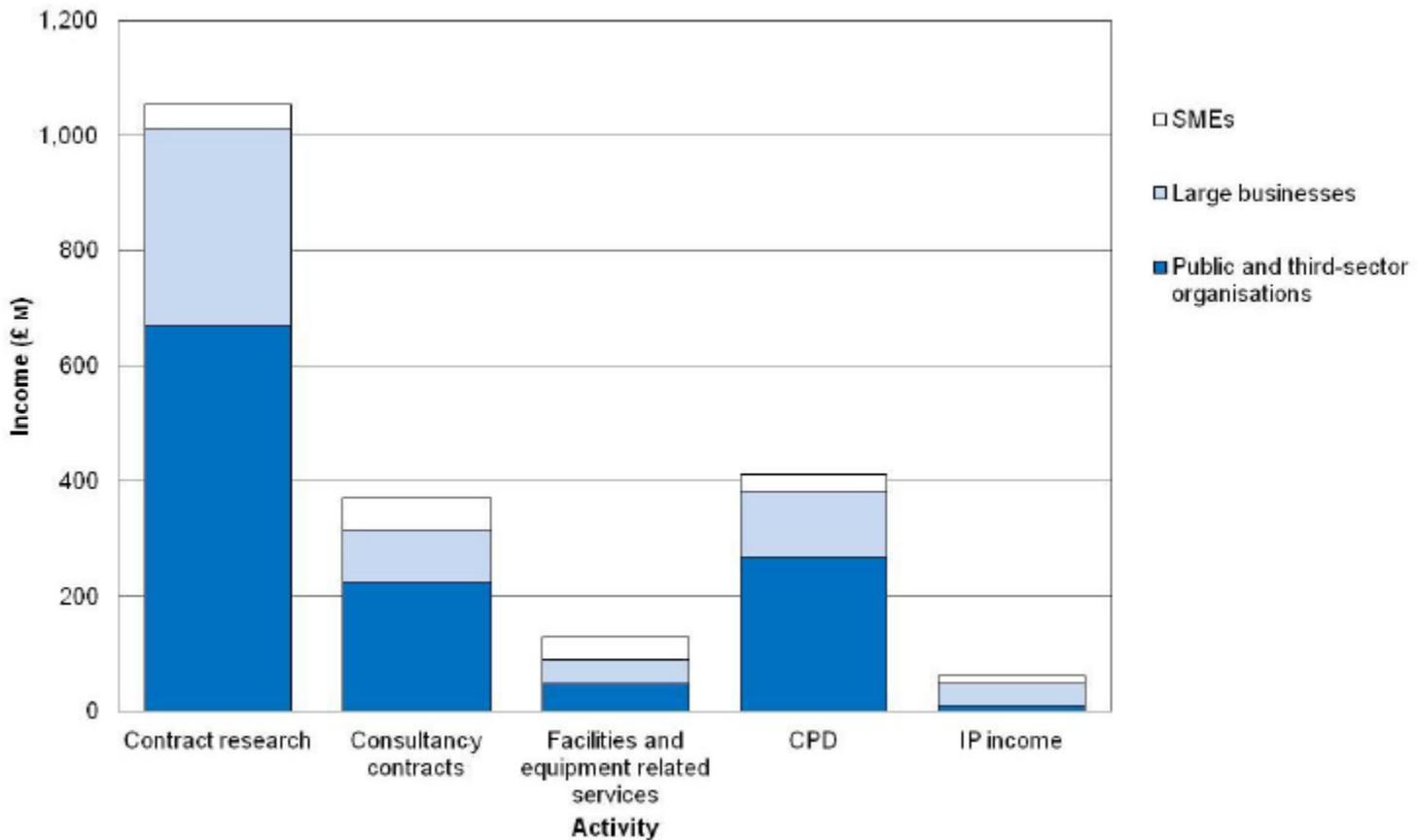
# 2010–11 HE–BCI Report

- 159 institutions responded to the 2010–11 round
- Covers:
  - Contract Research
  - Consultancy
  - Equipment and facilities
  - Regeneration
  - IP Income
  - Non–credit bearing courses (e.g. professional development)
- Stability in questions over time
- Very similar to the data collected by MEXT

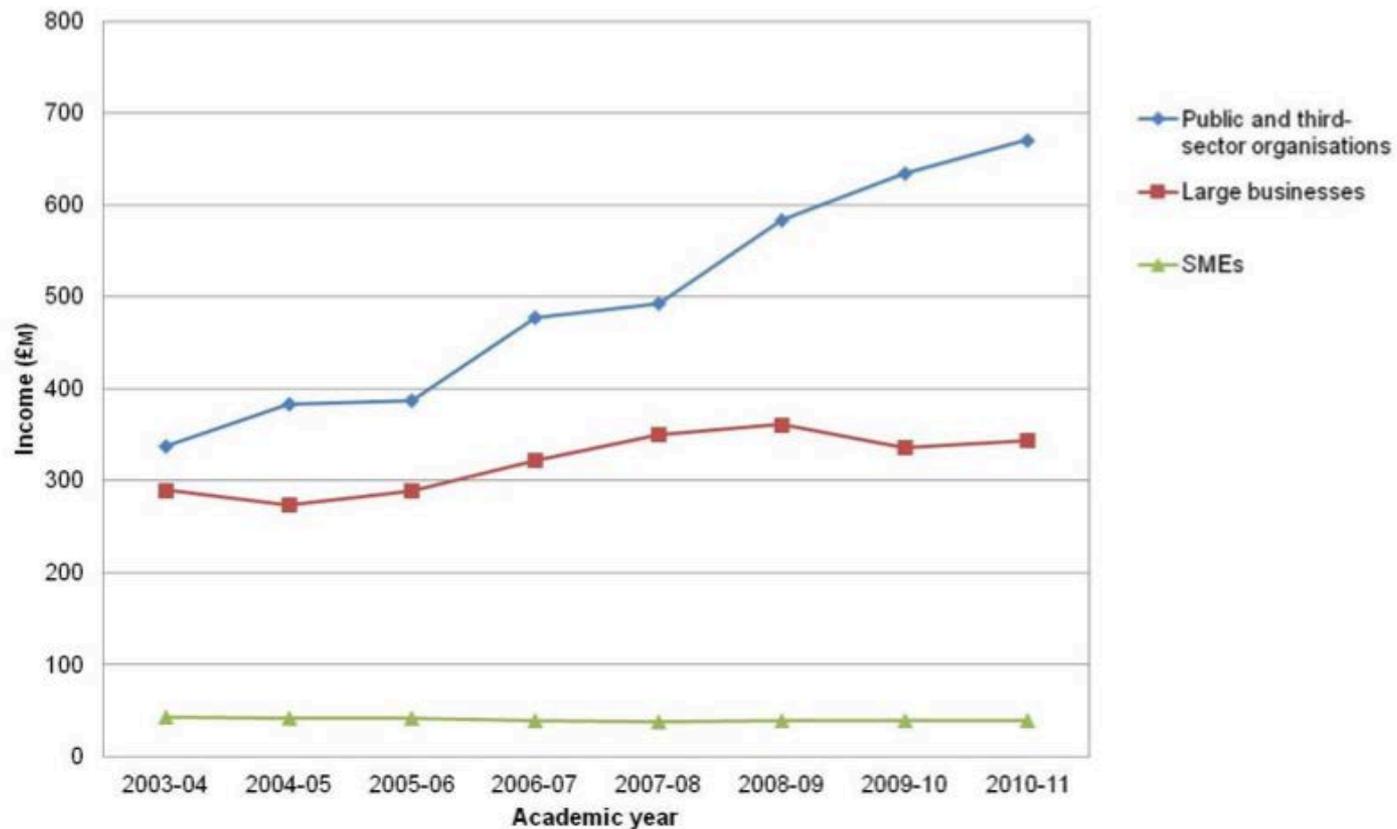
# UIL Income 2003–11



# Interactions with different partners

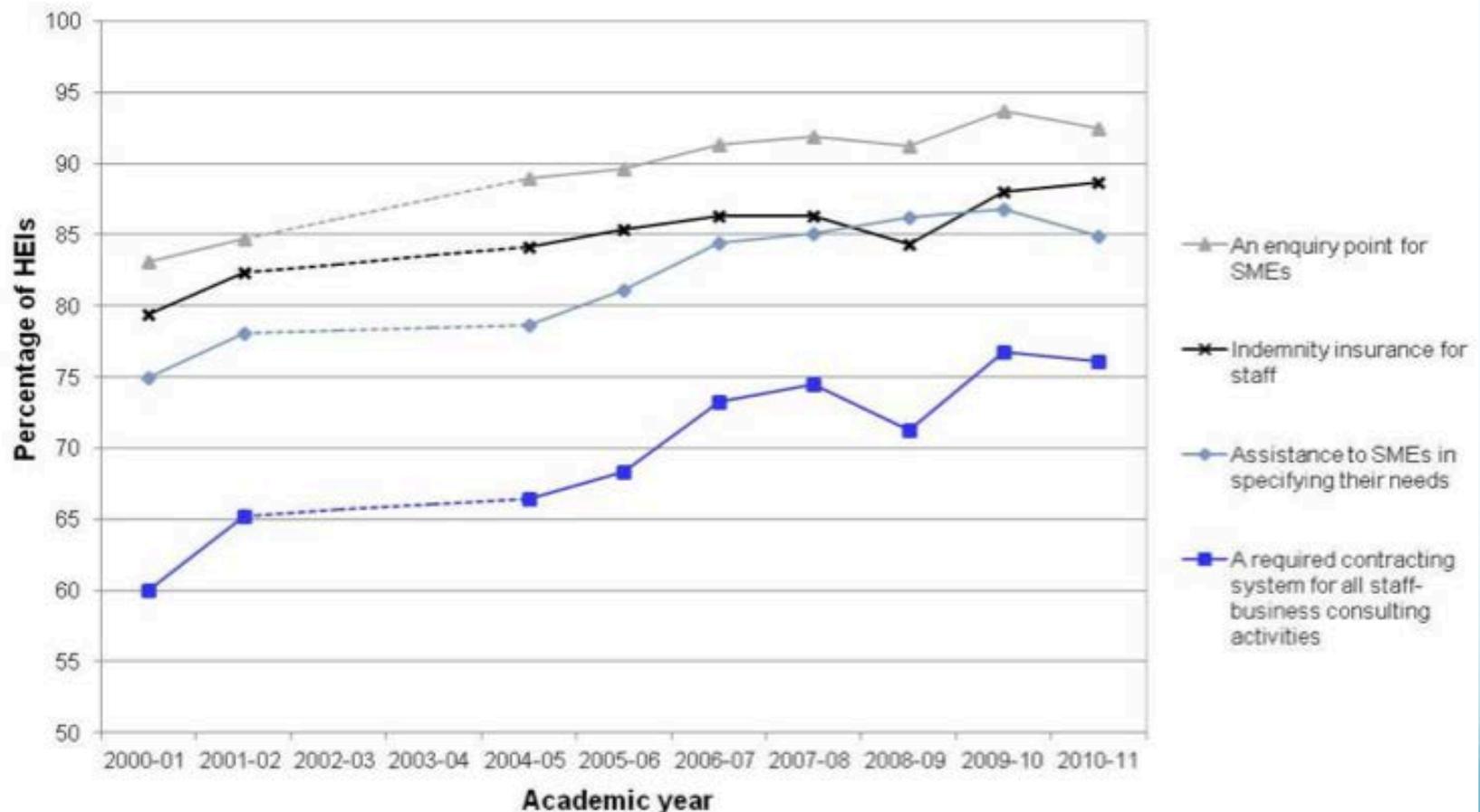


# Contract Research Income



# Types of Infrastructures

Figure 5 Selected infrastructure indicators (2000-01 to 2010-11)



*“Evidence of a much wider set of knowledge exchange mechanisms than is captured by HEBCI”*

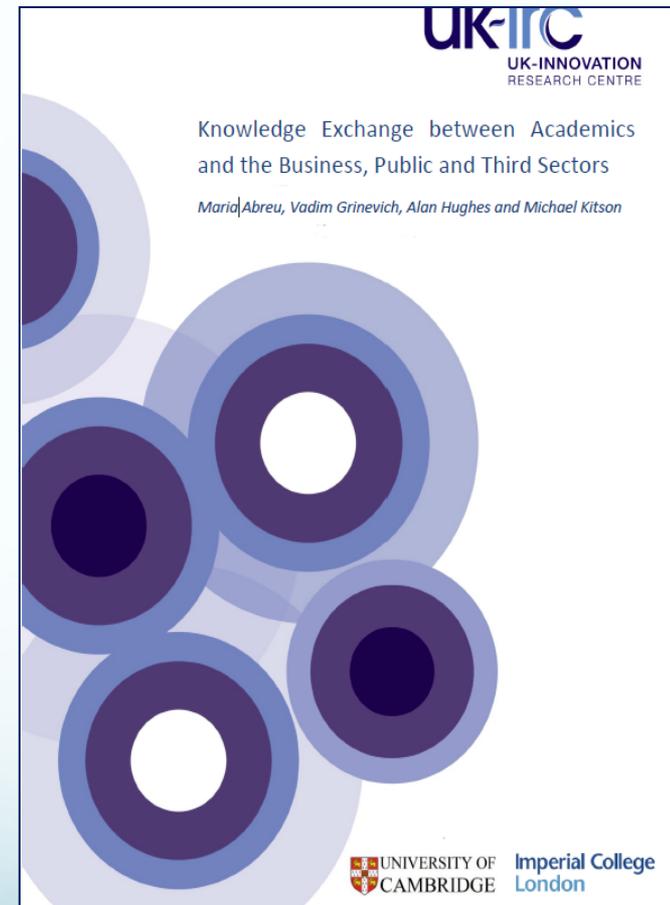
PACEC (2012)

# Abreau et al. (2010) studies

- University of Cambridge / Imperial College London studies
  - Funded by the ESRC (2007–9)
  - Cost £499,437 (¥71.3百万)

Two Studies:

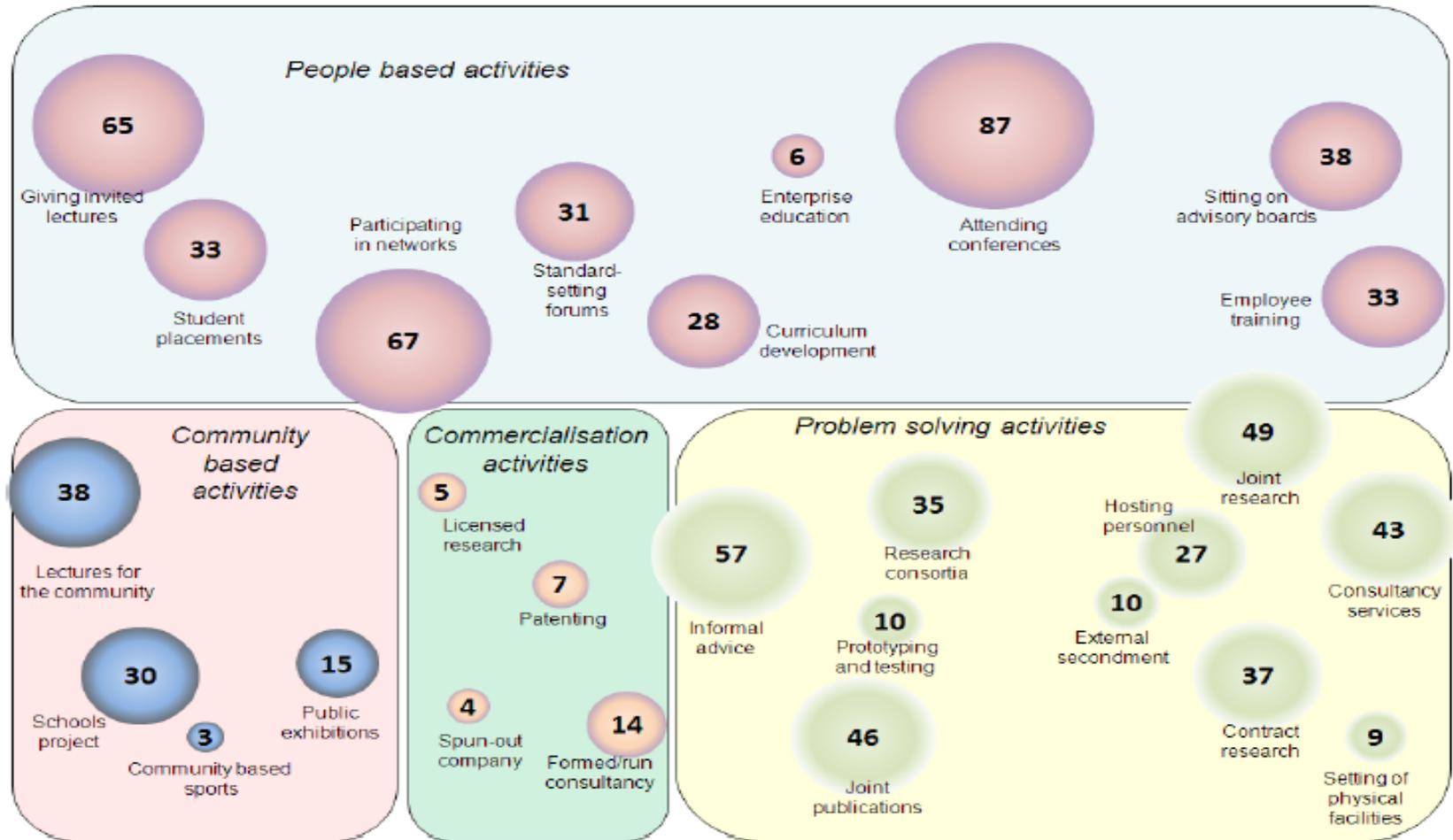
- UK Academics
- UK Businesses
- Published in the Cambridge Journal of Economics (2012)



# Response Distribution

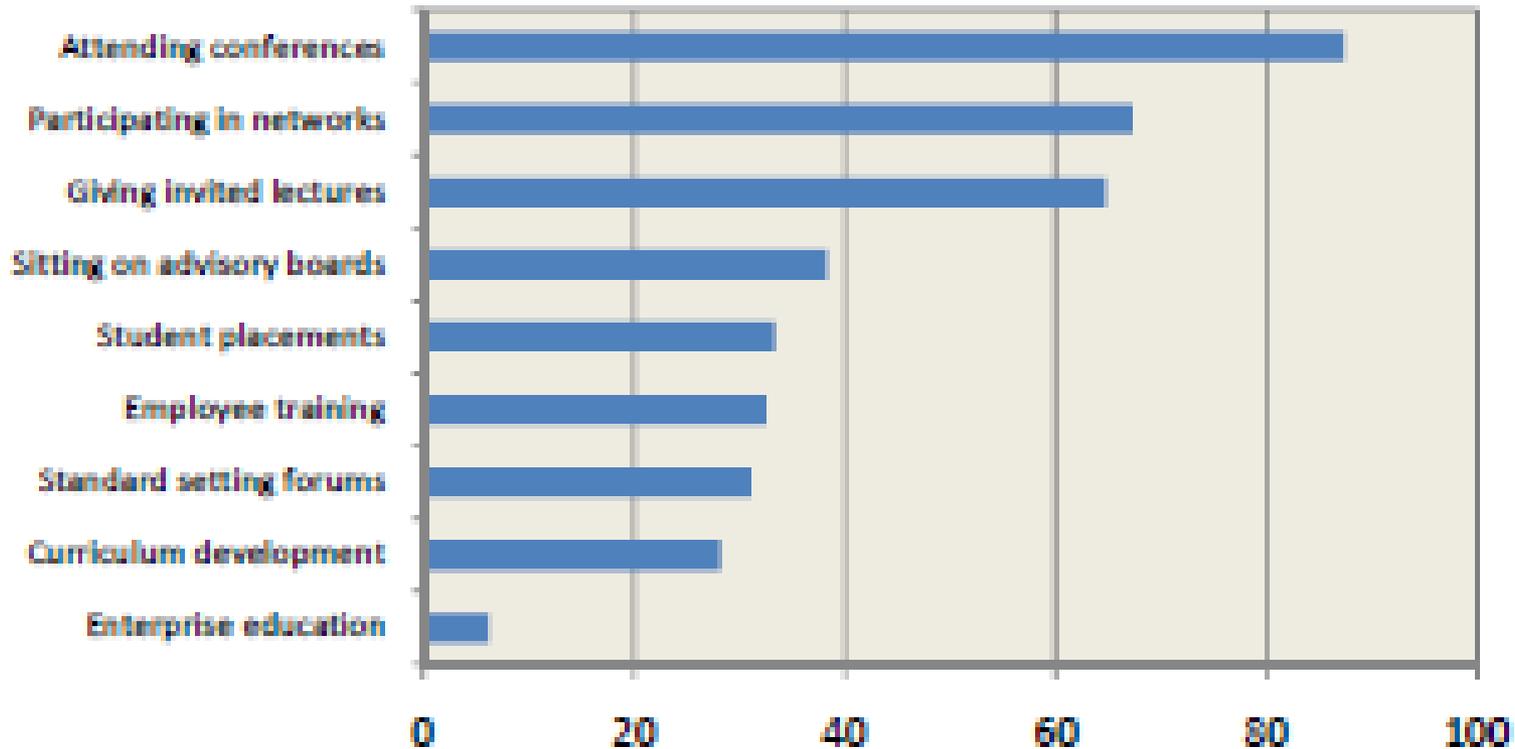
Discipline	All (N)	Sex (%)		Seniority (%)		
		Male	Female	Prof.	Reader / Senior Lecturer / Lecturer	Other
Health Sciences	3,623	44.7	55.3	18.6	53.8	27.5
STEM	7,590	72.8	27.2	20.0	44.8	35.2
Arts & Hum.	3,680	55.1	44.9	19.8	61.0	19.3
Soc. Sci.	7,236	56.6	43.4	20.4	60.1	19.5
<b>Total</b>	<b>22,129</b>	<b>60.0</b>	<b>40.0</b>	<b>19.8</b>	<b>54.0</b>	<b>26.2</b>

# Academic External Interaction Activity (%)



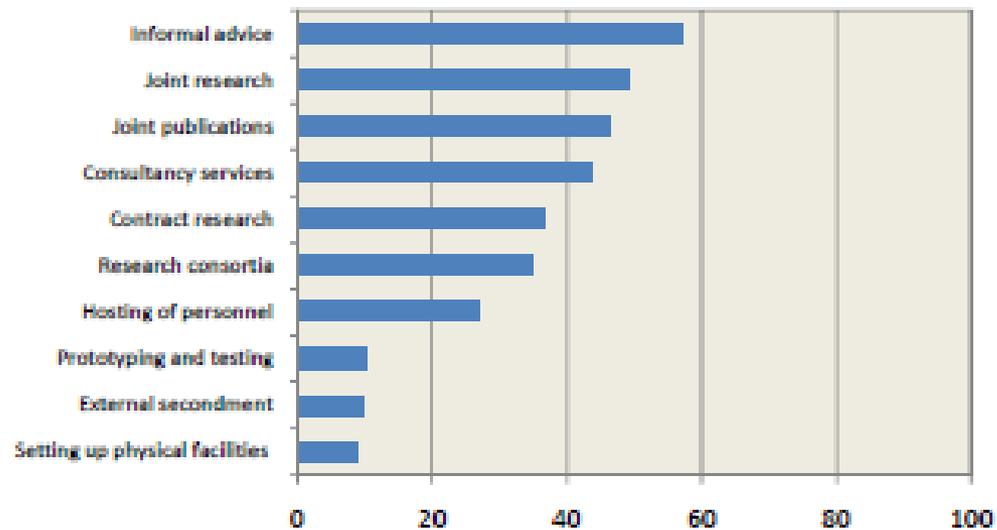
# Academic Engagements

## People based activities (% of respondents)



# Academic Contributions

Exhibit 12 Problem solving activities (% of respondents)



# Interactions by Field & Activity

Exhibit 14 Highly intensive interactions (% of respondents)

Exhibit 14a People based

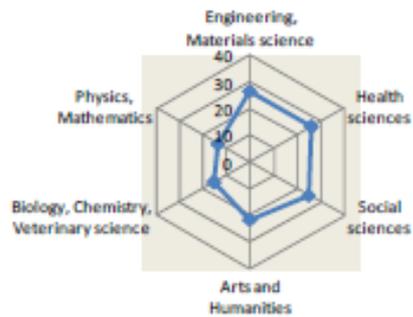


Exhibit 14b Problem solving

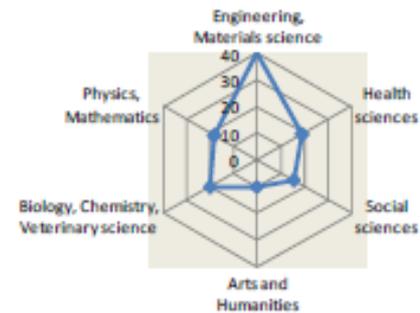


Exhibit 14c Community based

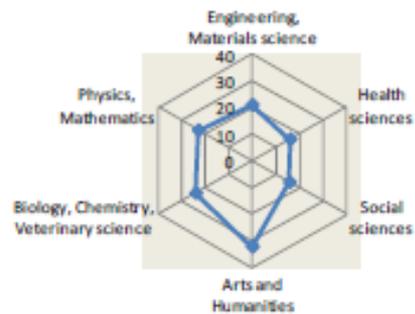
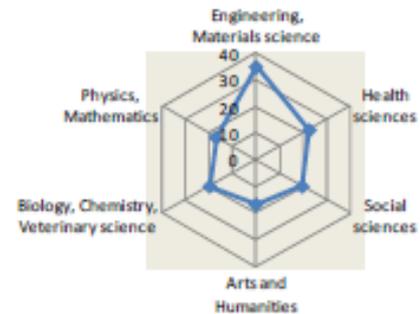
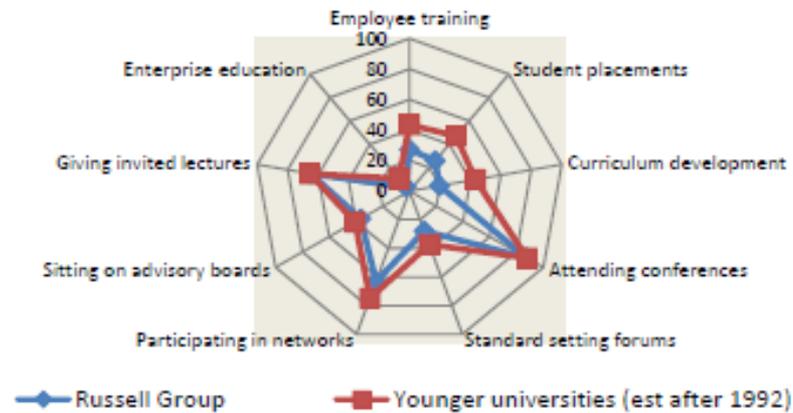


Exhibit 14d All interactions

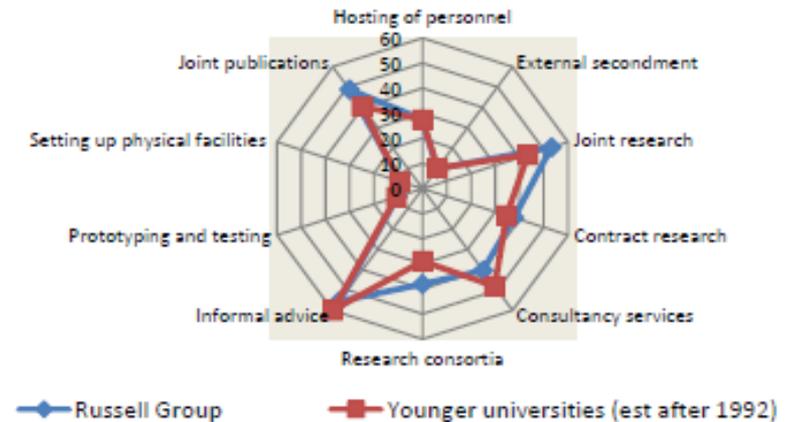


# Institution Types & Engagement

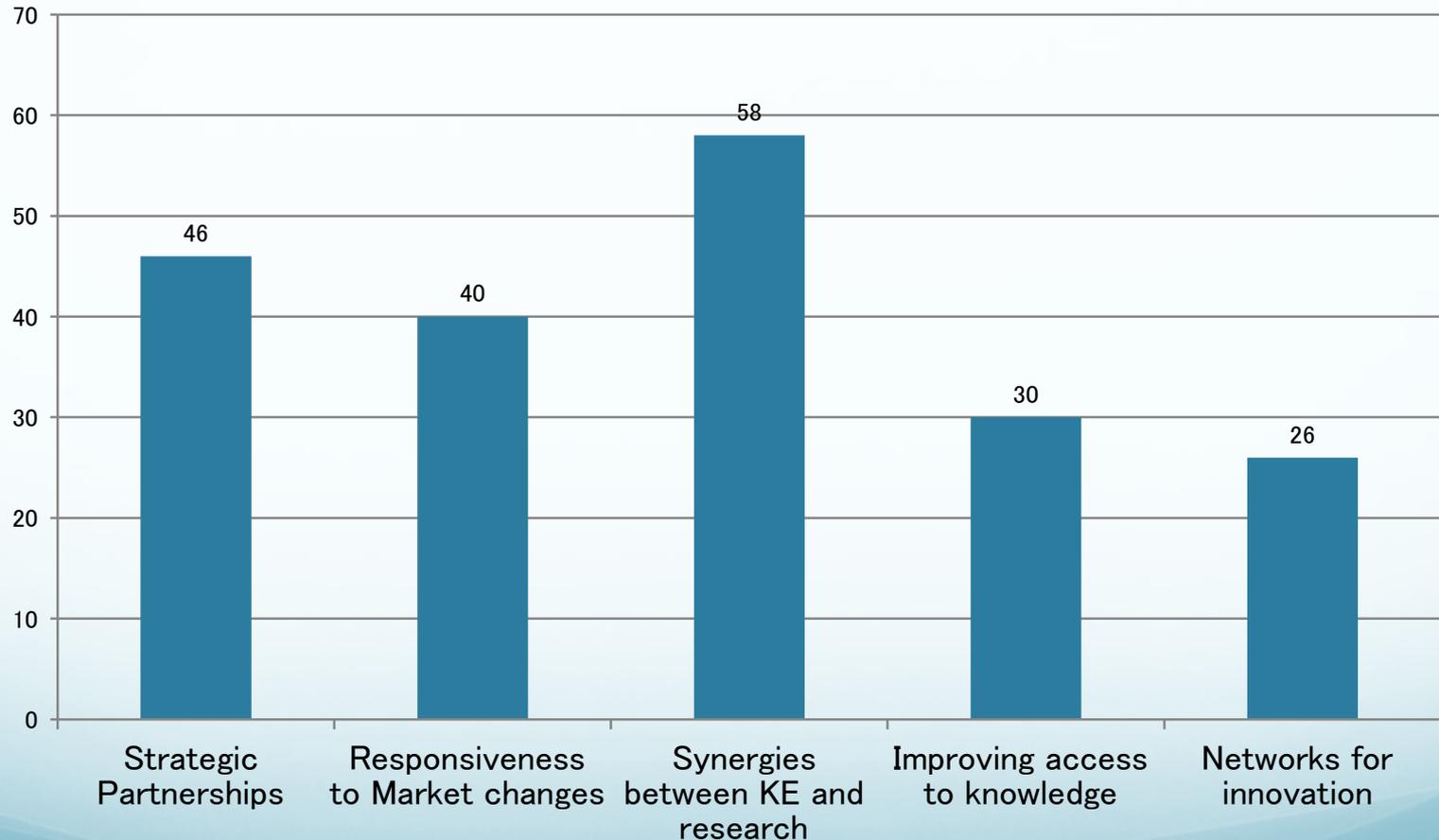
People based activities by institution (% of respondents)



Problem solving activities by institution (% of respondents)



# University strategies for UIL



# Cranfield University: Strategic Partnerships

## Strategic partnerships

Home > Business > Strategic partnerships



Cranfield University works with a wide range of private, public and SME to multinationals. Work with these organisations (part and full time), research consultancy and long-term contracts.

Our partners see us as a valuable extension to their own organisation and are able to benefit from our knowledge, facilities and flexible working arrangements.

Whatever way you choose to partner with us, you will benefit from our knowledge transfer and improving the performance of your organisation.

### Types of partnerships:

- Licensing and joint IP development
- Bilateral Partnerships
- Open Innovation Clubs
- Open Innovation Centres
- Gateways



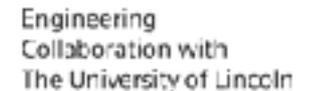
- Rolls Royce:
  - Gas Turbine Engineering and Technology Group
    - MSc Thermal Power
    - Doctoral research
    - Continuing Professional Development courses.
  - University Technology Centres
    - Long term research on aircraft engines
    - UTC Master and Doctoral students

# Siemens & University of Lincoln

- Started with a collaborative research framework
- Co-located in the Engineering department
- “Principal Partner”
  - Teaching of students & providing scholarships
  - Internships, consultancy projects
  - Co-design of an MSc on Energy Renewables and Power
  - Staff training



SIEMENS



Engineering  
Collaboration with  
The University of Lincoln



# BAE Systems – Bristol University

- Memorandum of Understanding
- Engineering and Science
- Covers wide range of activities
  - Long term research projects
  - Medium / short term projects
  - Staff secondments
  - Project / Thesis supervision
  - Placements for students (MSc. PhD etc.)



# Staff Exchanges

- Small number of universities are implementing such schemes (Pacec 2012)
- Outward (professor to industry) & inward exchanges
- “Professors of Practice”

## Involvement in Newcastle Science City

The Professors of Practice play a central role in the work being done by School and University for Science City, and each Professor is linked to one of the four key themes of Newcastle Science City:

- **Energy and Environment:** Professor of Practice [Harry Bradbury](#)
- **Drug Discovery - Bioprocessing:** Professor of Practice [Andy Lyddiatt](#)
- **Drug Discovery:** Professor of Practice [David Leahy](#)
- **Ageing and Vitality:** Professor of Practice [Peter Gore](#)

You can find out more about the backgrounds of each of the Professors of Practice by following the links above to their staff profiles.

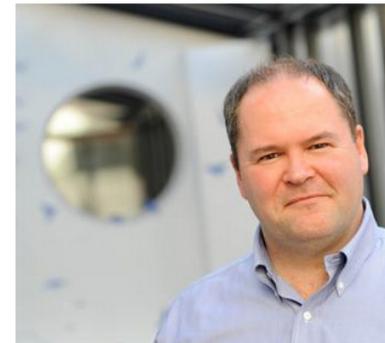
## David Elmes

### Professor of Practice

Email: [David.Elmes@wbs.ac.uk](mailto:David.Elmes@wbs.ac.uk) / Tel: 024 761 50912 / Room B3.14

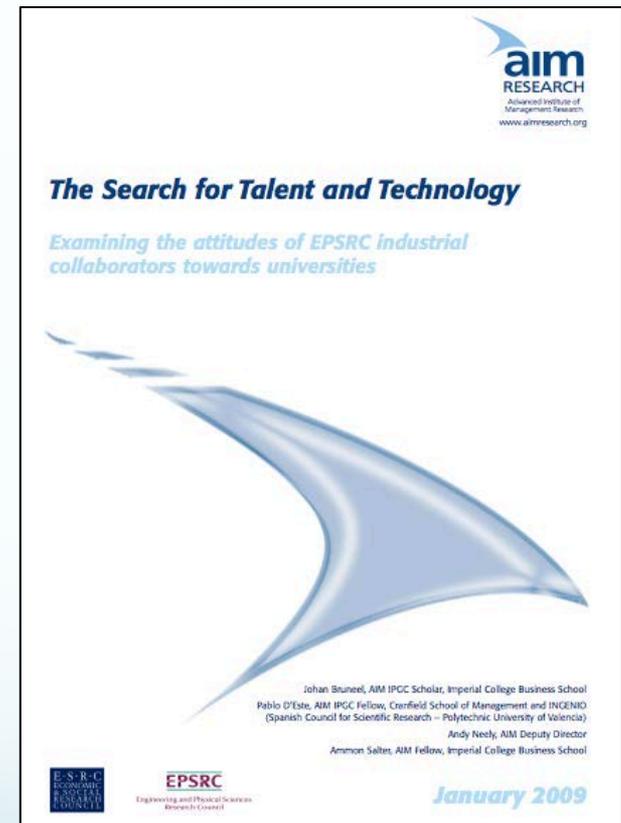
### Biography

David has joined WBS as Academic Director for the Warwick Global Energy MBA after more than 20 years working in the energy & management consulting industries. After graduating in Natural Sciences from Christ's College, Cambridge, David joined BP, working in the UK then the US. While in the US he completed his MBA at the Weatherhead School of Management, Case Western Reserve University in Cleveland, Ohio where he received the Dean's Award for academic excellence. He then joined Gemini Consulting in 1995 and, after various mergers, was Vice President with the UK Energy, Utilities & Chemicals team of CapGemini. In 2004 he joined Schlumberger as Vice President & Director in the team who created the firm's management consulting arm, Schlumberger Business Consulting. David initially focused on the London-based team then spent a year in Houston as Director for SBC's North & South America activities before returning to London and



# Industrial Survey

- Draws on two surveys:
  - 2004 survey by SPRU (D' Este)
  - 2008 survey by Advanced Institute of Management Research (Aim Research)
- Sample of firms that have participated in UIL through EPSRC schemes
- Overlap of sample frames between the two surveys



# Respondent Firms

Industry	2004	2008
Chemicals & chemicals related	64 (13%)	75 (12%)
Machinery & Metals	54 (11%)	60 (10%)
Electronics & Instruments	74 (16%)	72 (12%)
Transport	17 (4%)	23 (4%)
Utilities & Construction	37 (8%)	54 (9%)
Business Services	136 (29%)	220 (37%)
Not classified elsewhere	93 (20%)	98 (16%)
<b>Total</b>	<b>475 (100%)</b>	<b>602 (100%)</b>

# Industry interactions with universities

Table 3: Degree of engagement across different types of interaction with universities, 2004 and 2008

<b>Types of interaction</b>	<b>2004</b> At least once (%)	<b>2008</b> At least once (%)
Attendance at conferences	88.8	90.0
Recruitment of graduates	66.6	72.2
Joint research	66.5	65.7
Student placements	58.4	61.9
Contract research	45.6	48.3
Training of company employees	49.2	44.4
Consultancy	42.0	41.5
Postgraduate training	43.6	40.8
Creation of physical facilities	15.5	34.2

# Conclusion 1: UIL

- Universities core roles are teaching and research. Knowledge exchange has been embraced (for the most part).
- HEIF has stimulated a lot of diversity based on institutional profile and core competencies
- Moving more towards ongoing collaborations around portfolios
  - Research + teaching + training
  - Rather than one-off transactions
- Many different types of interactions

# Conclusion 2: Data

UK data collection exercises are now standard and embedded within the UK HEI system

- These capture the “hard”, quantifiable aspects of UIL
  - Additional surveys have been necessary to ascertain the full scale of UIL across the HEI landscape
  - These suggest that the range of interactions are quite substantial.
  - Interactions proceed across a range of dimensions:
    - Conferences
    - Invited talks
    - Networks
    - Informal Advice
    - Consultancy
    - Joint research
- these tend to have higher regularity than IP related measures.

# References

- Abreau, M., et al., (2012), Knowledge Exchange between Academics and the Business, Public and Third Sectors, UI-IRC
- D' Este P., and Patel, P., (2007), University-Industry Linkages in the UK: What are the factors underlying the variety of interactions with Industry, *RP*, 36, 1295-1313
- HEFCE, (2011) , Higher Education Innovation Funding 2011-12 to 2014-15 , May 2011/ 16
- HEFCE, (2012), Higher Education – Business Community Interaction Survey 2012  
[http://www.hefce.ac.uk/media/hefce1/pubs/hefce/2011/1116/11\\_16.pdf](http://www.hefce.ac.uk/media/hefce1/pubs/hefce/2011/1116/11_16.pdf)
- HESA, (2011), HE-BCI Survey Part A Questions and Guidance, <http://www.hesa.ac.uk/content/view/2228/233/>
- Hughes, A., and Kitson, M., (2012), Pathways to Impact and the Strategic Role of Universities: New evidence on the breadth and depth of university knowledge exchange in the UK and the Factors constraining its development, *Cam. J. of Econ.* 36, 723-750
- NISTEP, (2012), Science and Technology Indicators 2012
- Patel, P., and D' Este, P., (2007), University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *RP*, 36: 1295-1313
- Rothaermel, F., et al., (2007), University entrepreneurship: a taxonomy of the literature, *ICC*, Vol. 16, No. 4, pp.691-791
- PACEC, (2009), Understanding the Knowledge Exchange Infrastructure in the English Higher Education Sector
- PACEC, (2012), Strengthening the Contribution of English Higher Education Institutions to the Innovation System: Knowledge Exchange and HEIF Funding, April
- Perkmann, et al., (2012), Academic Engagement and Commercialisation: A Review of the Literature on University-Industry Relations, *RP*, in press
- Royal Society, (2010), The Scientific Century: Securing our Future Prosperity
- Salter and Martin, (2001), The Economic Benefits of Publicly Funded Basic Research: A Critical Review, *RP*, 30, 509-532
- Senker, J., (1995), Tacit Knowledge and Models of Innovation, *Industrial and Corporate Change*, Vol. 4, No. 2
- Wilson, T., (2012), A Review of Business-University Collaboration, February

**Table 1 Summary and comparison of HEIF 4 and HEIF 2011-2015 methods**

HEIF 4 (2008-2011)	HEIF 2011-2015
Support for a broad range of KE activities across all subjects which result in economic and/or social impact.	Same as HEIF 4.
Formula funding released against a high-level strategy for KE and plan for use of HEIF.	Same as HEIF 4.
A first component (40 per cent) focused on capacity-building based on full-time equivalent academic staff numbers.	No capacity component.
A second component (60 per cent) based on performance – using a variety of income measures as a proxy for impact.	All funding based on performance (100 per cent) – using a variety of income measures as a proxy for impact.
Data sources for income: HE-BCI Contract Research HE-BCI Consultancy HE-BCI Equipment and facilities HE-BCI Regeneration HE-BCI Intellectual property income HESA Non-credit-bearing courses Knowledge Transfer Partnerships income provided by Technology Strategy Board.	Same as HEIF 4.
Absolute cap on maximum allocation per HEI – £1.9 million.	Absolute cap on maximum allocation per HEI – £2.85 million.
Moderation.  Maximum allocation constrained to 150 per cent increase (250 per cent of the previous allocation).  Transition so an HEI is guaranteed 80 per cent of its previous allocation.	Moderation.  Maximum allocation constrained to 50 per cent increase.  Transition so no HEI (subject to being above the threshold allocation) sees its allocation drop more than 50 per cent of its previous allocation.
Minimum allocation £100,000. All HEIs gain an allocation of at least £100,000.	Threshold allocation £250,000. HEIs that are not achieving an allocation of £250,000 get no allocation at all.
Year of data – 2006-07 (the intention to utilise all years of data was highlighted in our HEIF 4 guidance, HEFCE 2008/02).	Years of data – 2007-08, 2008-09, 2009-10 weighted 1:2:7.