UK University–Industry Relations: Multiple Modes of Knowledge Exchange

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Content

- UIL in Context
  - Snapshot of the UK Innovation System
    - Funding Flows
    - Nature of UK universities
    - Publications on UIL

- Sources of Multi-Modal UIL – Funding System
  - HEIF: support system has generated diversity

- Studies on multi-modalities of UIL
  - Academic Surveys
  - Industry Surveys

- Conclusions
  - Variety of interactions beyond IP / co-publication – well acknowledged
  - Questionnaires appear useful for obtaining clearer picture
### Key Indicator Snapshot

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

Eurostat – most recent year available
R&D Expenditure Flows

(A) Japan (2010年度)

(B) United Kingdom (2009年)

Source: NISTEP 2012: 16-18
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

<table>
<thead>
<tr>
<th>Informal groupings</th>
<th>Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russell Group</td>
<td>24 Top institutions: Oxford, Cambridge, UCL, Manchester, Bristol, Edinburgh, etc.</td>
</tr>
<tr>
<td>Pre-1992</td>
<td>Warwick, York, Surrey, Sussex, Lancaster, Essex, UEA, Loughborough, SOAS etc.</td>
</tr>
<tr>
<td>Post-1992</td>
<td>Many former polytechnics; former specialist colleges or institutes</td>
</tr>
</tbody>
</table>
UIL Publication Trends


Rothaermel et al. (2007)
Keyword search of databases (Proquest’s ABI/Inform, Business Source Premier, and EconLit)

413 results (1980–2011)


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

- Consulting, 26
- Conversations, 6
- Collaborative Research, 12
- Patents and Licenses, 7
- Publications, 18
- Co-Supervising, 9
- Recruit Graduates, 17
- Conferences, 5

Agrawal and Henderson (2002), Management Science 48:1
## External Sources of Knowledge for Innovation

### With Other Companies

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Technical Product Innovation</td>
<td>Formal</td>
<td>Formal (some tacit)</td>
<td>Formal (some tacit)</td>
<td>Formal and Tacit</td>
<td>Tacit</td>
<td></td>
</tr>
</tbody>
</table>

### With Public Sector Research

<table>
<thead>
<tr>
<th>Research Equipment</th>
<th>Bio</th>
<th>Ceramics</th>
<th>Parallel Computing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Equipment</td>
<td>Tacit</td>
<td>Tacit</td>
<td>Formal and Tacit</td>
</tr>
</tbody>
</table>

60 interviews with 31 companies

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 (Abreu 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 (219亿) (601m total) over 4 years

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Number of Institutions receiving funds</td>
<td>129 (all)</td>
<td>99 English HEIs</td>
</tr>
<tr>
<td>Max / Min. funding per institute</td>
<td>Max: 1.9m</td>
<td>Max: 2.85m</td>
</tr>
<tr>
<td></td>
<td>Min: 100k</td>
<td>Min: 254k</td>
</tr>
<tr>
<td>Funding allocation method</td>
<td>Partly on income performance (HE–BCI data); capacity building</td>
<td>Solely on income (x2 for SMEs)</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Facilitating the research exploitation process</th>
<th>Skills and human capital development</th>
<th>Stimulating interactions</th>
<th>Exploiting the physical assets of the HEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access points for external orgs</td>
<td>CPD / short courses</td>
<td>Provision of public space</td>
<td>Science parks</td>
</tr>
<tr>
<td>Business development</td>
<td>Lifelong learning</td>
<td>Alumni networks</td>
<td>Incubators</td>
</tr>
<tr>
<td>Technology transfer</td>
<td>Careers services</td>
<td>KE professional networks</td>
<td>Facilities / equipment</td>
</tr>
<tr>
<td>Consultancy support</td>
<td>Work placements / project experience</td>
<td>Staff exchanges</td>
<td></td>
</tr>
<tr>
<td>Contracts / legal support</td>
<td>Joint curriculum development</td>
<td>Academic – external organisation networks</td>
<td></td>
</tr>
<tr>
<td>Patenting / IP advice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporate Relations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press / communications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment funds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External fundraising for research</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Social enterprise / entrepreneurship

- Social enterprise
- Enterprise and entrepreneurship training

### 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 1
- HEIF 2
- HEIF 3
- HEIF 4

Total accumulated funding:
- 00/01 – 07/08: £698 million (£714 million)
- % of total income: 0.6%

Total projected funding:
- 08/09 – 10/11: £341 million (£396 million)

constant 2003 prices (current prices)

Growth 2000-11 (%)

Cluster
- Top 6: -13
- High: 65
- Med: 250
- All HEIs: 284
- Low: 385
- Arts: 120
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)
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
“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

<table>
<thead>
<tr>
<th>Discipline</th>
<th>All (N)</th>
<th>Male</th>
<th>Female</th>
<th>Prof.</th>
<th>Reader / Senior Lecturer / Lecturer</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Sciences</td>
<td>3,623</td>
<td>44.7</td>
<td>55.3</td>
<td>18.6</td>
<td>53.8</td>
<td>27.5</td>
</tr>
<tr>
<td>STEM</td>
<td>7,590</td>
<td>72.8</td>
<td>27.2</td>
<td>20.0</td>
<td>44.8</td>
<td>35.2</td>
</tr>
<tr>
<td>Arts &amp; Hum.</td>
<td>3,680</td>
<td>55.1</td>
<td>44.9</td>
<td>19.8</td>
<td>61.0</td>
<td>19.3</td>
</tr>
<tr>
<td>Soc. Sci.</td>
<td>7,236</td>
<td>56.6</td>
<td>43.4</td>
<td>20.4</td>
<td>60.1</td>
<td>19.5</td>
</tr>
<tr>
<td>Total</td>
<td>22,129</td>
<td>60.0</td>
<td>40.0</td>
<td>19.8</td>
<td>54.0</td>
<td>26.2</td>
</tr>
</tbody>
</table>
Academic External Interaction Activity (%)
Academic Engagements

People based activities (% of respondents)

- Attending conferences
- Participating in networks
- Giving invited lectures
- Sitting on advisory boards
- Student placements
- Employee training
- Standard setting forums
- Curriculum development
- Enterprise education
Academic Contributions

Exhibit 12  Problem solving activities (% of respondents)

- Informal advice
- Joint research
- Joint publications
- Consultancy services
- Contract research
- Research consortia
- Hosting of personnel
- Prototyping and testing
- External secondment
- Setting up physical facilities
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)**
- Employee training
- Enterprise education
- Giving invited lectures
- Sitting on advisory boards
- Participating in networks
- Curriculum development
- Student placements
- Attending conferences
- Standard setting forums

**Problem solving activities by institution (% of respondents)**
- Hosting of personnel
- Joint publications
- Setting up physical facilities
- Prototyping and testing
- Informal advice
- Joint research
- Contract research
- Consultancy services
- Research consortia

Graphs compare activities between Russell Group and Younger universities (est after 1992).
University strategies for UIL

- Strategic Partnerships: 46
- Responsiveness to Market changes: 40
- Synergies between KE and research: 58
- Improving access to knowledge: 30
- Networks for innovation: 26

PACEC report (2012: 25)
Cranfield University: Strategic Partnerships

- 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

http://www.unialliance.ac.uk/campaigns/growingthefuture/inwardinvestment/siemens/
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”
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

<table>
<thead>
<tr>
<th>Industry</th>
<th>2004</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals &amp; chemicals related</td>
<td>64 (13%)</td>
<td>75 (12%)</td>
</tr>
<tr>
<td>Machinery &amp; Metals</td>
<td>54 (11%)</td>
<td>60 (10%)</td>
</tr>
<tr>
<td>Electronics &amp; Instruments</td>
<td>74 (16%)</td>
<td>72 (12%)</td>
</tr>
<tr>
<td>Transport</td>
<td>17 (4%)</td>
<td>23 (4%)</td>
</tr>
<tr>
<td>Utilities &amp; Construction</td>
<td>37 (8%)</td>
<td>54 (9%)</td>
</tr>
<tr>
<td>Business Services</td>
<td>136 (29%)</td>
<td>220 (37%)</td>
</tr>
<tr>
<td>Not classified elsewhere</td>
<td>93 (20%)</td>
<td>98 (16%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>475 (100%)</td>
<td>602 (100%)</td>
</tr>
</tbody>
</table>
## Industry interactions with universities

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

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

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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Support for a broad range of KE activities across all subjects which result in economic and/or social impact.</td>
<td>Same as HEIF 4.</td>
</tr>
<tr>
<td>Formula funding released against a high-level strategy for KE and plan for use of HEIF.</td>
<td>Same as HEIF 4.</td>
</tr>
<tr>
<td>A first component (40 per cent) focused on capacity-building based on full-time equivalent academic staff numbers.</td>
<td>No capacity component.</td>
</tr>
<tr>
<td>A second component (60 per cent) based on performance – using a variety of income measures as a proxy for impact.</td>
<td>All funding based on performance (100 per cent) – using a variety of income measures as a proxy for impact.</td>
</tr>
<tr>
<td>Absolute cap on maximum allocation per HEI – £1.9 million.</td>
<td>Absolute cap on maximum allocation per HEI – £2.85 million.</td>
</tr>
<tr>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>Minimum allocation £100,000. All HEIs gain an allocation of at least £100,000.</td>
<td>Threshold allocation £250,000. HEIs that are not achieving an allocation of £250,000 get no allocation at all.</td>
</tr>
<tr>
<td>Year of data – 2006-07 (the intention to utilise all years of data was highlighted in our HEIF 4 guidance, HEFCE 2008/02).</td>
<td>Years of data – 2007-08, 2008-09, 2009-10 weighted 1:2:7.</td>
</tr>
</tbody>
</table>