



## Five ways universities drive innovation

Universities have traditionally had three main missions: undertaking research; teaching; and transferring knowledge. The UK's increasing need to innovate to meet the economic and social challenges of the 21st century will place further pressure on these roles, but importantly will also introduce two more – universities' international and regional missions.

Universities increasingly provide important national and regional links into the global knowledge economy. They exchange knowledge, gather intelligence and facilitate international flows of highly-skilled people who, in turn, create and attract high value-added businesses. As powerful institutions with well-connected and highly-educated leaders, they are also important actors in regional networks, and help lead the design and delivery of economic development strategies.

However, few universities can excel in all five roles. Each must choose where to concentrate its efforts depending on its strengths and regional requirements. Government should encourage greater interaction between universities and the wider economy and society, and ensure that research funding encourages innovation.

### The role of universities has evolved

#### 'Big Science' placed universities at the heart of scientific innovation

During the 19th century, universities began to develop significant capacity in industrial science. By the Second World War, military requirements prompted governments to undertake large scale, resource intensive, 'Big Science' projects. These were characterised by enormous budgets, large numbers of staff and investment in hi-tech machinery.<sup>1</sup>

In 1945, Vannevar Bush, Director of the US Office of Scientific Research and Development, proposed that wartime science and research efforts should continue to be applied in peacetime.<sup>2</sup> This led to universities receiving funding from government to conduct basic research, some of the results of which were commercialised by industry – the origins of the 'linear model' of innovation.<sup>3</sup>

#### Increased focus on commercial exploitation of knowledge

By the 1980s, universities had become increasingly interested in the potential financial gains from their intellectual property (IP). In the United States, the Bayh-Dole Act of 1980 established that universities could keep the IP generated by government funding.<sup>4</sup> This encouraged them to focus their research on commercially-relevant topics, a pattern subsequently copied around the world.

#### Interlocking relationship between university, government and industry

By the 1990s, it was increasingly clear that the linear model of knowledge production and exploitation did not capture the dynamic relationships between government, industry and universities. Instead a 'Triple Helix' was recognised: an overlapping series of institutional arrangements among universities, industries and the government, with hybrid organisations emerging at the interfaces.<sup>5</sup> However, even this more nuanced understanding of the role that universities play does not fully capture their importance in today's global economy.<sup>6</sup>

#### UK policymakers have placed universities at the heart of innovation policy

##### Government has recognised the role of universities in innovation

The UK Government increasingly sees universities as agents of economic growth. Most significantly, it commissioned the Lambert Review of Business-University Collaboration, which argued that universities should 'get better at identifying their areas of competitive strength in research', that Government should 'do more to support business-university collaboration', and that business should 'learn how to exploit the innovative ideas that are being developed in

1. For an account of perhaps the best-known example of 'Big Science', see Hughes, J. (2003), 'The Manhattan Project: Big Science and the Atom Bomb', (Princeton University Press, Princeton).  
 2. Bush, V. (1945), 'Science The Endless Frontier: A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development', (United States Government Printing Office, Washington).  
 3. Ibid. In the linear model of innovation, projects advance in a 'line', for example from basic research to applied research to development to production.  
 4. The effects of the Bayh-Dole Act have been widely debated. Mowery, D. (2005), 'The Bayh-Dole Act and High Technology-Entrepreneurship and U.S. Universities: Chicken, Egg, or Something Else?' in: Lieback, G. (2005), 'University Entrepreneurship and Technology Transfer', (Elsevier, Amsterdam); Colyvas, J., Crow, M., Gelijns, A., Mazzoleni, R., Nelson, R., Rosenberg, N., and Sampat, B.H. (2002), 'How Do University Inventions Get into Practice?', 'Management Science', 48, pp. 61-72; Dasgupta, P. and David, P.A. (1994), 'Toward a New Economics of Science', 'Research Policy', 23, pp. 487-521.  
 5. Etkowitz, H. and Leydesdorff, L. (February 2000), 'The dynamics of innovation: from national systems and "mode 2" to a triple helix of university-industry-government relations', 'Research Policy', Vol. 29, No. 2, pp. 109-123.  
 6. Erno-Kjohled, E., Husted, K., Monsted, M. and Wenneberg, S.B. (2001), 'Managing university research in the triple helix', 'Science and Public Policy', Vol. 28, No. 1, February 2001, pp. 49-55.

7. Most of the recommendations of the Review were taken forward. Lambert, R. (2003), 'Lambert Review of Business-University Collaboration', (HM Treasury, London).  
 8. HM Treasury, DTI & DFES (2004), 'Science & Innovation Investment Framework 2004 - 2014', (HM Treasury, London).  
 9. HM Treasury website, [http://www.hm-treasury.gov.uk/independent\\_reviews/sainsbury\\_review/sainsbury\\_index.cfm](http://www.hm-treasury.gov.uk/independent_reviews/sainsbury_review/sainsbury_index.cfm)  
 10. DIUS website, 'The functions of the new Department, available at <http://www.dius.gov.uk/functions.htm> [accessed 14 August 2007].  
 11. Welsh Assembly Government (March 2002), 'Reaching Higher: A Strategy for the HE sector in Wales', (Welsh Assembly Government, Wales).  
 12. Scottish Government (2004), 'The Competitiveness of Higher Education in Scotland, Phase 3: Summary', available at <http://www.scotland.gov.uk/Resource/Doc/47171/0028787.pdf> [accessed 14 August 2007].  
 13. Northern Ireland Government, the Department of Employment and Learning website, 'About the Department, available at <http://www.delni.gov.uk/index/about-the-dept.htm> [accessed 14 August 2007].

14. Llewellyn Smith, C.H. (2006), 'What's the Use of Basic Science?', available at the CERN website <http://public.web.cern.ch/public/Content/Chapters/AboutCERN/WhatsCERN/BasicScience/BasicScience1/BasicScience1-en.html> [accessed 14 May 2007].

15. Nelson, R. (1993), 'National Innovation Systems: a comparative analysis', (Oxford University Press, Oxford).

16. HM Treasury and DIUS (July 2007), 'Science and Innovation Investment Framework 2004-2014: Annual Report 2007' (HM Treasury, London). At 13.3 per cent, the UK's share of world academic citations is second only to the US.

17. Higher Education Funding Council for England website, Dual Support Reform, available at <http://www.hefce.ac.uk/research/funding/dual/> [accessed 13 August 2007].

18. The Higher Education Funding Council for England, the Higher Education Funding Council for Wales, The Scottish Further and Higher Education Funding Council and the Department for Employment and Learning in Northern Ireland.

19. Research Assessment Exercise 2008 website, available at <http://www.rae.ac.uk/> [accessed 13 August 2007].

20. For examples of criticism of the RAE see: Universities UK's response to the DFES consultation on the reform of HE research assessment and funding, 13 October 2006, available at: <http://www.universitiesuk.ac.uk/consultations/responses/downloads/ResearchAssessmentAndFundingResponse.pdf> [accessed 16 August 2007]; Association of University Teachers (December 2005), Research Assessment Exercise 2008: Overview and Guidance, available at <http://www.ucu.org.uk/media/docs/3/8/rae08guidance.rtf> [accessed 15 August 2007].

21. HM Treasury and DIUS (July 2007), 'Science and Innovation Investment Framework 2004-2014: Annual Report 2007', (HM Treasury, London).

22. DCSF press release (27 March 2007), 'Participation Rates In Higher Education On The Up - Rammell', available at [http://www.dfes.gov.uk/pns/DisplayPN.cgi?pn\\_id=2007\\_0052](http://www.dfes.gov.uk/pns/DisplayPN.cgi?pn_id=2007_0052) [accessed 09 August 2007]. This refers to 2005/06, the number of people aged 18 to 30 in HE in England increased to 43%. In 2005-06 participation in HE in Scotland was 47% according to the Scottish Government, (2007), 'Statistics Publication Notice, The Age Participation Index for Scotland 2005-06', available at <http://www.scotland.gov.uk/Resource/Doc/179337/0051010.pdf> [accessed 28 August 2007].

23. DFES, PSA Target 14 (2004), 'By 2010, increase participation in HE towards 50% of those aged 18 to 30 and also make significant progress year on year towards fair access, and bear down on rates of non-completion.' The target is for English domiciled students.

24. HM Treasury (2006), 'The Leitch Review of Skills: Prosperity for all in the global economy - world class skills', (HM Treasury, London).

25. SSDA (January 2006), 'Working Futures Report 2004-2014', available at <http://www.ssda.org.uk/PDF/Working%20Future%20042014%20National%20Summary%20R%20060215.pdf>

26. For example, in subjects that feed the creative industries, see NESTA (May 2007), 'Creating Entrepreneurship - entrepreneurship education for the creative industries', (NESTA, London).

the university sector.<sup>17</sup> Universities also form a critical element in the Science and Innovation Investment Framework<sup>8</sup> and their role has been a core area of investigation for Lord Sainsbury's Review of Science & Innovation.<sup>9</sup>

### **The link between universities and innovation is now reflected in Government structures**

The creation of the Department for Innovation, Universities and Skills (DIUS) in June 2007 emphasised the link between innovation policy and universities. It has a remit to 'bring together the nation's strengths in science, research, universities and colleges to build a dynamic, knowledge-based economy.'<sup>10</sup>

This approach is reflected across the UK. The Welsh Assembly Government's strategy for higher education (HE) includes a proposal for an innovation fund intended to drive up collaboration across the HE sector.<sup>11</sup> The most recent phase of the Scottish Government's review of HE recognises that, 'a flourishing and competitive system of HE is critical to the country's economic success and to the well-being of its people.'<sup>12</sup> In Northern Ireland, the Department for Employment and Learning is expected to publish a comprehensive review of HE policy in December 2007.<sup>13</sup>

## **Universities play five distinct roles in innovation**

### **1. Driving forward the research frontier**

#### **UK universities generate knowledge needed for innovation**

Basic scientific research primarily intended to advance knowledge lays the groundwork for many innovations, though it is normally conducted without a final application in mind.<sup>14</sup> Universities also conduct applied research – the pursuit of knowledge to solve a practical problem like the development of drugs to cure specific diseases.

In other countries including Germany and France, major industrial laboratories, institutes and national research centres conduct much of the research, leaving universities to focus on teaching.<sup>15</sup> In the UK, universities play a stronger role in research and development (R&D). UK universities also appear to be highly efficient at converting this expenditure into traditional measures of academic output.<sup>16</sup>

#### **Research funding has increased and is being reformed**

The UK operates a dual support system whereby the Research Councils allocate grants for specific research projects (£3.3 billion in 2007-08, up from £2.6 billion in 2004-05)<sup>17</sup>

and the Higher Education Funding Councils in England, Scotland and Wales and the Northern Irish Department for Employment and Learning allocate core grants for institution and infrastructure building.<sup>18</sup>

The Funding Councils use the Research Assessment Exercise (RAE) to allocate university research funding. The RAE uses intensive peer review to rank academic performance and allocate funding accordingly.<sup>19</sup> This process has attracted criticism for focusing tightly on a set of narrow targets that can discourage higher risk, innovative and interdisciplinary research.<sup>20</sup> Partly as a result of these criticisms, the RAE is being modified to take into account a combination of criteria to assess research, and a lighter-touch peer review system.<sup>21</sup>

## **2. Giving people the skills for innovation**

#### **Policy is focused on increasing the number of graduates**

The UK Government has set a target to increase participation in higher education in England from the current 43 per cent<sup>22</sup> to 50 per cent by the end of the decade.<sup>23</sup> Most recently, the Leitch Review of Skills made a series of recommendations to make UK skills provision more 'demand-led' by the needs of business.<sup>24</sup> However, while doing this, the UK needs to focus on producing sufficient graduates who have the full range of technical and cognitive skills necessary to become innovators in later life.

#### **Giving graduates the skills they need**

Not all skills will be equally in demand in the UK economy as the 21st century progresses. In particular, by 2014 the demand for science and technology professionals is estimated to increase by one-fifth, compared to an increase for all other occupations of four per cent.<sup>25</sup>

Universities can also do much more to give people the entrepreneurial skills they need. While most students and post-graduates have access to institutional facilities that support entrepreneurship education, such as enterprise and incubator units, quality of provision varies widely.<sup>26</sup>

#### **Innovators need a combination of skills**

Successful innovators tend to demonstrate a particular set of cognitive skills and attributes on top of pure technical skills.<sup>27</sup> However, while technical skills can be taught throughout life (albeit with varying degrees of success), cognitive skills, such as problem-solving, leadership and analytical skills, are best learned young.<sup>28</sup> University teaching should therefore

focus on driving up the technical skills of their students in an environment that also encourages them to develop their existing cognitive skills.

### 3. Exchanging knowledge

#### Universities have mixed results in commercialising research

UK universities have a mixed record in commercialising their research. The best 'are international benchmarks of excellence,' while some are 'not engaged in the commercialisation of IP in any substantial way.'<sup>29</sup> While universities appear to be improving their performance in some areas – both the number of spin-offs and licences granted have increased – progress is not uniform.<sup>30</sup> Only ten per cent of the UK's innovative businesses currently interact with universities,<sup>31</sup> though new models of university business collaboration, such as the IP Group, are beginning to emerge.<sup>32</sup> Knowledge exchange is also important for the public and third sectors, although as yet this is poorly understood.

#### Policy has recognised the importance of knowledge transfer

The UK Government has implemented Lambert's recommendation to develop model collaborative research agreements for voluntary use by industry and universities.<sup>33</sup> The Government has also funded venture capital and proof of concept funds, some of which focus on university spin-outs,<sup>34</sup> as well as Knowledge Transfer Partnerships.<sup>35</sup>

Since 2001, the Higher Education Innovation Fund (HEIF) has provided a 'third stream' of HE funding in England to facilitate knowledge transfer from universities to business and the public sector.<sup>36</sup> While HEIF funds engagement rather than research itself (at £238 million for the period 2006-08), it is dwarfed by the other two streams, particularly the RAE, which consequently dominate university investment, recruitment and promotion decisions.<sup>37</sup>

#### Knowledge exchange, not knowledge transfer

The 'linear model' of idea production is relevant in very few sectors; most involve multiple exchanges of knowledge over an extended period of time.<sup>38</sup> However, many of the fundamental processes that underpin university administration are not suited to maximising innovation or engagement with business. For instance, if a firm funds research, the success of the project is normally not judged in terms of whether the needs of the company have been solved, but rather on measures of academic excellence.<sup>39</sup>

Likewise, faculty recruitment, reward and retention strategies focus heavily on pure research and neglect other activities essential to innovation, including external engagement and more applied research. Several universities have recognised the need to change: Nottingham and Newcastle universities, for example, now also assess staff promotion on the extent to which their research and teaching reaches out to business and the wider public.<sup>40</sup> At Newcastle these activities are embedded in the human resources strategy.<sup>41</sup>

#### People transfer is an under-recognised form of knowledge exchange

Researchers moving between locations bring three great assets: knowledge of recent research; skills needed to perform research and develop new ideas; and skills in using advanced instrumentation and techniques.<sup>42</sup> In fact, one of the most significant contributions by universities to business is a steady flow of well-educated graduates.<sup>43</sup>

### 4. Acting as a hub in an international network of knowledge

#### Globalisation and the knowledge economy

Globalisation enables business, people and knowledge to flow freely across national boundaries.<sup>44</sup> This is already beginning to affect the university-based research process – for example, the Human Genome Project involved a partnership between 20 international academic institutions.<sup>45</sup> And these processes are becoming increasingly more important to the UK, where over 40 per cent of scientific output over the last five years involved international collaboration.<sup>46</sup>

Universities are also moving beyond their original geographic origins, seeking out collaborations across the world. For example, Imperial College London recently signed Memoranda of Understanding with Shanghai Jiao Tong University and Tsinghua University in Beijing to promote interaction and exchange between the institutions.<sup>47</sup>

#### Creating global knowledge hubs

Through their links with other leading knowledge centres, universities not only facilitate the flow of ideas and people in and out of the UK, they also strengthen the capacity for innovation of local businesses, the specialist knowledge of the local labour market and the attractiveness of their region to new investors.

#### Increasing the focus on exploiting ideas created elsewhere

To harness this global knowledge for the purposes of innovation, the UK needs

27. Csikszentmihalyi, M. (1996), 'Creativity: Flow and the psychology of discovery and invention', (Harper Collins Publishers, New York). Csikszentmihalyi acknowledges that creative individuals must both 'learn the rules and content of the domain' (p. 47) as well as 'have an ability to adapt to almost any situation and to make do with whatever is at hand' (p. 53).

28. Visser & Krosnick, (1998), 'Development of Attitude Strength Over the Life Cycle: Surge and Decline', *Journal of Personality and Social Psychology*, Vol. 75, No. 6, pp. 1389-1410.

29. UNICO Press Release, (22 November 2005), 'Survey Of UK University Commercialisation Shows A Doubling Of Licensing Activity In 2004', available at <http://www.unico.org.uk/msurvey.doc> [accessed 08 August 2007].

30. HEFCE (July 2007), 'Sixth Education-Business Community Interaction survey', available at [http://www.hefce.ac.uk/pubs/hefce/2007/07\\_17/](http://www.hefce.ac.uk/pubs/hefce/2007/07_17/) [accessed 08 August 2007].

31. Eurostat press release (2007), 'Fourth Community Innovation Survey, More Than 40 Per Cent of EU 27 Enterprises are Active in Innovation', (Eurostat, Luxembourg).

32. For example, the IP Group deals with a number of UK universities involving an upfront payment in return for exclusive rights to the commercialisation of intellectual property, although the university retains some of the profit. Information from IP Group website, available at <http://www.ip2ipo.com/ipo/> [accessed 15 August 2007].

33. Lambert, R. (2003), 'Lambert Review of Business-University Collaboration', (HM Treasury, London).

34. For example, The London Proof of Concept Funds, available at <http://www.london-innovation.org.uk/server.php?show=nav.008003007> [accessed 17 August 2007]; and the Scottish Enterprise Proof of Concept Programme, available at <http://www.scottish-enterprise.com/proofofconcept> [accessed 17 August 2007].

35. The UK Government funds Knowledge Transfer Partnerships, whereby businesses identify a specific problem core to their strategic development and partner with a university to recruit a KTP Associate to work on it. For further information see <http://www.ktponline.org.uk/default.aspx>

36. Scotland, Wales and Northern Ireland have their own support mechanisms.

37. NESTA (June 2007), 'Science: an engine of innovation', (NESTA, London).

38. NESTA (October 2006), 'The Innovation Gap: Why policy needs to reflect the reality of innovation in the UK', (NESTA, London).

39. Universities UK (July 2007), 'The changing academic profession in the UK: setting the scene', (Universities UK: London).

40. Personnel Today Magazine (23 November 2004), 'Academic reward in the firing line', available at <http://www.personneltoday.com/Articles/2004/11/23/26878/academic-reward-in-the-firing-line.html> [accessed 15 August 2007].

41. For example, see Criteria for Promotion from Lecturer to Senior Lecturer, available at [http://www.ncl.ac.uk/hr/promote/academic/lecturerstosenor/documents/20060920\\_promote-lecturer-to-senior-criteria\\_1j.pdf](http://www.ncl.ac.uk/hr/promote/academic/lecturerstosenor/documents/20060920_promote-lecturer-to-senior-criteria_1j.pdf) [accessed 16 August 2007].



42. Martin, B. and Tang, P. (2006), 'The Benefits from Publicly Funded Research, Science and Technology Policy Research', University of Sussex, (UMIP, Manchester).
43. Lundvall, B. A. (2002), 'The University in the Learning Economy', 'DRUID Working Paper', No. 02-06
44. Felsenstein, D., Schamp, E.W. and Shachar, A. (eds) (2002), 'Emerging Nodes in the Global Economy: Frankfurt and Tel Aviv Compared', (Kluwer Academic Publishers: Dordrecht).
45. Global Science and Innovation Forum (2006), 'A Strategy for International Engagement in Research and Development', available at <http://www.berr.gov.uk/files/file34726.pdf> [accessed 10 August 2007].
46. BERR (July 2007), 'UK Science and Innovation at the Heart of the Global Knowledge Economy', available at <http://www.berr.gov.uk/files/file40397.pdf> [accessed 10 August 2007].
47. Imperial College London press release (23 April 2007), 'International study tour strengthens academic links between Imperial and China', available at [http://www3.imperial.ac.uk/newsandeventspggrp/imperialcollege/newsummary/news\\_23-4-2007-14-56-10](http://www3.imperial.ac.uk/newsandeventspggrp/imperialcollege/newsummary/news_23-4-2007-14-56-10) [accessed 29 August 2007].
48. Tajnai, C. (1982), 'Links Between Stanford University and Industry', available at <http://www.netvalley.com/archives/mirrors/tajnai-links.html> [accessed 10 August 2007].
49. South West of England Regional Development Agency, information taken from Bristol Science Park webpage, available at <http://www.southwestrda.org.uk/area-teams/west-of-england/bristol-science-park/index.shtml> [accessed 03 September 2007].
50. Council for Science and Technology, September 2006, 'Innovation and Wealth Creation - Services Sector and Public Procurement: letter to the Chancellor of the Exchequer', [http://www.cst.gov.uk/cst/reports/files/services\\_letter.doc](http://www.cst.gov.uk/cst/reports/files/services_letter.doc), [accessed 07 August 2007].
51. The Sainsbury Review of Science and Innovation Policies of Government. Submission by Universities UK, available at [http://www.universitiesuk.ac.uk/research/downloads/Sainsbury\\_Review\\_Submission.pdf](http://www.universitiesuk.ac.uk/research/downloads/Sainsbury_Review_Submission.pdf) [accessed 07 August 2007].
52. Aston University Press Release (27 November 2006), 'Aston University pilots revolutionary innovation voucher scheme', available at <http://www.aston.ac.uk/downloads/bpu/index2.pdf>
53. DTI (June 2007), 'Simplifying Business Support: A Consultation', available at <http://www.berr.gov.uk/files/file39908.pdf>
54. Research Assessment Exercise 2008 (June 2005), Guidance on Submissions, available at <http://www.rae.ac.uk/pubs/2005/03/rae0305.doc> [accessed 29 August 2007].
55. From 2010-2014 the new system for science, engineering, technology (SET) and medicine will draw on a combination of research income, postgraduate research student data and a bibliometric indicator of quality to assess research. See: <http://www.hefce.ac.uk/research/assessment/reform/>

to become adept at exploiting ideas and concepts whatever their origin. Universities (as access points into the international network of knowledge and as producers of highly skilled people) have a critical role to play in making sure that the UK benefits from this fundamentally changed innovation system, where ideas created elsewhere may be as important as those created at home.

## 5. Providing regional leadership

### Universities are important for regional development

Universities can be instrumental in the economic development of their region. Stanford University, for example, played a central role in the economic development of Silicon Valley back in the 1950s, transforming it from a low-tech rural area into a global high-tech leader.<sup>48</sup> However, aside from these direct and indirect economic roles, universities in the UK are often partners or leaders in wider regional leadership structures.

### Government policy increasingly connects universities and regions

Universities are increasingly seen as partners in any regional strategy for economic development, and often form a major element of any innovation strategy. HM Treasury's Science Cities initiative places a university partnership at the heart of local economic development, and RDAs are increasingly trying to capture the teaching and research output of universities for the benefit of the regional economy. For example, the South West RDA is working with the region's universities to create a new science park, which is expected to create 6,000 jobs and support the region's aerospace and technology industries.<sup>49</sup>

## Putting universities at the heart of innovation

### Universities should reach out to a wider range of businesses

As the UK economy is increasingly dominated by the service sectors, universities must identify how their academic research and knowledge could benefit these businesses.<sup>50</sup> Reaching out to a wider range of businesses will mean introducing more flexible schemes, with limited bureaucracy and incentives for both sides to collaborate. In time, this should lead to more extensive collaborative activity. For example, to help spread the benefits of Knowledge Transfer Partnerships to smaller businesses, the UK Government should look at introducing mini-KTPs that have shorter-term projects of 3-12 months.<sup>51</sup>

### Boosting business demand for university interaction

Further, rather than focusing entirely on the supply-side of knowledge exchange, policy should seek further ways to develop business demand from all sectors. A specific initiative that merits attention is the Innovation Voucher scheme currently being piloted by Aston University, which provides high-growth SMEs with vouchers to purchase academic support.<sup>52</sup> This initiative should be included as one of the schemes taken forward as part of the Business Support Simplification Programme.<sup>53</sup> Closer links between universities and businesses should also help to ensure that universities are educating their students with the skills most needed in the UK economy.

### Ensuring that funding streams encourage innovative research

The current focus of the RAE can act to discourage researchers, especially early-career researchers, from taking on higher risk and interdisciplinary research. Peer review is an effective means of ensuring high quality research within established disciplines, but the current assessment of interdisciplinary research presents challenges.<sup>54</sup> In the RAE 2008, and as criteria are developed for the post-2008 research arrangements,<sup>55</sup> further consideration should be given to how to stimulate interdisciplinary and innovative research in universities.

### Specialisation: building on strengths – and focusing on the needs of regions

All universities impact on the regional and national economies in the five ways discussed above. However, few institutions will be able to excel in all five. Further, each region will require different services from its university depending on its demographic and economic make-up.

Each university must choose where to concentrate its efforts. For example, in an area dominated by services a university might choose to provide more consulting and teaching services. In regions that feature greater amounts of advanced manufacturing or biotech, a more important focus might be on pure research and spin-out companies. For those regions heavily dependent on a small number of large companies, the best contribution may well be a focus on working closely with those large firms to deepen the labour pool and retain their activities in the region.

The recipe is unlikely to be the same across the country. Moreover, it is not one that can be decided by a central authority or a university alone, but only by consultation and entrepreneurial institutional leaders intelligently balancing institutional aspirations, national priorities and regional realities.