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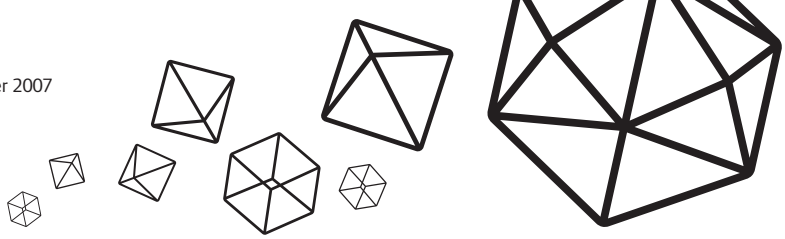

NESTA Making Innovation Flourish

Innovation policy in the modern world: Five big challenges

Innovation has changed dramatically since the model of 'Big Science' in the mid-20th century. Globalisation, new technologies and growth in the service sectors are all combining to quicken the pace of change today.

The innovation research community has tracked many of these trends, but few governments yet reflect them in their innovation policies. This is not ignorance or indifference, but a result of the failure of researchers and policymakers collectively to develop meaningful policies that could support these new forms of innovation.

The matter is now urgent. An increasingly competitive global economy and the failure of traditional approaches to meet pressing social challenges, mean that innovation is now a necessity, not a luxury. So, innovation policy needs to move beyond its comfort zone and respond to the five challenges set out here. Not all will be achieved, but to respond to the demands of the modern world innovation policy needs to become more exploratory, risk-taking and experimental. In short, innovation policy needs to take on more of the characteristics of innovation itself.

One: Base policy on an up-to-date understanding of innovation

Most innovation policy remains based on a linear view of the innovation process

Around the world, innovation policies assume innovation to be synonymous with scientific and technological invention – a subset of innovation only relevant to a small proportion of the economy.[1]

In this model, basic science coupled with formal research and development (R&D) leads to new discoveries that are then incorporated into a new product or process and then 'pushed out' to consumers. This linear or 'pipeline' model has failed to withstand the emergence of new sectors or the new forms of innovation that accompany them.

Science ≠ innovation

Although science is an important driver of innovation, science does not equal innovation, particularly given the straitjacket of international definitions,[2] which explicitly exclude, for example, technological investments undertaken for the purposes of oil exploration. They also exclude innovations – such as the iPod, financial services or the development of low cost airlines – that are not based on 'new-to-the-world' scientific invention.[3]

This is particularly important in the UK, where only 2.5 per cent of the economy is concerned with hi-tech manufacturing, but where 76 per cent is in service sector businesses.[4] By confusing science policy with wider innovation policy, we are in danger of ignoring the types of innovation most important to the UK today.

Connect, collaborate, innovate

Given increased competitive pressures, many organisations can no longer solely rely on generating their own ideas.[5] Instead, they are turning to outside companies and innovators, which, combined with the pressures and opportunities of globalisation, specialisation and new technologies, are making innovation an increasingly open process.[6]

In particular, collaboration with consumers and users is making many businesses more innovative.[7] In fields such as surgical equipment, machine tools and mountain bikes, the user generates more new ideas than the manufacturer. In many markets, the needs of 'lead users' foreshadow those of the general market and they are therefore more likely to innovate for themselves.[8]

Multiple agents rather than a single organisation or agent can also be responsible for the development of the innovation – the online encyclopaedia Wikipedia or the open source operating system Linux are good examples.[9]

1. NESTA (2006), 'The Innovation Gap', (London, NESTA).
2. Over time, previously distinct definitions became conflated; in particular, 'science' became analogous to 'R&D'. This has been formalised by the codification of the OECD's definition of R&D in the Frascati Manual: any project to resolve 'scientific or technological uncertainty'. OECD (2002), 'Frascati Manual 2002', (Paris, OECD).
3. NESTA (2006), 'The Innovation Gap', (London, NESTA).
4. Office of National Statistics (2006), 'United Kingdom Input-Output Analyses', (London, ONS).
5. See http://www.btnewsonline.com/BTNewsOnline/Downloads/InnovationWP_Final_V2.pdf; http://www.openmalaysiablog.com/2006/10/open_innovation.html; http://www.whatpc.co.uk/computing/analysis/2183941/case-study-procter-gamble
6. Chesbrough, H. et al. (2006), 'Open Innovation: Researching a New Paradigm', (Oxford, Oxford University Press).
7. Von Hippel, E. (2005), 'Democratizing Innovation', (Massachusetts, MIT Press).
8. Ibid.
9. Von Hippel, E. and von Krogh, G. (2003), The Private-Collective Innovation Model in Open Source Software Development: Issues for Organization Science, 'Organization Science', pp.14, 209-223.
10. Fredriksson, T. (2005), R&D spreads out. Foreign Direct Investment. Available at http://www.fdimagazine.com/news/fullstory.php/aid/1438/R_D_spreads_out.html [accessed 10 October 2007].
11. OECD (2006), 'OECD Science, Technology and Industry Outlook 2006', (Paris, OECD).
12. These organisations rely on groups of practitioners and users submitting ideas before screening them and marketing the best ones to large developers.
13. InnoCentive operates as an online marketplace where problem 'seekers' find problem 'solvers'. Currently, it features a 'solver' database of over 120,000 scientists from 175 countries who consider problems posted by companies including Dow AgroSciences and Eli Lilly. A recent study found 240 people, on average, examined each problem, ten offered answers and 29.5 per cent were solved. Interestingly, the further the problem was from a solver's traditional area of expertise, the more likely they were to solve it.

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14. Chesbrough, H. (2003), 'Open innovation: the new imperative for creating and profiting from technology', (Massachusetts, Harvard Business School Press).

15. Chesbrough, H. (2003), The Era of Open Innovation, 'MIT Sloan Management Review', Vol. 44, No.3.

16. Ball, P. (2004), 'Critical Mass: How One Thing Leads to Another,' (New York, Farrar, Strauss and Giroux); Surowiecki, J. (2004), 'The Wisdom of Crowds', (London, Abacus).

17. Gann, D. and Dodgson, M. (2007), 'Innovation Technology: How new technologies are changing the way we innovate', (London, NESTA).

18. The UK's R&D intensity, at 1.9 per cent of GDP in 2003, is below that of its competitors. It is lower than Japan (3.2 per cent), Germany and the United States (2.6 per cent), France (2.2 per cent), and the EU-15 average (2.0 per cent). Organisation for Economic Co-operation and Development (2005), 'OECD Science, Technology and Industry Scoreboard 2005', (OECD, Paris). The UK was granted 3.76 per cent of triadic patent families in 2003, far lower than the US (37.56 per cent) but also lower than Germany (13.82 per cent) and Japan (25.85 per cent). All data from Organisation for Economic Co-operation and Development (2006), 'Main Science and Technology Indicators (MSTI): 2006/2nd Edition', (Paris, OECD). A 'patent family' is a set of patents taken out in various countries for the purposes of protecting a single invention. Triadic patents are filed at the European Patent Office, the Japan Patent Office, and granted by the US Patent and Trademark Office.

19. Further information is available at http://ec.europa.eu/growthandjobs/index_en.htm

20. HM Treasury, DTI and DfES (2004), 'Science & Innovation Investment Framework 2004 – 2014', (London, HM Treasury).

21. NESTA (2007), 'Hidden Innovation', (London, NESTA). Also, large companies tend to invest proportionately more in R&D than small companies. The UK has fewer large companies in some R&D-intensive sectors than countries like the US and Japan, and therefore invests somewhat less in R&D. See Abramovsky, L., Griffith, R., and Harrison, R. (2005), 'Background Facts and Comments on 'Supporting Growth in Innovation: Enhancing the R&D Tax Credit'', (London, Institute for Fiscal Studies).

22. NESTA (2007), 'Hidden Innovation', (London, NESTA).

23. NESTA (2006), 'The Innovation Gap', (London, NESTA).

24. Lord Sainsbury of Turville (2007), 'The Race to the Top – a Review of Government's Science and Innovation Policies', (London, HM Treasury), p.5.

25. NESTA (2007), 'Hidden Innovation', (London, NESTA).

26. Ibid.

27. Lord Sainsbury of Turville (2007), 'The Race to the Top – a Review of Government's Science and Innovation Policies', (London, HM Treasury), p.5.

Innovation goes global
Many companies are internationalising their R&D. The different components that made up this previously unified group of activities are being outsourced to different locations, often to make the most of local advantages like skills availability or tax rates.[10]

Indeed, in 2003, the world's biggest companies spent $70.6 billion on R&D outside their home countries, compared to $33.9 billion in 1995.[11] This fragmentation of innovation activities is also creating a new breed of intermediary agencies, such as Big Idea Group, Eureka Medical[12] and InnoCentive.[13]

For businesses to innovate in this way, they must share knowledge with external partners,[14] thus making international collaboration and networking increasingly important to innovation processes.[15]

Innovation technology is creating a new environment for innovation
'Innovation Technology' (IvT) – including eScience, virtual reality, simulation techniques and rapid prototyping – is enabling firms to collaborate, and to innovate more rapidly, efficiently and accurately than ever before.

IvT helps new communities of innovators to evolve, creating flatter structures, subverting 'experts' through on-line communities using wikis, MySpace, Facebook and other collaborative spaces.[16] The mainstreaming of these technologies should create an entirely new environment for innovation.[17]

Two: Build effective metrics to measure the innovation that matters to the UK

Traditional metrics are based on a subset of innovation
Traditional innovation indicators, such as R&D expenditure and patent production, reflect and reinforce the 'pipeline' view of innovation that dominates international innovation policy. Based on these indicators, the UK does not perform well, particularly compared to other leading countries.[18]

The European Union has set a 'Lisbon agenda' target of increasing 'R&D intensity' (total expenditure on R&D as a percentage of national GDP) to 3 per cent by 2010.[19] The UK Government responded with a goal of increasing the UK's R&D intensity to 2.5 per cent by 2014.[20]

However, this target may be misplaced because the UK's relatively low R&D intensity largely reflects a services-dominated economy where traditional R&D intensity is inevitably lower since the innovation that matters most to service sectors is rarely science-based. We term this uncounted innovation 'hidden innovation'.[21]

Many sectors are more dependent on 'hidden innovation'
Despite going unmeasured, 'hidden innovation' frequently represents the innovation that most directly contributes to the real practice and performance of a sector.

This refined definition includes science-based innovation but adds other innovations neglected by traditional indicators such as new drilling techniques in oil production, back-office technologies in financial services, or improved programmes for the rehabilitation of offenders.[22]

Traditional metrics ignore public services
Traditional indicators also ignore innovation in public services and the significant economic and social benefits that it can deliver.

Sometimes, public sector innovation resembles that in the private sector – new genetic tests in the NHS are a good example.[23] In other cases, new forms of organisation like the Open University create opportunities for previously under-served communities. Similarly, new concepts such as the introduction of market principles to create emissions trading can help to meet social challenges such as climate change.

Developing more complete metrics
The Sainsbury Review recognised the need to understand innovation in the UK's service sectors, and to move away from R&D spend and patent production as lone proxies for innovation performance.[24]

Four criteria are essential to the development of these new metrics: accuracy, longevity, comparability and ease of collection.[25] Previously, a focus on comparability (and, arguably, longevity) has compromised accuracy. New metrics should better balance these criteria, focusing on the overall health of a sector's innovation system rather than specific inputs or outputs.[26]

Understanding innovation in different sectors
The Sainsbury Review recognises that 'we need to understand better how innovation takes place in the very different industries which make up the services sector'.[27] Recognising this, the Department for Business, Enterprise and Regulatory Reform (BERR) has commissioned research on broader categories of innovation, including innovation in services.

NESTA is currently working with BERR to establish five business-led Sector Innovation

Groups (SIGs). When they report in Spring 2008, they will identify the drivers and barriers to innovation in selected service sectors, and show where and how Government might better support and stimulate their innovation.

Three: Ensure that thinking and learning skills are taught alongside technical skills

Policy associates innovation skills almost exclusively with STEM skills

Traditionally, when discussing skills for innovation, policymakers focus on the supply of graduates with science, technology, engineering or maths (STEM) skills. In the UK, this was most recently reflected in a new Government target that measures the proportion of doctorates in STEM subjects at UK universities.[28] The Government is right to see this as part of a broad agenda to ensure that the UK has the skills necessary to build an innovative economy, but it is not the only such driver.

Innovative individuals have a range of skills and attitudes that support innovation

Innovative individuals generally require a combination of technical and cognitive skills and attitudes conducive to innovation.

Technical skills tend to be highly subject-specific and can be taught with varying results throughout life. By contrast, cognitive skills are cross-disciplinary – adaptability, creativity, problem-solving, collaboration, interpersonal skills and leadership – and these building blocks of thinking and learning are best taught at an early age.[29]

Although innovators are diverse, they often have common attributes, including the willingness to take risks, challenge established practices, seize initiatives, and confront problems.[30]

Embed soft skills across the school curriculum

To drive up levels of innovation, the current policy focus on basic and technical skills must be supplemented by a better understanding of the importance of cognitive skills and a long-term strategy to embed them across the school curriculum. Given that such skills help individuals to learn hard, technical skills,[31] doing this will support existing educational aims.[32]

Develop a coherent approach to skills across the educational system

While the Government has rightly united Higher Education and Further Education with the innovation agenda in the Department for Innovation, Universities and Skills (DIUS), some of the most important skills and attitudes necessary for innovation are best developed early in the educational process.[33]

DIUS must work closely with the Department for Children, Schools and Families (DCSF) to develop the skills necessary for innovation throughout the lifelong educational system.[34] And, following the recommendation for a 'demand-led' skills system in the Leitch Review, both DIUS and DCSF must work closely with BERR to ensure that the UK's future economy is well-supplied with the skills it needs.[35]

Four: Encourage innovation across government

Innovation policy has tended to neglect the public sector and social innovation

Innovation is critical to meeting social challenges

Our most significant social challenges – such as those associated with an ageing population and environmental sustainability – defy conventional solutions. The UK currently lacks sufficient capacity to develop the necessary innovations or scale up existing good practice to meet these challenges.

Innovation is often inhibited in the delivery of public services

In the process of public sector innovation, all ideas at some point have to pass through gatekeepers – either politicians or civil servants. This system often discourages public sector workers from being innovative, chiefly through excessive bureaucracy, siloed working practices and short-termism.[36] While there has been some significant innovation in public services or by the third sector, it remains the exception rather than the norm.

Leading for innovation

Pro-innovation governance should be recognised and supported by those in power. Each department should have a Minister responsible for protecting and nurturing innovation, with board members aligning the 'major forces' of an organisation (such as budgeting and audit) towards innovation. Any governance structure that does not regularly assure itself that there is a flow of potential new ideas will, albeit inadvertently, stifle innovation.[37]

Departments and agencies should develop teams to organise and advance innovation. Given the growing importance of open innovation, these units need to include people who look across different sectors and different parts of the world for promising ideas.[38]

28. PSA Delivery Agreement 4: Promote world class science and innovation in the UK (October 2007), available at: http://www.hm-treasury.gov.uk/media/F/D/pbr_csr07_psa4.pdf; see p.20.

29. Bloom, B. S. (1956), 'Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain', (New York, David McKay Co Inc.).

30. Colangelo, N. et al. (2003), 'Young Inventors' (chapter) in 'The International Handbook on Innovation', (UK, Elsevier Science).

31. Ofsted (2005), 'Developing enterprising young people: features of the successful implementation of enterprise education at Key Stage 4', (London, Ofsted). This report states that inspection evidence shows that 'students are motivated by effective enterprise education and that it can also result in better teaching and learning across the curriculum.'

32. NESTA (April 2007), 'Education for Innovation', (London, NESTA).

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

34. NESTA (July 2007), 'Innovation Policy at the Cabinet Table', (London, NESTA).

35. Lord Leitch (December 2006), 'The Leitch Review of Skills: Prosperity for all in the global economy - world class skills', (London, HM Treasury). NESTA (December 2006), 'Skills and Innovation: A Response to the Leitch Report', (London, NESTA).

36. Mulgan, G. and Albury, D. (2003), 'Innovation in the Public Sector', Working Paper Version 1.9, October (Prime Minister's Strategy Unit, UK Cabinet Office).

37. Mulgan, G. (April 2007), 'Ready or Not? Taking innovation in the public sector seriously', NESTA Provocation No.3, (London, NESTA).

38. Geroski, P. and Markides, C. (2005), 'Fast second: How smart companies bypass radical innovation to enter and dominate new markets', (San Francisco, Jossey Bass).

39. For more on SBRI see www.berr.gov.uk/innovation/sbri and for more on SBIR see www.sba.gov/SBIR.

40. Connell, D. (2006) '"Secrets" of the World's Largest Seed Capital Fund', Centre for Business Research, (Cambridge, University of Cambridge).

41. Ibid. 13 per cent of US federal R&D contracts go to small businesses. This is amplified by additional annual 'set aside' targets for departmental spend with small US businesses, with a statutory minimum of 23 per cent.

Encouraging innovation through procurement

SBRI targets must be backed by programmatic and cultural change
The UK's Small Business Research Initiative (SBRI) programme was modelled on the Small Business Innovation Research (SBIR) scheme in the US.[39] However, the UK scheme has not yet matched the success of its US counterpart.[40] While both share targets of 2.5 per cent of external R&D being sourced from small businesses, the US figure is viewed only as a starting point.[41]

NESTA therefore welcomes Lord Sainsbury's proposal that departments should actively engage with innovative businesses and that they should specify the technological areas where they would like to see projects.[42]

Reforms must lead to a broader change
However, even if these recommendations are implemented, this will not maximise the impact that public sector procurement can have on the UK's innovative capacity.

Greater success will require a broader cultural change within government. Departments must recognise that a mandatory minimum target is only the beginning of greater engagement with small innovative firms. And, in the longer-term, wider public sector procurement should be used to spur innovation beyond the narrow science and technology remit of the SBRI.

Monitoring innovation in government

Developing an Innovation Report
The Sainsbury Review recommended that the DIUS Director of Innovation should produce an annual report 'on the innovation activities of DIUS, including the Technology Strategy Board, other government departments and the Regional Development Agencies'.[43]

Such an Innovation Report could help DIUS to understand and drive innovation across the UK economy and society. Given how 'non-innovation policy' (such as skills, taxation or regulation)[44] can stimulate or hinder innovation, NESTA is also pleased that Lord Sainsbury recommended that innovation should be 'embedded in Departmental Strategic Objectives'.[45]

Five: Make the most of universities and play to their individual strengths

Universities have been placed at the heart of innovation policy
The UK Government increasingly sees universities as agents of economic growth.

The Lambert Review of Business-University Collaboration 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 the university sector'.[46] Universities also form a critical element in the Science and Innovation Investment Framework[47] and their role has been a core area of investigation for Lord Sainsbury's Review of Government's Science and Innovation Polices.[48]

The link between universities and innovation is now reflected in government structures
DIUS's remit emphasises the link between innovation policy and universities. It brings together 'the nation's strengths in science, research, universities and colleges to build a dynamic, knowledge-based economy'.[49] This approach is reflected in Scotland, Wales and Northern Ireland.[50]

Universities play five distinct roles in innovation
Universities have traditionally had three main missions: research, teaching and transferring knowledge. The UK's increasing need to innovate will place further pressure on these roles, but will also require universities to develop international and regional missions.

Universities can act as hubs in international knowledge networks, exploiting knowledge and attracting the best overseas talent. They are also increasingly becoming leading partners in regional economic development strategies, and a major element of any innovation strategy.[51]

Creating an appropriate recipe for success
Few universities can excel in all five roles outlined above. Each must choose where to concentrate its efforts, reflecting its strengths and regional requirements.

For example, in an area dominated by services, a university might choose to provide more consulting and teaching services. In regions with greater advanced manufacturing or biotech industries, their main focus might be on pure research and spin-out companies.

The recipe will vary across the UK. The exact balance cannot 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.[52]

42. Lord Sainsbury of Turville (2007), 'The Race to the Top – a Review of Government's Science and Innovation Policies', (London, HM Treasury), Recommendation 8.8, p.131.

43. Lord Sainsbury of Turville (2007), 'The Race to the Top – a Review of Government's Science and Innovation Policies', (London, HM Treasury), Recommendation 8.2, p.119.

44. For more information on 'non-innovation policy' and the importance of framework conditions, see NESTA (2007), 'Hidden Innovation', (London, NESTA).

45. Lord Sainsbury of Turville (2007), 'The Race to the Top – a Review of Government's Science and Innovation Policies', (London, HM Treasury), Recommendation 8.3, p.120.

46. Most of the recommendations of the Review were taken forward. Lambert, R. (2003), 'Lambert Review of Business-University Collaboration', (London, HM Treasury).

47. HM Treasury, DTI and DfES (2004), 'Science & Innovation Investment Framework 2004 – 2014', (London, HM Treasury).

48. Lord Sainsbury of Turville (2007), 'The Race to the Top – a Review of Government's Science and Innovation Policies', (London, HM Treasury).

49. DIUS website, The functions of the new Department, available at http://www.dius.gov.uk/functions.html [accessed 26 October 2007].

50. The Welsh Assembly Government's strategy for higher education includes a proposal for an innovation fund intended to drive up collaboration across the HE sector. Welsh Assembly Government (March 2002), 'Reaching Higher: A Strategy for the HE sector in Wales', (Welsh Assembly Government, Wales). 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 wellbeing of its people.' 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 26 October 2007]. In Northern Ireland, the Department for Employment and Learning is expected to publish a comprehensive review of HE policy in December 2007. 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 26 October 2007].

51. NESTA (September 2007), 'Five ways universities drive innovation', (London, NESTA).

52. Ibid.