Policy Briefing



Driving innovation in Scotland

Innovation is vital to Scotland's future economic prosperity and social well-being. As the nation becomes more reliant on services – and confronts national challenges such as an ageing population and environmental sustainability – it must develop its own distinctive innovation policies.

Scotland aspires to develop those sectors that add most value to its economy – advanced manufacturing, tradeable services and high-tech industries such as biotechnology, nanotechnology and genetics. In public services, the nation needs to do more with fewer resources, and better use the skills and resources of the third sector. All these aspirations have one thing in common – their dependence on a healthy innovation system. Scotland differs from other countries with similar goals in that it has a greater opportunity to make this transition, with a proud history of invention, a stronger Higher Education base than the rest of the UK, and a number of important growth sectors.

To make the most of these attributes the Scottish Government needs to develop a policy framework that supports all forms of innovation, led by a new Minister for Innovation in the Scottish Government. This Minister should consider creating a Scottish Innovation Centre to catalyse the nation's ecology of innovation.

Innovation is critical to meeting the economic and social challenges of advanced economies in the 21st century

Innovation has become a major source of competitive advantage¹

Variations in levels of innovation are directly related to economic growth and trade performance.² Investments in innovation enable individual businesses to outperform their competitors. Innovations in processes, products and services – together with expansion into new markets – are critical if Scottish businesses are to thrive in a globalised economy, creating social benefits by driving wealth creation and employment.³

Social innovations help tackle social and environmental challenges

Social innovation is innovation in response to social needs – the Open University and NHS Direct are well known examples but the term applies equally to the recent reorganisation of children's services in the Highlands and Islands.⁴ Developing social innovations is increasingly important to advanced economies as they struggle with seemingly intractable challenges such as those presented by climate change or an ageing population.

Scotland faces specific economic challenges

Scotland's economy is changing

Scotland's industrial and manufacturing base declined throughout the 20th century. Heavy industries such as coal, steel and shipbuilding now make up a smaller part of the economy, with manufacturing contributing only about 15 per cent of GDP in 2003 compared to 30 per cent in 1961.⁵

Significant regional differences

The Central Belt and Tayside/Grampian regions dominate Scotland economically and demographically.⁶ This is where most universities and businesses are located. However, 98 per cent of Scotland's land mass is rural.⁷ Regions such as the Highlands and Islands, Borders, and Dumfries and Galloway lack universities and have been traditionally more dependent on land-based and traditional manufacturing industries such as textiles and food production.⁸

However, this may be changing. Industry is diversifying with greater investments in renewable energy, and Higher Education is being introduced through the new Crichton University Campus in Dumfries and the development of the UHI Millennium Institute, a higher education facility for the Highlands and Islands.



1. The Department of Trade and Industry (DTI) defines innovation as the successful exploitation of new ideas. See Department of Trade and Industry (2003), 'Innovation Report, Competing in the Global Economy: The Innovation Challenge', London: DTI.

2. See Metcalf, J. S. (1998) 'Evolutionary Economics and Creative Destruction.' London: Routledge; also Fagerberg, J. (1987) A Technology Gap Approach to Why Growth Rates Differ. 'Research Policy.' 16. pp.87–99; and Fagerberg, J. (2002) 'Technology, Growth and Competitiveness: Selected Essays.' Cheltenham: Edward Elgar.

3. For example, see the discussion in The Young Foundation (2006) 'Social Silicon Valleys, A Manifesto for Social Innovation.' London: The Young Foundation.

4. For further details, please see the forthcoming NESTA-Young Foundation research project on local social innovation, to be released Q1 2008.

5. Harris, R. (2006) 'The Role and Importance of Manufacturing to the Scottish Economy.' Centre for Public Policy for Regions, Universities of Glasgow and Strathclyde.

6. Scottish Executive (2006) 'The Scottish Innovation System: Actors, Roles and Actions.' Edinburgh: Scottish Executive.

7. The Scottish Government defines 'rural Scotland' as 'settlements with a population of less than 3000.' For more information see http://www. scotland.gov.uk/Topics/Rural/ rural-policy/16780/6661 [accessed 02 October 2007].

8. South of Scotland Alliance (2007) 'South of Scotland Competitiveness Strategy 2007-2013'. Available at http://www. crred.org.uk/images/uploads/ southscotlandcompetitivenessstrat .pdf

9. Scottish Government (2007), 'Business Enterprise Research and Development 2005.' Edinburgh: Scottish Executive.

 Scottish Executive (January 2007) 'Statistics Publication Notice: Business Enterprise Research and Development 2005.' Edinburgh: Scottish Executive.
 Ibid.

NESTA Policy & Research Unit

1 Plough Place London EC4A 1DE research@nesta.org.uk www.nesta.org.uk 12. Scottish Executive (2006) 'Measuring Progress Towards a Smart, Successful Scotland: 2006.' Edinburgh: Scottish Executive. 13. Scottish Enterprise website. Available at http://www. scottish-enterprise.com/es/ sedotcom_home/grampian-lifesciences/grampianlifesciences/ the_bigger_picture.htm [accessed 10 October 2007].

14. Scottish Enterprise website. Available at http://www. talentscotland.com/view_item. aspx?item_id=1365 [accessed 10 October 2007].

17. Financial Services Skills Council website. Available at http://www.fssc.org.uk/cgi-bin/ wms.pl/News_and_events/841 [accessed 30 October 2007]. 18. The Scottish Executive uses DCMS's definition of the creative industries: 'The creative industries are those that have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property.' Scottish Executive website. Available at http:// www.scotland.gov.uk/Topics/ ArtsCulture/CreativeIndustries/ creativeindustries [accessed 25 October 2007].

 Scottish Enterprise website.
 Available at http://www.scottishenterprise.com/sedotcom_home/ sig/digitalmedia/digitalmediakeyfacts.htm?siblingtoggle=1 [accessed 25 October 2007].
 Bell, D. and Sarajevs, V. (2004) "Scottish education: spending more – earning less?" Stirling: Scotecon.

21. Scottish Executive (2006) 21. Scottish Executive (2006) 22. Scottish Covernment (2007) 23. Scottish Government (2007) 24. Scottish Government (2007) 25. Scottish Executive. 25. Scottish Executive. 26. Scottish Executive. 27. Scottish Executive. 28. Scottish Executive. 29. Scottish Executive. 20. Scottish

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 Scottish Executive (2006) The Scottish Innovation System: Actors, Roles and Actions.' Edinburgh: Scottish Executive.
 Ibid.

26. Scottish Executive (2001) 'A Science Strategy for Scotland.' Edinburgh: Scottish Executive. 27. Scottish Executive (2006) 'A Science Strategy for Scotland 2001: A Progress Report.' Edinburgh: Scottish Executive. 28. Scottish Government (2007) 'Science and innovation strategy for Scotland, report on the consultation.' Edinburgh: Scottish Executive.

Traditional innovation indicators show variable performance

Scottish universities perform particularly well in terms of Research and Development (R&D) with 0.65 per cent of GDP in 2004.⁹ However, gross expenditure on R&D represents just 1.46 per cent of GDP overall, less than the UK average of 1.71 per cent.¹⁰ This is partly because business expenditure on R&D (BERD) accounts for just 0.59 per cent of GDP.¹¹ The low level of business expenditure is reflected in the low figures for patents filed. In 2004, the UK Patent Office registered just 1,085 patent applications originating in Scotland.¹²

But Scotland has good 'innovation fundamentals'

Scotland has a great history of inventions

Scotland has a culture that encourages invention. This is personified in great inventors like James Watt (the steam engine), John Dunlop (rubber tyres), Alexander Graham Bell (the telephone), Alexander Fleming (penicillin) and John Logie Baird (television) – together with its ongoing record of social innovation.

Scotland performs well in a number of important industries

Scotland has a solid and long track record in life sciences. Its biotechnology industry is growing at 30 per cent per annum, well above the 17 per cent growth rate for the rest of Europe.¹³ Indeed, even though less than ten per cent of the UK population live there, Scotland accounts for approximately 15 per cent of the UK's life science companies and attracts 13 per cent of the total health research funds in the UK.¹⁴

Financial services account for seven per cent of total GDP and for one in ten jobs.¹⁵ Since early 2000, the industry has grown by 55 per cent.¹⁶ Indeed, Edinburgh is the second largest financial services centre in the UK after London and the fifth largest in Europe.¹⁷

Similarly, the creative industries are a significant and growing share of the economy and one of Scotland's fastest growing sectors.¹⁸ The digital media and creative industry sectors currently contribute five per cent of the total GVA and employ approximately 194,000 people.¹⁹

An above-average and improving skills base

Historically, investment in education has been higher than in the rest of the UK.²⁰ Scotland not only has a higher proportion of graduates in the workforce than the UK average,²¹ but the proportion of the working age population with degrees has grown faster than in England, Wales and Northern Ireland over recent years, rising by eight per cent between 1997 and 2004 compared to just six per cent across the UK.²²

Scotland is more active in knowledge transfer than the UK as a whole

Scottish universities produced 11 per cent of UK spin-out companies in 2003.²³ However, their research doesn't always reach or impact on indigenous small and medium-sized enterprises (SMEs).²⁴ Indeed, most Scottish universities have stronger links with externally-owned and non-Scottish UK firms than with indigenous SMEs.²⁵

The Scottish Government has focused on boosting science, R&D and knowledge transfer

Development of science and innovation strategies

A Science Strategy for Scotland was published in 2001, which set out a vision of harnessing the potential of science to increase prosperity.²⁶ It focused on research excellence, commercialisation of science, science education, public understanding and science in Government.

A report by the Scottish Executive in 2006 suggested that 'good progress' had been made on implementing the strategy, but recognised that it needed refreshing.²⁷ A consultation on a Science and Innovation Strategy for Scotland was then carried out, with a report on the consultation issued in September 2007.²⁸

A focus on boosting R&D spending

There are several schemes in Scotland that support R&D and knowledge transfer activity, including SMART: SCOTLAND, the SCORE programme, the Small Company Innovation Support, the Proof of Concept Programme and R&D PLUS.²⁹ Three Intermediary Technology Institutes have also been set up in the areas of Life Sciences, Energy and Techmedia to increase the level of knowledge transfer between businesses and universities in these sectors.³⁰

Improving STEM skills and supporting enterprise in education

Over recent years, the Government has focused on boosting Science, Technology, Engineering and Mathematics (STEM) skills and enterprise education. In 2001, the Science Strategy led to an increase in the number of science teachers and improved advice on career opportunities in science.³¹ The Scottish Executive also launched the Determined to Succeed programme in 2003, which has helped create nearly 8,000 school/business partnerships and helped train 22,000 teachers in enterprise education.³² The Scottish Institute for Enterprise was funded in 2005 to stimulate enterprise among Scotland's students.³³ The Government's 2007 lifelong learning skills strategy identified the need for a new unified skills body to make it easier for people to access the support they need to develop their skills.³⁴ The merger of Careers Scotland and learndirect scotland is a step towards achieving this.³⁵

Traditional indicators are necessary but insufficient

Traditional metrics are based on an outdated model of innovation

Traditional innovation indicators assume that innovation is synonymous with scientific and technological invention – a subset of innovation only relevant to a small proportion of the economy.³⁶

In this model, formal R&D leads to new discoveries that are then incorporated into a new product or process and then 'pushed out' to consumers. This is the linear or 'pipeline' model of innovation, which was not designed to anticipate the emergence of new sectors and the new forms of innovation that accompany them.

Traditional metrics ignore innovation across different sectors

In fact, Scotland's 'R&D intensity' (total expenditure on R&D as a percentage of national GDP) is lower than many other countries largely because its economy is skewed towards industries (particularly services) where R&D intensity is lower. However, the innovation that matters most to service sectors is rarely science-based.³⁷ Furthermore, traditional indicators ignore innovation in public services and the significant economic and social benefits that it can deliver.

Many sectors are more dependent on 'hidden innovation'

Despite going unmeasured, non-science-based 'hidden innovation' that goes uncounted by traditional indicators frequently represents the innovation that most directly contributes to the real practice and performance of a sector. This refined definition of innovation continues to include science-based innovation but also many other innovations neglected by traditional indicators of innovation. For instance, in the private sector it includes new drilling techniques in oil production or backoffice technologies in financial services.³⁸

In some instances, innovation in the public sector is very similar to that underway in the private sector – as with the development of new genetic tests in the NHS.³⁹ In others, new forms of organisation (like the Open University) create opportunities for previously underserved 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.

Innovation itself is changing

Innovation is increasingly a collaborative process

Given increased pressure to innovate to remain competitive, many organisations can no longer solely rely on generating their own ideas.⁴⁰ As a result of these pressures and supported by globalisation, specialisation and new technologies, innovation is increasingly becoming an open process, involving users, suppliers and companies of all sizes from up and down the supply chain.⁴¹ However, Scottish businesses currently do not interact enough with external actors or with universities in particular.⁴²

Collaboration with users is increasingly a source of innovation for many businesses. In many fields such as surgical equipment, machine tools and mountain bikes, the user is frequently more innovative than the manufacturer. In many markets, 'lead users' have needs that foreshadow those of the general market and they are highly likely to innovate for themselves.⁴³

Finally, multiple agents rather than a single organisation or agent can be responsible for innovation. Examples include online encyclopaedia Wikipedia and the open source software movement, most famously the operating system Linux.⁴⁴

Globalisation is changing where innovation happens

Many companies are internationalising their R&D activities and choosing to place different components of these previously unified activities in different locations depending on their particular advantages (such as skills availability and tax rates).⁴⁵ In Scotland, almost 70 per cent of R&D is undertaken by foreignowned enterprises.⁴⁶

Collaboration and networking across geographical boundaries are therefore increasingly central to innovation processes.⁴⁷ This fragmentation of innovation activities is also leading to the emergence of a new breed of intermediary agencies, such as Big Idea Group, Eureka Medical⁴⁸ and InnoCentive.⁴⁹

Innovation technology is creating a new environment for innovation

A new set of technologies is emerging that enables firms to collaborate, and therefore innovate more rapidly, efficiently and accurately than ever before. This 'Innovation 29. Scottish Government website. Available at http:// www.scottishbusinessgrants. gov.uk/rsa/CCC_FirstPage.jsp [accessed 30 October 2007]. 30. Scottish Enterprise website. Available at http://www. scottish-enterprise.com/ sedotcom_home/services-tobusiness/ideas-and-innovation/ iti.htm?siblingtoggle=1 [accessed 09 October 2007] 31. Scottish Executive (2006) 'Science strategy 2001: Progress report.' Edinburgh: Scottish Executive

32. Smarter Scotland Scottish Executive (2007) 'Determined to Succeed, Three Years On...'. Glasgow: Scottish Executive.
33. Scottish Institute for Enterprise. Available at http:// www.sie.ac.uk/index.cfm/ display_page/about [accessed

10 October 2007]. 34. Scottish Government (2007) 'Skills for Scotland, A Lifelong Skills Strategy.' Edinburgh: Scottish Executive.

35. Scottish Government press release (26/09/2007) 'Scottish Skills Strategy.' Available at http://www. scotland.gov.uk/News/ Releases/2007/09/10100853 36. NESTA (2006) 'The Innovation Gap.' London:

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Innovation.' London: NESTA. 38. Ibid.

39. Ibid.

40. For more information, see http://www.btnewsonline.com/ BTNewsOnline/Downloads/ InnovationWP_Final_V2.pdf; and http://www.openmalaysiablog. com/2006/10/open_innovation. html; and http://www. whatpc.co.uk/computing/ analysis/2183941/case-studyprocter-gamble

41. Chesbrough, H. et al. (2006) 'Open Innovation: Researching a New Paradigm.' Oxford: Oxford University Press.

42. Scottish Executive (2006) 'The Scottish Innovation System: Actors, Roles and Actions.' Edinburgh: Scottish Executive.

43. Von Hippel, E. (2005) 'Democratizing Innovation.' Massachusetts: MIT Press.

44. 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.

45. 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].

46. Scottish Executive (2006) 'The Scottish Innovation System: Actors, Roles and Actions.' Edinburgh: Scottish Executive. 47. Chesbrough, H. (2003) The Era of Open Innovation. 'MIT Sloan Management Review.' 44 (3).

48. These organisations rely on groups of practitioners and users submitting ideas before screening them and marketing the best ones to large developers.

49. InnoCentive operates as an online marketplace where problem 'seekers' find problem 'solvers'.

50. 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.

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

52. See Realtime Worlds website. Available at http://www. realtimeworlds.com/ [accessed 25 October 2007].

53. Glasgow School of Art website, available at http:// www.gsa.ac.uk/gsa.cfm?pid=19 49&version=flash&detect=done [accessed 25 October 2007]. 54. Scottish Executive (2007) 'Next Generation Broadband in Scotland.' Edinburgh: Scottish Executive.

55. NESTA (2007) 'Hidden Innovation.' London: NESTA.

56. Ibid.

57. Ibid.

58 Scottish Screen and Scottish Arts Council (2006) 'Response of the Scottish Arts Council and Scottish Screen to the Draft Culture (Scotland) Bill 2006.'Available at http://www. scottisharts.org.uk/resources/ publications/arts_culture/pdf/ Response%20of%20the%20S cottish%20Arts%20Council% 20and%20Scottish%20Screen %20to%20the%20Draft%20C ulture%20bill%20050407.pdf [accessed 30 October 2007]. 59. Scottish Government (2007) 'Principles and priorities: The Government's Programme for Scotland.' Edinburgh: Scottish Government.

60. Starter for 6 website. Available at http://www.nesta. org.uk/programmes/starter_for_ 6 faccessed 30 October 20071.

61. Technical skills tend to be highly subject-specific and can be taught with varying degre of effectiveness throughout life. By contrast, cognitive skills are not subject-specific and are best taught at an early age. They refer to cross-disciplinary skills such as adaptability, creativity, problem-solving, collaboration, interpersonal skills and leadership - the skills that are the building blocks of thinking and learning Bloom, B. S. (1956) 'Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain.' New York: David McKay Co Inc. 62. NESTA (2007) 'Education for Innovation.' London: NESTA

Technology' (IvT) includes eScience, virtual reality, simulation techniques and rapid prototyping. IvT provides new opportunities for communities of innovators to evolve, creating flatter structures, subverting the role of 'experts' through discussions in on-line communities using wikis, MySpace, Facebook and other collaborative spaces.⁵⁰ Over time, the mainstreaming of these technologies is likely to create an entirely new environment for innovation.⁵¹

The opportunities represented by IvT are already reflected to some extent in Scotland with the development of software technology companies such as Realtime Worlds in Dundee⁵² and of initiatives such as the Digital Design Studio at the Glasgow School of Art.⁵³ However, the diffusion and adoption of IvT might be slowed down by the fact that only around 44 per cent of Scotland's population will be able to benefit from the third generation broadband by 2015, because of inadequate infrastructure.⁵⁴

Developing the right framework to boost innovation

A Minister for Innovation in the Cabinet

The importance and cross-functional nature of the innovation agenda means that effective innovation policy needs to have a senior departmental home, with a Government Minister for Innovation represented in the Cabinet. Such a Minister would have a role to encourage innovation across all sectors of the economy and in Government. As well as the direct levers under their control, they must also have influence over the other areas of policy – such as regulation and procurement – that can be critical for innovation performance.⁵⁵

Understanding how different sectors innovate

Most initiatives focus on basic science, formal R&D and commercialisation. However, in many service sectors, innovation relies on other types of innovation: the exploitation of existing technologies or the development of new business models. Policymakers therefore need to understand these different dynamics and examine how innovation happens in the most critical sectors of the Scottish economy. Where possible, this process should be conducted through both existing industry groups and other stakeholders essential to innovation (consumer groups, regulators and representatives of a sector's 'innovation hinterland').⁵⁶

Developing an annual Innovation Index to monitor innovation

The Scottish Government should seek to develop its own annual Innovation Index

better to guide policy development. By using sector-specific indicators, this would capture both the traditional and hidden innovation in major sectors better than the current generic indicators, and provide a better health-check of the capacity of the Scottish innovation system. For instance, in oil production, investment in exploration technologies is a better proxy for innovation than traditional R&D.⁵⁷

Implementing initiatives to boost innovation

Developing a hub to catalyse innovative activity

The Government should be considering innovative ways and testing new models to catalyse collaborative activity across Scotland. One such approach would be to create a Scottish Innovation Centre. This would have a number of functions. Primarily it would develop a series of platforms that brings together individuals and organisations from the public, private and third sectors to collaborate and find innovative solutions to tackle specific challenges.

However, small businesses often do not have the knowledge to engage in such processes. The Centre should therefore use the learning generated from these activities to work with small businesses to encourage and enable them to engage in collaborative activity with other businesses, sectors and universities.

Developing support for the creative industries

There is no single overall strategy for the creative industries, and support remains fragmented.⁵⁸ However, the Creative Scotland Bill being introduced into Parliament will legislate for the amalgamation of the Scottish Arts Council and Scottish Screen to establish a new national cultural development body – Creative Scotland.⁵⁹ NESTA's Starter for 6 programme could form a useful basis for identifying how best to support creative businesses.⁶⁰

Giving people the full set of skills essential to innovation

If individuals are to participate successfully in innovation, they generally require a combination of technical and cognitive skills and attitudes conducive to innovation.⁶¹ The Scottish Government should build on initiatives such as the schools enterprise programme 'Determined to Succeed' to ensure that the full range of these skills for innovation are embedded across the primary and secondary curriculum.⁶²