

SCOTLAND'S SCIENCE STRATEGY: AN EXERCISE IN CONCURRENT POWER?

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INTRODUCTION

When the Scottish Parliament was formed in the summer of 1999 one of the founding aspirations was to develop a policy-making process in Scotland that engendered a shift from a narrow conception of government to a more inclusive notion of associative governance (Brown 2001) that would involve both policy-makers and a wide range of stakeholders in the policy-making process. At the same time, in the field of science, technology and innovation policy, the Scottish Parliament inherited both a suite of existing UK policies and also a distinctive Scottish trajectory in regional innovation policy and economic development, supported by a number of significant pre-existing institutions. The devolution settlement gives Scotland some scope to develop its own distinctive policies for science, technology and innovation but also presents some limitations as many of the factors that influence this policy field are reserved to the UK Parliament at Westminster (for example, research funding, defence policy, European policy). While it is clear from the devolution settlement that the Scottish Parliament has limited fiscal and monetary autonomy, the situation surrounding science, technology and innovation policy is more complex: with certain aspects devolved and others reserved, science policy, and to a significant extent innovation policy, are 'concurrent powers'¹.

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1 This is the technical term used to describe policy matters that are partly devolved to the Scottish Parliament and partly reserved to the UK Parliament. Although the Scotland Act 1998 (Chapter 46, Section 56) uses the term 'shared powers' to describe the functions that are to be exercisable jointly by Scottish and UK ministers (see

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Used in this sense, the term ‘concurrent power’ indicates shared policy competences between governance levels and exemplifies the concept of multi-level governance. However, Scottish devolution was intended not only to transfer powers downwards territorially but, as noted above, to foster a new type of politics with more participation that would lead to more consensus politics, stronger Parliamentary committees, and power sharing between the Executive, Parliament and the civil service, and so this research has extended the concept of concurrent power to include power sharing – or at least power relations – between key Scottish policy actors. Finally, a key focus is on the impact that devolution has had on the actual processes of policy-making and policy learning for science, technology and innovation and the research project, of which the study reported here forms a part, adopted an ethnographic approach to examine the interactions between policy-makers² and representatives from the academic and commercial life sciences sector (‘policy targets’³) to explore whether the policy-making process has become more interactive and participative. So this is the third sense in which this study uses the term ‘concurrent power’: to reveal power sharing between policy-makers and policy targets.

If governments wish to influence technological and innovation capacity at the regional level (such as the Scottish level) they must develop policies that support learning processes; that develop policy networks to improve communication and co-ordination within the region; and that foster policy learning by ensuring that regional bodies understand their own strengths and weaknesses, compare their situation with other regions and learn from their experiences (Cooke et al 1997; Cooke 1998). But, there are limits to what a ‘region-state’ such as Scotland can achieve when it seeks to use science, technology and innovation policy to foster regional economic growth. Maskell and Tornquist (1999, p.50) describe regional development policy as mainly a process of ‘making do’ with the historical legacy of institutions and

www.hmso.gov.uk/acts/acts1998/80046--e.htm#56, last accessed 08/02/05), the term ‘concurrent power’ seems to have been adopted into general parlance by the Scottish Parliament to describe these circumstances (see Scottish Parliament Official Report Wednesday 2 June 1999, www.scottish.parliament.uk/business/officialReports/meetingsParliament/or-99/or010504.htm, last accessed 08/02/05).

2 Specifically, unelected officials, i.e. civil servants, rather than elected policy-makers.

3 The term ‘policy targets’ is used to denote those on whom science, technology and innovation policy is designed to have an impact, i.e. universities, research institutes, technology-based firms and their representatives.

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routines, maintaining that economic processes are so strongly path dependent that we can never build anything entirely new. In recently devolved territories, key policy actors tend not to have significant expertise in policy development and often favour a simplistic, linear approach to science, technology and innovation policy; thus Cooke et al (2000, p.134) suggest that the first challenge for the regional governance level is to facilitate learning processes that look both internally (matching policy to regional needs) and externally (learning from good practice elsewhere).

This paper explores the extent to which users are involved in the policy-making process for science, technology and innovation in order to gauge whether Scottish devolution has had a positive impact on the government to governance shift (see, for example, Pierre and Peters (2000)). It takes the specific example of the Scottish Executive's science policy document, **A Science Strategy for Scotland** (Scottish Executive 2001a), as an exemplar of regional science, technology and innovation policy post-devolution, and examines the consultation process that preceded its publication and the establishment of the ensuing Scottish Science Advisory Committee in order to analyse the extent to which policy targets influenced the content of this strategy⁴.

This paper argues that, although devolution presented the Scottish Executive with the prospect of developing an integrated and inclusive approach to Scotland's research and innovation strategy, the model promoted by the Executive continues to be one of 'academic push' rather than 'industry pull'. One might suppose that, under the terms of the devolution settlement, Scotland would have greater autonomy with respect to innovation policy than science policy, and perhaps infer that the Science Strategy was an attempt to integrate these two areas but, as we shall see, this has proved not to be the

⁴ This paper is an extract from a more extensive piece of empirical research which studied the impact of devolution on the policy-making process for science, technology and innovation in Scotland. The research adopted a primarily qualitative methodology to assess the role of policy networks for science and innovation in Scotland and used an exploratory case study approach in an attempt to illuminate the process whereby policy targets are involved in the governance of science, technology and innovation policy in Scotland post-devolution. The core methodology involved a series of in-depth, semi-structured interviews with a sample of policy targets connected to the Scottish life sciences sector and included a smaller comparative sample of policy targets from the Cambridge area. These interviews were complemented by case studies of Scotland's post-devolution flagship science strategy (reported here) and comparative policy networks drawn from different levels of governance.

case. This paper seeks to demonstrate that the thrust of the Scottish Executive's science policy document, **A Science Strategy for Scotland**, from inception, to consultation, to publication, and then to implementation has been on the public sector and on supporting the science base in Scottish universities, without reflecting sufficiently on the need to develop greater capacity on the demand-side in order to foster a vibrant technology-based economy. This apparent adherence to an out-dated way of thinking about innovation means that Scotland has so far failed to optimise the opportunities offered by devolution in terms of shared policy competences for science and innovation between and within levels of governance *and* between policy-makers and policy targets.

ENGAGING USERS IN THE POLICY-MAKING PROCESS

The production of the Science Strategy was a multi-stage process that took just under two years to complete. Only months after the establishment of the Scottish Parliament the then Minister for Enterprise and Lifelong Learning set up a Science Strategy Review Group to conduct a scoping study to identify the questions that needed to be addressed in order to put a Science Strategy for Scotland in place⁵. This Review Group identified 41 questions under six main themes and interested external parties were then invited to contribute their thoughts on what the answers to these questions might be. The consultation on the Review Group's report and the subsequent drafting of the Science Strategy were carried out by a small team of civil servants (the Science Strategy Team) under the overall direction of the Head of the Enterprise and Lifelong Learning Department⁶. Although initially intended as a six-month project, the final draft was not submitted to Ministers until February 2001.

The strategy document took a number of forms before settling on the one in which it was eventually published. Several reasons have been suggested for

5 Some would claim that the origins of the Science Strategy lay in the Royal Societies' report on devolution and science (Royal Society of Edinburgh and Royal Society of London 1999) which raised, amongst others, the issue of whether Scotland needed a Chief Scientific Adviser.

6 Now the Enterprise, Transport and Lifelong Learning Department (ETLLD) but the former title is retained in this article for consistency.

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the delay in approving the final draft including the need to redraft to make the document shorter; the intractability of Ministers (in particular the debate about 'the agriculture question'⁷); competing Ministerial priorities; and the political handling of the recommendation to set up a new science committee at a time when there was an initiative to cut the number of quangos (Scottish Parliament 2001).

Responsibility for the Science Strategy Team oscillated around various departments within the Executive during the prolonged gestation of the Science Strategy. Although this should have helped to facilitate a balanced strategy, the Enterprise and Lifelong Learning Department was the overall champion and what emerged from Ministerial discussions was a diluted version of the draft with a clear emphasis on the policy preoccupations of the Enterprise and Lifelong Learning Department. This has probably served to reinforce the pre-devolution policy trajectory, which emphasised the commercialisation of university research, and has not helped to promote a more 'joined-up' approach to science, technology and innovation policy within the Scottish Executive and its agencies.

The consultation on the report of the Science Strategy Review Group has been described as open but not necessarily very proactive (personal interview with policy-maker, 5 March 2002). According to Scottish Executive records, 656 individuals from around 460 different organisations received a written invitation to comment on the report. Over half (54%) of the consultees were from the public sector (Scottish government and tertiary education); and this figure increases to 61% if other UK government departments and agencies are included. Industry represented only 8% of the mailing list in the form of trade associations and individual companies⁸. Unsurprisingly, given this asymmetric sample, there were very few written responses from industry: of the 106 written responses on file in the Scottish Executive library, only five (5%) were from industry or trade associations, 34% were from the tertiary education sector and 19% from local government.

⁷ Agriculture being a high-spending department within the Scottish Executive where the issue of whether it is right to spend this amount was seen as a political question and not one for civil servants to answer.

⁸ Data from Scottish Executive.

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In addition to the written responses, the Science Strategy Team also conducted a number of meetings with a total of 147 individuals, the majority of whom were other civil servants (48%) and tertiary education representatives (20%). This asymmetry in responses and the focus on the public sector (government departments, agencies and higher education institutes) suggests that, from the outset, the Scottish Executive's interests lay in continuing its pre-devolution policy focus on the commercialisation of the science base and not in developing an integrated research and innovation policy for Scotland in which industrial R&D actors might have a role in order to improve Scotland's poor commercial research record.

Two recurring themes are strongly apparent in the 106 written responses to the consultation that were made publicly available. These encompass:

- Better co-ordination between 'science' and 'innovation' and the need to co-ordinate the science strategy with the multiplicity of initiatives and organisations already addressing many of the issues raised by the Review Group.
- Improving Scottish industry's research capacity.

As Scottish Enterprise noted in its response to the science strategy 'this is already a very busy space'⁹ and several respondents indicated that many of the issues raised by the Review Group's report had already been the subject of debate and consultation in Scotland in recent years¹⁰ and, indeed, were already being taken forward by existing organisations, some of which had only relatively recently been created¹¹. In pointing to the many different government technology transfer schemes, managed by a range of different departments and agencies at both the UK and Scottish levels, the Wellcome Trust suggested that some of this confusion and duplication could be obviated by a clear strategy that set the variety of funding schemes for technology

⁹ Written response from Scottish Enterprise dated 12 July 2000.

¹⁰ Written response from SHEFC dated 22 June 2000.

¹¹ Written response from SHEFC dated 22 June 2000; written response from Technology Ventures Scotland Ltd dated 3 July 2000.

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transfer in context, allowing for greater synergy and the possibility of comparative evaluation¹².

The need for co-ordination and coherence was a common theme and the University of Glasgow was one of a number of bodies calling on the Executive to ensure that there was an integrated approach to policy development, which would necessarily cut across the departments and agencies involved¹³. The Royal Society of Edinburgh noted that:

over-compartmentalisation between government departments and between scientific disciplines, and lack of co-ordination across the wider SET [science, engineering and technology] base, will frustrate an effective, integrated use of the science base in policy formulation¹⁴,

while the Executive's key agencies expressed the belief that 'significant benefits could be achieved by seeking greater co-ordination among the various agencies in Scotland that are involved in science policy'¹⁵ and called for 'a close alignment between frameworks for science, innovation and economic development, supported by close working between respective organisations'¹⁶.

The Scottish Council for Development and Industry pointed out in their response that, although a policy area such as science presents 'an excellent opportunity to practise the ideas of joined-up government and other holistic thinking'¹⁷, it would be very difficult to get the support of industry and the universities behind a Science Strategy 'if government has not got its own

12 Written response from Wellcome Trust dated 30 June 2000.

13 Written response from University of Glasgow dated 23 June 2000; see also Institute of Biology (29 June 2000), SUPRA (28 June 2000), Technology Ventures Scotland Ltd (3 July 2000), Scottish Council Development and Industry (10 July 2000), Institute of Directors (25 May 2000).

14 Written response from Royal Society of Edinburgh dated 10 July 2000.

15 Written response from SHEFC dated 22 June 2000.

16 Written response from Scottish Enterprise dated 12 July 2000.

17 Written response from Scottish Council for Development and Industry dated 10 July 2000.

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house in order'. Thus an overriding priority identified for the Scottish Executive was to fully integrate R&D policy into other related policy areas, especially economic development and education, and not to restrict the focus too narrowly to science¹⁸. As the Scottish Higher Education Funding Council noted, many of the questions posed by the Review Group raise wider issues about innovation, enterprise and economic development which go beyond the scope of a science strategy and the Council suggested that an important prior question should have been whether Scotland needs a co-ordinated research and innovation strategy rather than simply a 'science strategy'¹⁹.

Significantly, when we compare the contents of the consultation report with the commentary and feedback from consultees, an obvious omission from the report is any mention of the strategic challenge facing Scotland in terms of encouraging more industrial R&D, even though many responses pointed to the fact that universities are limited in their capacity to be engines of the economy if the corporate R&D capacity is a limiting factor²⁰. The considerable emphasis placed on encouraging commercialisation of research-generated ideas in Scotland in recent years highlights one of the major weaknesses of the Scottish economy where there is an absence of locally-based businesses capable of developing such ideas: the RSE noted in its response that the model promoted by the Executive was very much one of 'academic push' rather than 'industry pull'²¹. In a similar vein, several respondents expressed the view that a greater focus on the development of the capacity of the demand-side should be part of Scotland's science strategy²².

But despite these clearly articulated views from a range of different policy targets, there is a strong sense, reinforced by evidence gathered from policy targets and policy insiders, that at the end of the day it is neither the users' nor even the politicians' views but those of the civil servants that prevail.

18 Written response from University of Glasgow dated 23 June 2000.

19 Written response from SHEFC dated 22 June 2000.

20 Written responses from University of Glasgow dated 23 June 2000; Institute of Biology dated 29 June 2000.

21 Written response from Royal Society of Edinburgh dated 10 July 2000.

22 Written responses from University of Glasgow dated 23 June 2000; COSHEP (now Universities Scotland) dated 4 July 2000; Heriot Watt University dated 15 June 2000.

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When **A Science Strategy for Scotland** (Scottish Executive 2001a) was finally published in August 2001 it appeared to have been written very much as a framework, setting out the Scottish Executive's aspirations for science and taking as its starting point a vision of Scotland as a modern, dynamic country where the role of the science strategy was to meet the challenges of global competition, making the nation more prosperous and its economy more competitive. It focused on five key objectives:

- maintaining a strong science base;
- increasing the effective exploitation of scientific research;
- ensuring that enough people study science to meet the future needs of Scotland;
- promoting the awareness, appreciation and understanding of science across society;
- ensuring the effective use of scientific evidence in policy formulation and resource allocation by government.

The publication of the Science Strategy was described by the Scottish Executive as a 'major milestone' which resulted in the appointment of a Minister for Science and increased resources for university science as well as increased funding for knowledge exploitation initiatives such as the Proof of Concept awards and RSE Enterprise Fellowships²³.

Although promoted by the Scottish Executive as an 'integrated' strategy that 'marks the start of a more "joined up" approach to policy and investment decisions from the laboratory to business' (Scottish Executive 2001b), and despite the arguments for a coherent and co-ordinated approach to science and innovation set out by many of the respondents to the consultation, the thrust of the final document was on supporting the science base in Scottish universities and encouraging them to commercialise their inventions in order to foster a vibrant, technology-based, community of small and medium-sized enterprises in Scotland. The imagery and language throughout the strategy document imply that science is what takes place in laboratories in universities and publicly-funded research institutes, and so it is very much grounded in

²³ Proof of Concept awards and RSE Enterprise Fellowships are Scottish Enterprise funded initiatives aimed at increasing the commercialisation of the Scottish academic research base.

the ‘treasure trove model’ (SUPRA 2000) where universities are exclusively seen as *the* source of innovation²⁴.

CREATION OF THE SCOTTISH SCIENCE ADVISORY COMMITTEE

One of the most tangible outcomes was the establishment of the Scottish Science Advisory Committee to provide independent, expert advice to Scottish Ministers on scientific issues, including science priorities so that funding can be directed strategically. Although the membership of the Committee represented a breadth of expertise across a range of scientific disciplines, its members were predominantly senior academics with little representation from technology-based businesses or the social sciences.

The Scottish Science Advisory Committee was established under the auspices of the Royal Society of Edinburgh, with funding from the Scottish Executive, and was tasked with providing advice to Scottish Executive Ministers on ‘science strategy, policy and priorities to allow the Scottish Executive to make effective use of available scientific advice, knowledge and techniques in formulating and implementing policies to support the full range of its objectives’²⁵. The Scottish Science Advisory Committee was to take a medium- to long-term, horizon-scanning, strategic view in formulating its advice to Ministers and its role was specifically not to provide advice to the Executive on particular scientific matters, such as the previous incidents with BSE or foot and mouth disease. The Scottish Executive continues to get advice from a wide range of bodies and organisations including: the Council for Science and Technology, the established system of UK and European scientific advisory committees which provide independent expert advice on a wide range of specific scientific subjects, the Foresight programme and advice from organisations including the Food Standards Agency Scotland, the Scottish Agricultural Science Agency and the Scottish Environment Protection Agency.

²⁴ This ‘treasure trove model’ is clearly based on the discredited linear model of innovation discussed in more detail later in this article.

²⁵ http://www.scottishscience.org.uk/main_files/terms.htm (last accessed 6/12/04).

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The Scottish Executive apparently provided the Scottish Science Advisory Committee with a steering brief, which identified a number of key topics for the Committee to address based on the commitments contained in **A Science Strategy for Scotland**. However, the goals of the Strategy, itself, with some 55 commitments, many of which were given in very general terms, were not very precise, making performance measurement problematic. Above all, the Committee is only an advisory committee and cannot tell the Executive what to do:

It can only provide advice ... if we deem the committee to be functioning properly, it'll be advice that we would want to take. (personal interview with policy-maker, 18 February 2003)

The Science Strategy has been credited by policy-makers with helping to galvanise action by the Scottish Executive and its agencies and one of the positive outcomes was certainly the establishment of an internal group to co-ordinate the various departments within the Executive that have a responsibility for science policy. But, although this was meant to engender cross-portfolio working within the Executive, there were no representatives from either Scottish Enterprise or the Scottish Higher Education Funding Council on this Cross-Cutting Science Group and little free flow of information between the Group and the Scottish Science Advisory Committee, prompting the observation that:

the Executive preaches collaborations for everybody else, they're not so good at doing it internally. ... It's very much the civil service mentality of ... we can't share with people outside. (personal interview with policy adviser, 28 February 2003)

MAKING CONNECTIONS

The Scottish Science Advisory Committee's first report **Science Matters: Making the Right Connections for Scotland** (Scottish Science Advisory Committee 2004a) was launched on 13 January 2004. It called for all aspects of science activity in Scotland, including science funding via the research councils and the three main Scottish Executive departments (Enterprise and Lifelong Learning; Environment and Rural Affairs; and Health), to be brought into a better integrated framework to ensure that Scotland is more able to realise its full potential as well as improved access to and engagement

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with the science base for the public and policy-makers (Scottish Science Advisory Committee 2004b).

In launching the report, the Chair of the Scottish Science Advisory Committee called on the Executive to ‘add value through greater connectivity’ but acknowledged that a more integrated approach was difficult to achieve as it required interlinked policies, better connections within and between departments of the Scottish Executive, and better connections within and between government, higher education institutions, the NHS and industry so that ‘organisational boundaries should be [viewed as] conduits and not barriers’²⁶.

The report’s seven recommendations spanned science education, excellence in the science base, knowledge transfer from the science base, and science and society. In particular, the report took the view that:

to ensure the long-term viability and sustainability of science in Scotland, it is essential that there is a suitably broad appreciation of science and that all government departments must work together with the best possible coherence and complementarity to realise shared ambitions (Scottish Science Advisory Committee 2004a, p.15),

noting that this is particularly significant where new initiatives are being introduced, where there are ‘clear advantages to be gained by combining efforts and visions across and between departments and sectors’ (Scottish Science Advisory Committee 2004a, p.15).

The report also addressed the multi-level nature of science, technology and innovation policy and stressed the importance of Scottish connections with UK and European science policy discussions, calling on the Executive to establish ‘robust links into UK and EU networks, at both official and ministerial level, to ensure that the views and aspirations of Scotland are well represented’ (Scottish Science Advisory Committee 2004a, p.15). This section of the report also noted the need to develop ‘a network/forum to facilitate regular exchanges between the science base, policy-makers, funders and users of science’ in order to ‘share visions and aspirations in respect of

26 Speech by Professor Wilson Sibbett at the launch of Scottish Science Advisory Committee report *Science Matters: Making the Right Connections for Scotland*, 13 January 2004 in Glasgow.

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future planning'. According to the report, such a network should involve the Scottish Executive and its agencies with a range of organisations, including universities and higher education institutes, the Scottish Higher Education Funding Council, NHS Scotland, research institutes, Scottish Enterprise, Highlands and Islands Enterprise and the recently-formed Intermediary Technology Institutes.

The report's section on Science in Scotland concluded with the point that:

The framework for the support of science in Scotland should be made more effective through closer and better-connected interactions within and between the Executive Departments involved in developing policies that involve science. These connections should be extended to include those bodies, such as SHEFC, SEN, HIE and the Research Councils, that are involved in the distribution of funding for science activities. This will require better linkages being established between Departments and public agencies to promote connectivity within Government and this should extend to UK and EU bodies. (Scottish Science Advisory Committee 2004a, p.16)

and this need for greater connectivity is emphasised again in the report's concluding remarks:

The Scottish Science Advisory Committee believes that Scotland can deliver more effectively, not only in areas of leading-edge research but also in areas of teaching and training through to knowledge transfer and engaging with society. A major component of this endeavour involves a new level of connectivity that engages all of the stakeholders such that planning strategies should extend from elementary science education through to the exploitation of science and associated policy generation (Scottish Science Advisory Committee 2004a, p.52)

The Scottish Science Advisory Committee was set a rather amorphous agenda and this is reflected in its report. Some observers criticise the fact that the Committee's role is to give advice to the Scottish Executive, not the Scottish Parliament, and point to the need for Parliament to have a source of advice on science independent from that of Ministers. Others imply that the Committee is a rather grand science lobby group, a point that is possibly borne out by the new remit of the Scottish Science Advisory Committee, issued in March 2004:

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With reference to the strategic relevance to the Scottish economy and quality of life, to provide advice and make recommendations on the strategic priorities for the science base in Scotland, including priorities for expenditure. (Scottish Science Advisory Committee Remit Phase II)

In delivering this new remit, the Committee is required to consider amongst others:

- the distribution of public investment in the science base in Scotland; areas where expansion of investment is justified; areas where ceasing or reducing activity may need to be considered;
- new and emerging areas of science and research that could be of particular strategic relevance for Scotland;
- whether existing funding structures are consistent with the new strategic priorities that emerge and how they or modified structures might best facilitate the development of pan-Scotland initiatives²⁷.

Rather than optimising the interactions between policies to promote the science base and enhance industrial innovation, one early observer's suspicions that the Scottish Science Strategy might turn out to be 'how much money are we going to put into biotechnology' may well have been justified. Moreover, despite all of the exhortations to 'make the right connections', it is not evident from discussions with the actors involved that the foresighting role of the new Intermediary Technology Institute Life Sciences initiative, for example, will be integrated with the work of the Scottish Science Advisory Committee which is tasked with advising the Scottish Executive on science funding priorities.

The Scottish Science Advisory Committee has attempted to look at science across the breadth of the Scottish Executive's remit without being bound by civil service policy 'silos' and, through a series of working groups, the committee has examined mechanisms to promote excellence in the Scottish science base; the quality and content of science education; and public engagement with science and the use of science in policy-making. However,

27 [http://www.scottishscience.org.uk/main_files/word_docs/Scottish
Committee%20remit%20phase%20II.doc](http://www.scottishscience.org.uk/main_files/word_docs/Scottish%20Science%20Advisory%20Committee%20remit%20phase%20II.doc) (last accessed 6/12/04).

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the Executive's steering brief suggests that the real priority is the science base, the commercialisation of its outputs, and the identification of science funding priorities. With so many other organisations already tasked with science, technology and innovation-related priorities, including within the Executive itself, where the Environment and Rural Affairs Department and the Health Department already have clearly articulated research funding priorities, this draws attention to the fact that the Enterprise and Lifelong Learning Department does not have such priorities, which may explain its ardent quest for the Scottish Science Advisory Committee to deliver on this aspect of the Science Strategy.

But from the outset, there have been mixed messages about whether the strategy is simply about science policy or whether it is about co-ordinating science and innovation. The report of the Science Strategy Review Group made the case for developing a coherent and co-ordinated strategic approach, linking the science base with industry but, although it raised the issues of how to foster increased 'industry pull' in Scotland and how best to link a science strategy into a related economic framework for Scotland, the report maintains that this 'raises wider issues beyond the scope of a science strategy' (Scottish Executive 2000).

According to the European Commission (Anon 2003), 'innovation primarily takes place in enterprises, so they need to be involved in developing policies' but Scottish firms certainly view the Science Strategy as being very much about the science base and the membership of the Scottish Science Advisory Committee as being predominantly academic – 'the usual suspects'. Policy insiders also criticise the remit of the Scottish Science Advisory Committee for taking far too narrow a view of science and feel that it was wrong of the Executive not to integrate enterprise and innovation with science. As discussed above, the Scottish Science Advisory Committee advocated the adoption of a more integrated framework in their report to the Scottish Executive (Scottish Science Advisory Committee 2004a). However, as it stands, neither Scottish Enterprise nor the Scottish Higher Education Funding Council has a role on the Scottish Science Advisory Committee, even as observers, nor are they members of the Scottish Executive's internal Cross-Cutting Science Group.

Accepted wisdom about innovation has evolved from thinking that information flows in one direction from basic science to technology and thence to the production and diffusion of new products (the so-called 'linear

model of innovation'), and instead conceptualises the innovation process as interactive, non-linear and characterised by learning across firms, sectors, regions and national systems (Mytelka and Smith 2002). Although public technology policies underpinned by these linear models are now seen as unhelpful (Williams and Edge 1996) and a significant body of work exists that demonstrates that thinking has moved on from the linear conception to produce a more realistic model of innovation²⁸, many commentators point to the fact that this linear approach is still implicit in much science, technology and innovation policy at both the UK and European levels (see, for example, Tait and Williams (1999)).

Nightingale (1998) suggests that the enduring success of this approach 'is more to do with how easily it provides a justification for the public funding of science ... than any empirical validation' and certainly the Scottish Executive's response to the Scottish Science Advisory Committee's report (Scottish Executive 2004) focuses primarily on public investment in science. While paying lip service to collaboration between different departments within the Scottish Executive, this Ministerial response presents a very one-sided view of science policy and makes no attempt to foster a co-ordinated research and innovation strategy.

CONCLUSIONS

In attempting to facilitate regional innovation, it would be foolhardy for Scotland to continue the tendency to place artificial boundaries around science and innovation. Such boundaries ignore the fact that innovation does not simply result from research undertaken in universities (Lyll and Tait 2004; Faulkner and Senker 1995). These points were clearly articulated by many of the respondents to the Scottish Executive's consultation exercise, analysed above. This analysis suggests that what Scotland needs is an integrated strategy for research and innovation that can begin to address the 'mismatch between the capacity of the knowledge base and an industrial base that is structurally unable to exploit it' (Dalton 2001). While some see the glimmer of a shared agenda between the various players in this game beginning to develop and the slow recognition of the nature of this mismatch, if Scotland's key policy instrument for the governance of science, technology

28 See, for example, Nightingale (1998) or Massey et al (1992, pp.58-85) for a review of the relevant literature.

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and innovation continues to focus on university spin outs, we will only ever address half of the equation and will not solve the problem of increasing the innovative capabilities of existing firms.

Although promoted by the Scottish Executive as an 'integrated' approach (Scottish Executive, 2001b), the thrust of the Science Strategy throughout the policy development process from inception, to consultation, to publication, and then to implementation has been on the public sector and on supporting the science base in Scottish universities and encouraging them to commercialise their inventions in order to foster a vibrant, technology-based, community of small and medium-sized enterprises in Scotland. Despite the claim that 'science has been interpreted to encompass the development, understanding and application of the physical, life and social sciences' (Scottish Executive 2001a, p.7), as noted above, the language of the Science Strategy document and the activities of the subsequent advisory committee imply that science is what takes place in universities and public sector research establishments, and a major role for the strategy is to hasten the transformation of this knowledge into new products, processes and services. Without wishing to down-play the value of what is included in the strategy document or the work of the Scottish Science Advisory Committee, this apparent adherence to an out-dated way of thinking about innovation is disappointing, albeit not entirely unexpected.

The Scottish government has missed a valuable opportunity with devolution, in general, and with the establishment of the Scottish Science Advisory Committee, in particular, to form a key network for science, technology and innovation, cementing roles between policy-makers in different government departments and agencies and with policy targets across the science base and technology-based industry. This lack of co-ordination within and between key government departments and agencies was highlighted in many of the written responses to the consultation exercise and again in the Scottish Science Advisory Committee's report (Scottish Science Advisory Committee 2004a). Instead, the policy system post-devolution is largely reproducing prior divisions between science, technology and innovation which is reflected in the unhelpful separation of responsibilities between different government departments and agencies; it continues to focus on science production rather than knowledge use; and is still failing to address the weaknesses in knowledge absorptive capacity within Scottish industry and the sector of small and medium-sized enterprises in particular.

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In their discussion of the new modes of knowledge production, Gibbons et al (1994) conclude that science and technology policies can no longer be regarded as functionally separate from innovation policies (ibid p.159) and describe how distributed knowledge production leads to the de-concentration of loci of advice whereby sources of specialist technical advice are more diverse and governments are less able to manage outcomes (ibid p.165). This article has tried to demonstrate that, although the Scottish Science Advisory Committee has made some preliminary steps on the way to becoming a more independent, integrated, and interactive policy network, the government is still firmly in control and we are not yet seeing the coming together of science, technology and innovation policy envisaged by Gibbons et al (ibid)²⁹.

While Scotland's Science Strategy could be viewed as an innovative first step towards tackling the 'silo' mentality around science, technology and innovation and economic development, it has not yet exemplified the model of concurrent power set out in the introduction to this article which envisaged a multi-faceted sharing of policy competences for science and innovation *between* and *within* levels of governance and between policy-makers *and* policy targets. It is, nevertheless, early days in this devolution experiment with a young administration at an initial stage of policy learning and it is hoped that some of the observations made in this paper will contribute positively to this process.

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29 Moreover, it is still too early in the devolution experiment to say with any certainty what impact many of the new breed of intermediary or representative organisations have had on the policy-making process for science, technology and innovation (Lyll, submitted).

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