Foresight in a Multi-level Governance Structure: Policy Integration and Communication

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Joyce Tait and Catherine Lyall

1. Introduction

At all institutional levels Foresight responds to a wide range of societal concerns - about risks and their regulation; prosperity and national wealth and how they are generated; public health; education and training; employment; social inclusion; and public perceptions and acceptance of technological innovation. To be effective regional Foresight should ideally be embedded in national and EU level systems. It should also take account of global developments, with smooth interactions across levels. Within each level there must be horizontal policy integration, particularly linking Foresight policies to science, innovation and regional development strategies.

Foresight is often planned and organised at national levels but where there are regional administrations, implementation of Foresight policies also takes place at the regional level. Effective implementation, with its attendant societal benefits, will thus depend on good communications within and across governance levels, including the global level, and also on ensuring that interactions among policies are mutually supportive and not antagonistic.

Many of these issues are being addressed by the development of new governance structures, for example in the UK under the 'Modernising Government' agenda, and Foresight ought to be a crucial component of these structures. Yet despite frequent references to the need for more integrated approaches to policy development, new governance initiatives are largely socially-oriented and ignore science and Foresight-related issues; and Foresight policies fail to recognise governance initiatives being developed in other policy contexts (UK Office of Science and Technology, 2000; Commission of the European Communities, 2001; Scottish Executive, 2001).

This paper builds on earlier research on policy integration and Foresight in the context of the development and implementation of science strategies and policies at regional, national and EU levels (Tait and Williams, 1999; Tait, Lyall and Williams, 2001) and also on studies for an EC funded project[1]. We are exploring the nature and extent of the linkages and perceived gaps in decision making structures in these areas and the implications this has for the regional development of Foresight and for communications, vertically and horizontally. These regional aspects are influenced by interactions at all policy levels, up to and including the global level, and can either promote or frustrate regional Foresight initiatives.

We draw particularly on experience in Scotland as a case study where the recent devolution settlement and the re-opening of the Scottish Parliament have, at least in some areas, allowed greater freedom of action at the regional level. In the context of Foresight, this example raises interesting questions about the relative importance of the size of the political unit and its ability to act autonomously. For example Scotland, a constitutional region of the UK, is similar in size to Eire, Denmark and Finland but has less political autonomy than these nation states. Similar issues may arise in other European states like Germany or Spain where there is also considerable devolution to the regional level but some reservation of political powers to the national level.

Foresight is widely interpreted to be about the processes of fostering scientific research in order to support technological innovation and hence regional and national competitiveness, and in many cases can be seen as reinforcing the much criticised linear model of innovation (Tait and Williams, 1999). Policy initiatives thus focus on:

[1] EC Fifth Framework STRATA Programme, Accompanying Measure 'Integrating Technological and Social Aspects of Foresight in Europe' ITSAFE.

- supporting science and fundamental research, including deciding which areas of scientific research are most likely to reward investment; and
- deciding how to encourage the commercialisation of the fundamental knowledge gained and tailoring the policy environment to support commercialisation.

Given the broad potential coverage of this paper we have structured it on the basis of the boundaries relevant to key actors operating at various administrative levels working with a range of Foresight-related issues. We thus envisage a hierarchical series of systems, some of which overlap, vertically or horizontally. Each of these interacting systems can facilitate the work of others or impose constraints on them, in the Foresight area usually through policy initiatives rather than formal regulation. Permeable and flexible system boundaries will facilitate communication and, counter-intuitively, although reducing the level of control exercised by each system, will support the achievement of higher level goals. These assumptions underline the switch from *government* to *governance* in debates about the modernisation of policy systems, as described in Section 2, implying a switch from constraining to enabling types of policy or regulation (i.e. from 'sticks' to 'carrots').

Policy integration, across and between administrative levels, is seen as crucial to achieving the benefits of these changes. Our analysis looks at policies and their integration in the contexts of science, Foresight and Governance at regional, national, European and global levels and we draw some conclusions relevant to their implementation, particularly at the regional level.

2. New Governance Approaches and Foresight

In the most common current usage of the term, ‘Governance’ is seen as implying a move from away from the previous *government* approach (a top-down legislative approach which attempts to regulate the behaviour of people and institutions in quite detailed ways) to *governance* (which attempts to set the parameters of the system within which people and institutions behave so that self regulation achieves the desired outcomes), or put more simply, the replacement of traditional 'powers over' with contextual 'powers to' (Pierre and Peters 2000).

New approaches to governance are being developed under a variety of labels at different institutional levels in many European countries. In the UK this on-going policy revolution has been referred to as the 'Third Way' (Giddens 1998)[2], with strong commitment to more integrated or 'joined up' approaches to policy.

Foresight is an offshoot of, or sometimes a synonym for, science, technology and innovation policies. Over the past thirty years there has been a steady shift in the emphasis of research policies at national and European levels, to obtain better value for money from public investment in research by ensuring that both curiosity-driven, fundamental research and applied research contribute as much as possible to improving competitiveness at national, European and international levels.

Effective policy integration would imply that science and Foresight-related policies ought to be crucial components of new governance initiatives but in our investigation of the relevant documents concerned with science, technology and innovation we found little evidence of their inclusion. The modernising government agenda concentrates almost entirely on the social policy arena covering social welfare, crime, health and education, these being the areas which focus groups tell government ministers are of most concern to voters. Science, technology, and innovation are apparently of lesser concern to voters in Europe and they are not linked in the public mind, and hence less likely to be linked by governments, to national competitiveness which generates the wealth to support the other functions.

[2] The term 'Third Way' seems to have been dropped from the political lexicon in the UK recently, although the new governance approaches it described are continuing to be developed.

This section considers these governance issues at UK and EU levels. The context of the Scottish case study is discussed in Section 4.

2.1 New approaches to governance and Foresight in the UK

2.1.1 Governance and Science Policy

Unlike other countries, Britain did not begin to expand state expenditure on R&D in the 1980s and was the only one of 19 major OECD countries during the period 1981-1985 where the growth in R&D expenditure was lower than growth in gross domestic product (GDP) (Nicholson *et al*., 1991, p.6). Priorities determined and choices made in this period have shaped many of the current weaknesses and strengths of the national system of innovation. To give just one example, in the 1980s and early 1990s the Conservative government withdrew all funding to universities and public sector research institutes (PSRIs) for any research that could be construed as 'near market', this being seen as the function of industry or commercial organisations. On the positive side this has led to a much leaner and more competitive public sector research environment in the UK. Alternatively, the policy failed to encourage more effective transfer of knowledge from public sector research to commercial exploitation. More recently there has been a complete reversal of this policy with much of science policy being directed towards encouraging, and also funding, of universities and PSRIs to engage actively in downstream development of the outputs of their research programmes.

In a surprise move in April 1992 the last Conservative government established the Office of Science and Technology (OST) which transferred responsibility for science and technology from the Department of Education and Science to the Cabinet Office and gave the UK a minister of Cabinet rank with responsibility for science for the first time since 1959. In creating the OST within the Department of Trade and Industry (DTI) the Government was seen to be proclaiming a new obligation for science and technology and some believed that this move was a recognition of the inadequacies of the market mechanism with its inability to deal satisfactorily with the competing claims for resources for research and development (Goldsmith 1992).

This new found interest in science policy was confirmed in 1993 with the publication of the first UK White Paper on science and technology for over 20 years. The white paper's failure to co-ordinate UK STI policy sufficiently (Lyall 1993) should be seen in the context of Ronayne's analysis that intradepartmental rather than overall co-ordination would seem to be the preferred policy mechanism in the UK where individual agencies are allowed self-determination while trying to avoid undue duplication of effort or pursuit of conflicting goals in different parts of Government (Ronayne 1984, p.141). In practice, co-ordination in Britain tends to mean cross-membership of committees: an 'insider's world' where a relatively small group of senior civil servants, elite scientists, and influential industrialists move from committee to committee (Ince 1986).

In the 1990s governments began to focus on their countries' specific strengths and the clusters approach to innovation, developed by Porter (1990) became increasingly influential on policy. Thus policy directed towards industry has been designed to be delivered at the local level and a clear trend, even before the devolution agenda, has been towards giving greater responsibility to agencies closer to the target audience. Decentralisation should encourage heterogeneity in national and regional technological capabilities and create opportunities for closer contact with firms but it can bring with it a loss of control and potential loss of learning as feedback to the centre may be lost (Dodgson and Bessant 1996).

In the UK, the focus on modernising the processes of government, as outlined in the *Modernising Government White Paper* (HM Government 1999), includes a complete framework for excellence in policy making and a strong emphasis on learning lessons from policy experience in other countries. The over-arching ethos is 'what matters is what works'

with, at least in theory, a much free-er flow of ideas across governments and government departments and from one level of government to another, focusing on ideas that can contribute to an effective system of governance, rather than on the ideology that generated the ideas.

The *cri de coeur* of the current Labour Government for 'joined up' policy is reflected in the goal of the *Modernising Government* initiative to develop a more integrated approach to policymaking, and a series of Cabinet Office publications (Cabinet Office Performance Innovation Unit 2000; Cabinet Office Strategic Policy Making Team 1999) aims to improve policy formulation and implementation in areas that cut across the policy boundaries of traditional government departments.

Some parameters of the new governance-based policy making systems are relevant to science strategy, such as initiatives on policy integration, evidence-based policy, the use of standards and guidelines linked to policy evaluation, encouragement of openness, stakeholder involvement and consultation, and avoidance of unnecessary regulatory burdens. However this integrated approach has not yet been extended to cover science and innovation policies *per se* and is not, for example, linked to the latest DTI White Paper on 'A Science and Innovation Policy for the 21st Century' published in July 2000 (OST 2000). Nevertheless a Ministerial Committee has recently been set up to consider UK Government policies in relation to scientific advances and public acceptance of them.

To varying degrees, at all institutional levels, science policy should cover a wide range of societal concerns about: risks and their regulation; prosperity, national wealth and how they are generated; public health; education and training; employment; social inclusion and public understanding; and the processes of government. Science is seen in some quarters as a passport to the worlds of innovation, quality of life and globalisation and an important component of competitive advantage but the policy framework does not yet reflect this vision.

Charles and Benneworth (2001) highlight the limitations of a governance system in which central departments are reluctant to cede powers to regions, as in the UK. They describe how the current UK system was established by the White Paper (OST 1993) whose 'central rationale …. was to create a system of scientific governance which generated excellence in UK science to boost the competitiveness of UK business'. However, these authors point out that a House of Commons enquiry (House of Commons Science and Technology Committee 2000) found that there was little coherence of research activity between government departments and they find that the problem with the system of scientific governance in the UK is that changes in science and technology policy do not fit well with other changes in the policy environment. Their claim that '…a top down scientific governance system weakens UK economic performance if it cannot direct scientific policy to create capacity for growth and development throughout its constituent regions' finds particular resonance in the context of devolution in a situation where science policy is dominated by the DTI and the top down approach to science policy can have negative regional impacts leading to a concentration of STI activity in SE England (Charles and Benneworth 2001) (see Section 6).

2.1.2 The evolution of UK Foresight

Against this background, the UK has been in the forefront of developing national approaches to Foresight since the first initiative was launched in 1994. In evaluating the first phase of Foresight, the Parliamentary Office of Science and Technology (POST, 1997) highlighted some key issues for OST to take on board. Their report noted that although barriers had been reduced between academics and industrialists and also between different disciplines and different companies, much remained to be done to reduce the cultural barriers between academe, industry, government and financial institutions. POST also pointed to concerns that government departments were not responding sufficiently to Foresight, thus losing the opportunity to implement a more co-ordinated science policy across government.

An analysis of the first round of UK Foresight conducted for the Scottish Higher Education Funding Council (Scottish Universities Research Policy Consortium, 1997) noted the need for more effective interdisciplinary interactions, given that the programme was structured around sixteen technology sectors which did not map naturally onto academic disciplines. Indeed many of the priorities identified within the Foresight process were interdisciplinary in nature. The report noted that the areas of coverage outlined for the Foresight Panels in the first phase provided a good example of a constructive approach to boundary setting in response to a new set of needs and opportunities:

> "As issues change and new issues and opportunities arise, as new information emerges about the issues of interest, or as research managers refine their ideas about useful boundaries around the area of interest, boundaries should be adjusted. … The existence of flexible and adjustable boundaries is a good indicator of the health of an interdisciplinary initiative such as Foresight."

Other comments from those evaluating Foresight programmes, which initially were largely controlled by industry and the science community, noted that they tended to yield discipline-based projections and that traditional Panel reviews are less appropriate for assessing prospects for the interdisciplinary areas covered in many programmes (Martin and Irvine, 1989, p.339). Martin and Johnston (1998) also noted that the successful development of technology policy requires the development of effective links between science and technology and the financial and legal systems and that '… the development of such links is becoming more crucial.'

The OST addressed many of these issues in the second round of Foresight, broadening the composition of Panels to include a broader range of public as well as private interests, and focusing on broad themes (such as 'Ageing Population' and 'Sustainable Development') as well as more conventional business and technology sectors. However, it was assumed (OST, 1998b) that Foresight II would not be fundamentally different from Foresight I but would concentrate on achieving its objectives more effectively, with its more inclusive and global approach, allowing systematic analysis of key issues and exploration of themes in a visionary manner (OST, 1998c, pp 3, 12)

A paper on the evaluation of Foresight II (Tait, Williams and Lyall, 2000) considered that, to be effective in meeting its own terms of reference, it should succeed in setting up a new 'social contract' which emerges through discussion and engagement between diverse actors (policymakers, scientists, industry, publics). To this extent it is necessary for Foresight to mean different things to different people and a diversity of goals can be seen as an indicator of flexibility and successful adaptation.

Foresight in the UK thus developed from its origins as a technically focused programme, geared towards research policy and the nexus between research and industry. Foresight II took on board criticisms that this involved a 'linear' technically-centred model of innovation and it pursued a broader societal approach, reflected in its emphasis on interdisciplinary working and interactivity. It sought to promote new kinds of thinking and changes in social relationships and networks across a wide range of players. However, the difficulties in pursuing such ambitious goals should not be underestimated and UK Government plans for the second phase of Foresight II suggest some dissatisfaction with progress to date. A more targetted approach is being promoted with the range of topics to be considered reduced to around four areas regarded by top thinkers from industry and the sciences as vital to the future economy. The idea of socio-economic integration into Foresight and indeed, in some cases, of incorporating panels dealing with social Foresight *per se*, has not been abandoned but the focus has been moved from the OST to other government departments more accustomed to dealing with such issues. It may be premature to conclude that the experiment of integrating a broader range of societal themes into Foresight processes, alongside scientific and technological concerns, has been abandoned but current indications would suggest that this may be the case.

2.2 Science Policy and Foresight at the EU level

Similar trends to those identified above in the UK are also beginning to emerge at the EU level with important documents being published on European Governance, the European Research Area, and developments in the Fifth and Sixth Framework Programmes. As in the UK there is evidence in these documents of difficulty in integrating policies, particularly across the science and technology/societal divide.

2.2.1 European Governance

The gap between innovative thinking on governance and developments in science and technology and in related policies is also apparent at the EU level. The recently published White Paper on European Governance (Commission of the European Communities 2001) has only one brief reference to the word 'science' in the context of managing '…the challenges, risks and ethical questions thrown up by science and technology'. There are no references to 'evidence', and for 'research' there is one mention of 'research centres' and one to the ERA, although there are references to scientific committees and the need for their advice to be made publicly available. The overall impression is that science-related issues are of only peripheral interest in the context of European governance. They come into the picture downstream, as a part of policy implementation but are not being integrated at a high level into the overall governance and policy development process.

However, this early reading of the Governance White Paper does not take account of more recent developments as indicated by the EC Science and Society Action Plan (European Commission, 2002) (see Section 2.2.3).

2.2.2 European Science Policy

The document on the European Research Area (ERA) is the main focus of innovative EU thinking on science and research-related issues. One of its main policy planks is the forging of closer links between the EU Framework Research Programmes and the research systems of EU member states, and the ERA will be implemented partly through the Sixth Framework Programme, involving also major changes in the organisation of research in Europe.

Prior to the development of ideas on the ERA, and influenced to some extent by UK thinking on the development of Foresight, the 5th Framework Research Programme took a new direction by giving a strong emphasis to interdisciplinary integration, particularly between the natural and social sciences, targeting Key Actions to socio-economic needs. FP5 was seen as incorporating major reforms, its underlying philosophy being described as as '… moving … to research which focuses on the social and economic problems which face society today'. This move towards greater interdisciplinary integration in research projects fits well with the need for more effective interaction between academic and industry partners and relevant markets and stakeholders, as incorporated into Foresight programmes.

Interdisciplinary integration has thus become an important element of Framework Programmes, guiding research collaboration among EU nations in a manner that has increasingly included socio-economic components. There is a strong link between the promotion of industry-academic links and the requirement for more interdisciplinary approaches to research in order to integrate the more complex array of issues that comes into play with the involvement in Foresight of a wider range of actors and stakeholders.

It would be unrealistic to expect such a major change in research orientation and management to bear fruit within the time scale of a single Programme. Although essential if Europe is to compete effectively in a global economy, it challenges many vested interests in both academic and policy spheres and, as we have noted, there have been strong reactions against it from several directions. The impact of such challenges on the Sixth Framework Programme is still not clear, but it was unfortunate that much of the detailed planning of programme areas was conducted in private consultation with a high level group of senior

European natural scientists, with no representation from other academic or public constituencies.

2.2.3 EC Science and Society Action Plan

An indication of the roles of scientific and societal issues in guiding thinking on both European governance and the ERA is given in the recent EC publication on *Science and Society: towards a new partnership*, adopted by the Commission in December 2001 (COM(2001)714 Final). The motivation for developing this paper arose from the perception that the European and global potential of contributions to innovation based on science and technology is out of step with European citizens' needs and aspirations. Suggested measures to combat such problems, incorporated in 38 specific actions, include: promoting education and a science culture in Europe; bringing science policy closer to citizens; and putting responsible science at the heart of decision making; thus changing the nature of the relationship between science and society. As noted in the Action Plan, these actions will only have an impact if member states make joint and co-ordinated efforts.

2.3 Global Governance Issues

As outlined by Tait and Bruce (2002, in press), the increasingly rapid pace of technological innovation and the increasing size and power of multinational companies are leading to globalisation of production and trading systems accompanied by pressures for further trade liberalisation.

In the context of one of the main themes of this paper, the rapid pace of technological change, supported in many cases by effective Foresight, poses enormous challenges for European nations, even when working together through the EU, to be internationally competitive with other major trading blocks in the global economy. Such questions are amplified for regional Foresight in considering what actions are appropriate and likely to deliver benefits at the regional level.

The emerging system of global governance is being mediated through international organisations like the World Trade Organisation. However, such changes diminish the sense of power and influence of individual citizens and appear to negate local and national democratic processes, raising fundamental questions of sovereignty and governance at national and regional levels. They are also being opposed by increasingly vocal and well organised public groups acting against globalisation and the pressures that are driving it. In the context of developments in genetically modified crops, Tait and Bruce (2002, in press) referred to the internationally organised consumer boycott as 'a new instrument of global governance'.

Giddens (1999) in his BBC Reith Lecture series on Globalisation noted this tension between pro- and anti- globalisation forces. He referred on the one hand to “… the mobilising dynamic of a society bent on change, that wants to determine its own future…”, and on the other hand he noted that we now live in a world where innovation and technological change has generated hazards that are regarded now as more threatening than so-called natural hazards.

Regional and national Foresight can no longer operate effectively without considering the pressures and constraints imposed at the global level. These include: international trading relationships; intellectual property rights; and the relevance of regionally-based technology clusters in the context of modern information and communication networks; as well as public support for, or opposition to, individual innovations.

3. The Multi-level Governance of STI Policy

The development or influencing of science policy is one of the main instruments open to those engaged in Foresight to encourage and foster the future outcomes that they identify as most desirable.

In many countries, policies to promote innovation, including Foresight, are developed at the national level and implemented regionally. Walker (1993) signalled a weakness in co-ordination within the UK national system of innovation (NSI) noting that Britain is poorly endowed with bridging institutions and has not historically had close producer-user relations. He attributes this to the British management style (traditionally hierarchical rather than participatory), a lack of a close co-ordinating relationship between banks and industry and a lack of 'collective integration' in the British economy, which he attributes at least in part to the cultural heterogeneity of Britain. As we note here, a similar range of gaps and inconsistencies can be found among various areas of policy relevant to Foresight

Generally, science policy is concerned with the advancement of knowledge, rather than the shorter term objective of solving problems or generating marketable applications. Technology policy on the other hand is concerned with the practical application of knowledge, often scientific knowledge, in a new way with the aim of generating commercial or other benefits (Diederen *et al.* 1999), for example by influencing the decisions of firms to develop, commercialise or adopt new technology. Technology can be considered as knowledge that moves between organisations in a variety of ways; this knowledge can be explicit and codified, for example in the form of patents or design specifications, or it may be tacit, for example based on the skills and experience of the workforce. Technology policy can thus be difficult to define precisely because the development process can be a continuum from relatively monodisciplinary scientific research to multidisciplinary commercial innovation (Jacobs 1998).

There has been a shift in recent decades from mission oriented technology policy (which led for example to the development of Concorde) to diffusion and demand-oriented 'innovation policy' which seeks to achieve successful exploitation of new ideas but recognises that innovation involves more than just technical issues and includes many organisational and managerial aspects. 'Technology transfer', used to describe the process through which technology moves among organisations, is necessary but not sufficient for effective innovation (Dodgson and Bessant 1996). It is a costly, cumulative activity which is often complex, multi-dimensional and firm specific. Although some aspects of technological knowledge are well articulated or 'codified', others are largely tacit. Furthermore, sectors and technologies differ in the ease and scope of technological advances as technological change generally follows trajectories defined by specific sets of knowledge and expertise (Dosi 1982; Dosi 1988). One of the chief aims of innovation policy must be to facilitate flows of technology and information among actors with the aim of improving the capacity of firms, networks, industries and entire economies (Dodgson and Bessant 1996).

Early attempts to model the process of innovation and to use such models for policy making were based on linear and simplistic views of how innovation occurs in firms. Innovation research has demonstrated the inadequacy of this linear model and promotes an interactive coupling of variables, recognising that effective innovation requires both push and pull as well as extensive interaction and feedback loops. However, versions of the linear approach still dominate public policy for technology transfer and innovation, despite the fact that many view it as not only inaccurate but harmful – 'It leads to a disproportionate emphasis on ‘getting the science right’ and insufficient emphasis on the business processes required to bring technology to the market place' (Howard Newby quoted in Tait and Williams 1999). Nevertheless, as Tait and Williams (1999) demonstrate, innovation processes are highly sector-specific and some may be more linear than others. For example, in the pharmaceutical and agrochemical sectors, stringent regulatory requirements force a more linear model of innovation on this sector than, for example in information and communication technology.

Current thinking on STI policy recognises the fundamental distinction between information and knowledge. Innovation is generally based on a variety of knowledge sources including public institutions and firm specific experiences. Success in innovation is no longer simply

the transfer of information but the capability of the recipient to do something useful with that knowledge and learning has become an essential feature of competitiveness.

With this deeper understanding of the innovation process has come a change in policy approaches which now tend to be more flexible and less specific, with less emphasis on technology push and a growing recognition that innovation is no longer simply a case of upgrading a company's resources but also of developing its innovative capability. Encouraging the learning process within firms and creating and increasing the effectiveness of intermediaries between users and suppliers have also become legitimate policy goals. Networks can diffuse and modulate policy so one task of government is to construct and maintain networks and design robust and flexible policy that can effectively be adapted and used through networks. In parallel with the decentralisation of industrial policy there has therefore been a corresponding growth of intermediary services that can expand the outreach of innovation policy.

UK policy recognises that technological change is the key to competitiveness but that the strong science base in UK universities is not reflected in industrial competitiveness. The 1993 White Paper identified the lack of UK technological progress not as a lack of innovative capacity but rather the inability to exploit innovation hence the proposed remedy was not increased investment but improved co-ordination to strengthen links between science (i.e. universities) and industry (Diederen *et al.* 1999). Policy aimed at developing collective learning and networking should be complemented by the development of linkages at national and international levels

Industry is affected by many facets of government policy including a vast array of laws, regulations and voluntary agreements such as tax law, employment law, and anti-discrimination legislation, only a few of which are the result of specific policies aimed at influencing the growth of industry (Coombs *et al*. 1987, p.199). As Porter notes (Porter 1990, p.626) the agenda of nearly every government agency touches national competitiveness in some way but it is the principal agenda of few bodies and in most governments the issue cuts across traditional ways of organising the social and economic policy agenda. He suggests (Porter 1990, p.618) that what is needed is a more varied role for government to engage in a wide-ranging programme which recognises that seemingly discrete policies are often interdependent. In UK policy development, for example, we are now seeing increasing emphasis on integrated approaches to policy development ('joined-up policy') although as we will demonstrate science and technology policy is one area that is not being integrated with others.

What is needed is an integrated research and innovation policy to create scientific and technical knowledge and provide the incentives for innovation (Branscomb and Keller 1999), including competition and regulation policies (Porter 1990, p.631). It should also focus on long-term investments in knowledge-based infrastructure and foster an economic climate that encourages private investment in R&D and the effective and innovative use and absorption of technology by firms and organisations. Substantial public investment in basic research in science and technology will continue to be needed as will workforce training at all levels, and encouraging regional initiatives to bring together firms, universities and research institutions (Pavitt and Sharp 1993).

Government policy must recognise that a 'one size fits all' approach is unlikely to work - every industry is different and government agencies must use a range of policy tools, direct (R&D funding) and indirect (tax and economic policy, regulations, standards, export promotion, procurement), to encourage R&D co-operation, access to capital and enhanced innovation. However, Maskell *et al.* (1998) have commented that 'many political programmes have intentionally only a symbolic effect on firm behaviour', 'a political rather than an economic purpose' and 'political action and engagement are often required to symbolise governmental rigour'.

STI policy today is thus no longer just a matter of resource allocation for research as it was in the early days of UK science policy. It is now a complex process involving multi-level governance at the national, sub-national and supra-national levels, which requires careful co-ordination to ensure effective policy integration. While discussions of competitiveness policy preoccupy national government, as much or more attention is necessary at the regional level in areas such as university education, infrastructure, and local research initiatives so that today the role of regional government is potentially as great or greater than the role of national government in ensuring competitive advantage (Porter 1990, p.622). Policies pursued by regional governments can give a distinctive identity to the regions in question, particularly where these regions are new and 'even somewhat artificial administrative units' (Cooke 1998). These points are borne out by our case study of the Scottish system of innovation.

4. The Components of the Scottish System of Innovation

Small countries or regions like Scotland face major challenges in developing their own approaches to successful technological innovation, international competitiveness and economic growth (Walsh 1988) and may struggle to make a significant contribution to new developments in world science and technology. They have less money to spend on R&D and fewer trained personnel but are faced with the same breadth of possible research areas as large economies. Small countries therefore face hard choices – they must either spread their resources more thinly or specialise and this issue must lie at the heart of their policies for science, technology and innovation.

4.1 Recent political developments

The opportunities for a specifically Scottish system of innovation is being influenced to some extent by the re-establishment of the Scottish Parliament in 1999, with powers to pass legislation but without powers over monetary policy and only very limited powers over fiscal policy. Although the implications of these major changes are still emerging, it is clear that Scottish businesses are more heavily affected by UK-level legislation on financial and economic matters than by aspects covered by devolved powers (Sloat 2000).

Key areas of responsibility devolved to the Scottish Parliament include:

- Health
- Education
- Transport
- Housing
- Training
- Economic development
- Agriculture
- Environment

Policy areas covered by the UK Government (known as reserved powers) are:

- Constitutional matters
- Foreign and Defence policy
- Most economic policy
- Social Security
- Medical ethics

Notably, there is no mention of science or innovation in either list. Many aspects of technology and innovation policy are covered by Scottish economic development policy; and some aspects of science policy, related to education, public understanding of science, universities and other higher education institutes may be covered by education policy. Science itself is a ‘concurrent power', meaning that responsibility is shared between the Scottish and UK Parliaments.

The split between devolved and reserved powers illustrates the highly complex situation of STI policy, with many of the key policy-makers remaining at the UK level. This means that, in the Scottish system of innovation, some of the key actors are essentially external to the system. This leads to questions about the boundaries of influence and control for the Scottish Parliament and the Scottish Executive, given that many of the drivers for UK

science are powers reserved either to the UK Parliament in Westminster or to the European Commission.

Critics doubt that the Scottish Parliament will be able significantly to enhance economic activity. While the Parliament may influence business decision-making, its powers may be largely confined to the public services given that many of the key aspects of government action that impact on business and the economy are reserved powers (Kerley 1999).

The National Systems of Innovation (NSI) approach provides a useful conceptual framework to define and describe these investments made by countries to promote and manage technical change (McKelvey 1991) and Figure 1 attempts to identify the key constituent parts that make up the system of innovation in Scotland, taking a broad definition of the NSI approach by encompassing all institutions and cultural factors which affect innovation in a national economy.

The role of government policy in NSI is not just about those policies directly targeted at technological advance but includes policies for educating the workforce and those aimed at shaping the macro-economic climate, regulation (e.g. environmental, patent protection), and public procurement. The role of government is particularly important in the Scottish system of innovation given the multi-level nature of governance with policy emanating from local, national and supra-national levels.

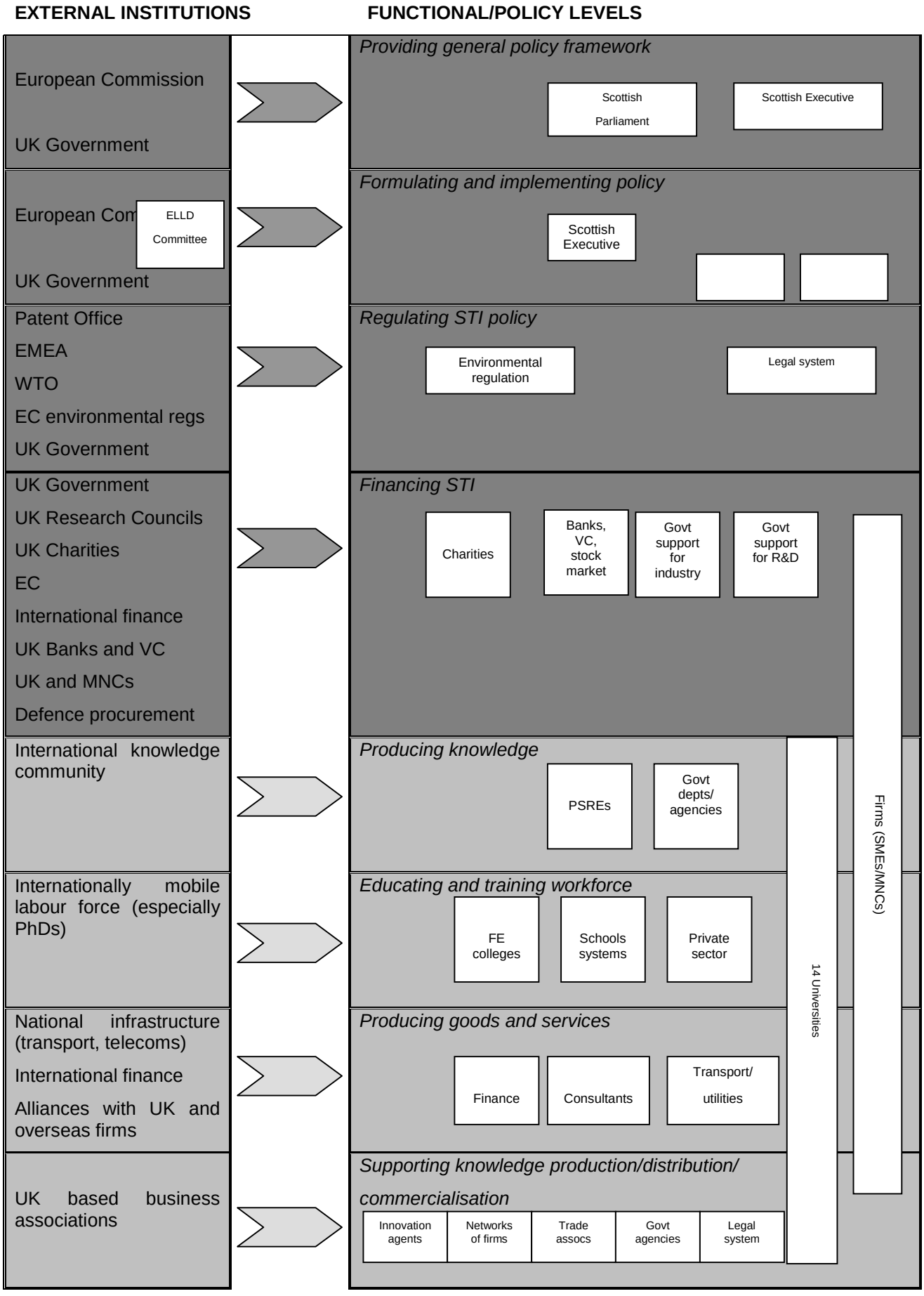
The right hand side of Figure 1 identifies eight functional/policy levels within the Scottish system of innovation. The left hand side of the diagram identifies institutions that are external to Scotland but which also have an impact on these policy levels. The top half of the diagram (darker shading) includes those policy areas that are the key drivers for science, technology and innovation – money, regulation and the overall policy framework for STI. What this approach illustrates is the relative autonomy of the Scottish system in the bottom half of the diagram (light shading), where there are few strong links with external institutions.

The concept of NSI also encompasses systemic interactions that cannot be reduced to the actions of specific firms, or to the existing R&D system or to competition among firms or institutions (McKelvey 1991). The component institutions regulate the manner in which the technological knowledge available within a nation or region is generated, developed and harnessed economically. Success depends on the synergy between these institutions. Within any system of innovation co-ordinated co-operation between governmental, scientific and political actors is needed to achieve international competitiveness. When one examines the Scottish policy arena from an NSI perspective many of the key drivers for science and innovation are external to the Scottish system. Devolution may thus be unintentionally reinforcing traditional tendencies to develop policy in separate compartments, rather than the more integrated approaches described above as desirable. This multi-level dimension of the Scottish system of innovation presents a considerable co-ordination and communication challenge.

4.2 The Scottish Science Strategy and its Links to Research and Innovation Policy

Policy links between the UK and EU levels are well defined and have been smoothed by long familiarity and regular use. Links between the UK and Scottish levels are still in their formative stages. They are based on a Memorandum of Understanding drawn up between the UK Government and the devolved administrations in Scotland, Wales and NI which includes specific supplementary agreements on financial assistance to industry, and EU policy issues. Again, science policy does not feature strongly, if at all, in most of these arrangements despite the fact that science-related issues underlie many of the policy areas being considered and that science is a concurrent power (i.e. some aspects are devolved to the Scottish Parliament and others are reserved to Westminster). Scottish science policy therefore spans a number of tiers of government - in Edinburgh, London and Brussels - and this institutional hierarchy is itself set within an evolving ferment of new ideas on how modern nations should be governed, as described above.

Figure 1 THE SCOTTISH SYSTEM OF INNOVATION



Providing general policy framework

At the top of the diagram is the general policy framework. This would include policies for the macro-economy, fiscal policy, trade and anti-trust laws, infrastructure development, regional development and public procurement. Although the Scottish Parliament does have the authority to vary the tax rate and is responsible for the infrastructure in Scotland, the macro-economy, defence (a significant driver for public procurement) and international trade law are all reserved powers. Regional development would fall within the Scottish Parliament's remit to a degree but is largely regulated (and financed) by the European Commission.

Formulating and implementing STI policy

The Scottish Parliament and the Scottish Executive do have more scope for formulating and implementing STI policy although again this has to be done within the frameworks set out by the UK government and the EC. For example, Foresight is a national initiative and the clusters approach to innovation although possibly given a different emphasis in Scotland is a central tenet of UK innovation policy.

Regulating STI policy

Scotland's distinctive legal system pre-dates devolution but the regulation of STI in the form of, for example, environmental standards, patent protection, and product licensing is still controlled by the UK, the EC and international law giving the Scottish Parliament little scope for high level policy interventions and leaving it essentially with an implementation and monitoring role and responsibility for local environmental issues such as planning.

Financing STI

Although the Scottish Parliament controls 60% of the public funding for research and development in Scotland (Miller 2000), the remainder comes from UK wide bodies in the form of the UK Research Councils and UK charities. Funding for research (both in the public and private sector) also comes in the form of European Framework funds and much of the private sector funding from banks, venture capital firms and multinational companies is also external to the Scottish system

Producing knowledge

Scotland has 14 universities and Scotland's academics produce 1 per cent of all research publications in the world - ranking Scotland third in the world for the number of research publications published per head of population (Universities Scotland website http://www.universities-scotland.ac.uk/). In the public sector there are several research establishments all of which could be said to contribute to the production of knowledge such as the five Scottish Agricultural and Biological Research Institutes (SABRIs), a range of non-departmental public bodies (NDPBs) including Scottish Natural Heritage, the Scottish Agricultural College, and the Royal Botanic Garden, and a number of executive agencies such as the Scottish Agricultural Science Agency, which an advisory and regulatory role.

Educating and training workforce

Countries that are sustaining competitive and innovative firms are characterised by good education and training systems, not just supporting universities but ensuring that universities and other education and training institutions provide graduates that meet industries needs. In addition to its universities Scotland also has two art schools, one conservatoire, one college of higher education, one university college, a teacher training college and are 47 further education colleges. Forty seven per cent of Scots now go into higher education (Universities Scotland website http://www.universities-scotland.ac.uk/) and around 400,000 students per year enrol in further education courses

Supporting knowledge production/distribution/commercialisation

UK government support for innovation relies less on direct financing and more on providing support mechanisms for technology transfer, developing organisational learning, and promoting networking. In Scotland there is a plethora of business support organisations from the public sector Scottish Enterprise Network to private sector law firms. Although the industry trade associations still tend to be UK and often London based, many are developing a greater Scottish presence post devolution based.

Producing goods and services

Finally, within the SSI there is the tier that actually produces goods and services although this is much broader than just the manufacturing sector. Customers fit in here as well as intermediate and final markets, supply chains and the infrastructure and utilities need to produce goods. Significant external actors include the alliances and collaborations that Scottish firms have with UK and international companies.

Cultural aspects

Although theoretical work on NSI tends to stress economic factors, technological innovation includes many complex factors, such as key industrial sectors, the national environment, cultural interactions, producer-user interactions. In the context of regional development, success is determined not only by technological and political considerations but also by institutional path dependencies (Braczyk and Heidenreich 1998). Cultural, social and historical explanations may therefore need to be taken into account and questions drawn from the literature on learning regions asked, such as:

- Is there an associative, learning culture where institutions co-operate?
- Does the system have a track record in managing institutional change?
- Are there good labour relations?
- What are the mechanisms to encourage networking?
- Is the education and research system integrated with the system of production?

There are thus limits to what a 'region-state' such as Scotland can achieve when it seeks to use STI 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 routines, maintaining that economic processes are so strongly path dependent that we can never build anything entirely new. Politics can both enhance and constrain innovation and governance at the regional level. Although regional states are limited in their legislative and policy aspirations (Latouche 1998), major political developments such as the re-establishment of the Scottish Parliament can create expectations and motivate individuals in ways that can circumvent long standing constraints and create unexpected outcomes.

As one example of such an outcome, Scotland is one of the few regions in the EU to have developed a formal science strategy (Scottish Executive 2001). The Strategy takes as its starting point a vision of Scotland as a modern dynamic country, the role of the science strategy being to meet the challenges of global competition, making the nation more prosperous and its economy more competitive. With clear connections to Foresight, it focuses 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

Although promoted by the Scottish Executive as an 'integrated' strategy (Scottish Executive News Release 2001) the thrust of the strategy document is on supporting the science base in Scottish universities and encouraging them to commercialise their inventions in order to foster a vibrant high tech SME community in Scotland[3]. Despite the claim that 'science has been interpreted to encompass the development, understanding and application of the physical, life and social sciences' the imagery and language throughout the strategy document imply that science is what takes place in laboratories in universities and PSRIs, 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, this apparent adherence to the linear model of innovation and the lack of recognition of a role for social and economic concerns is disappointing but not unexpected.

Where societal concerns are recognised the issues are presented in terms of greater public understanding of science and more effective communication by scientists in order to facilitate the transfer of knowledge from fundamental science through to the market place, once again a very linear, top-down perspective.

In the developmental stages of the Scottish Science Strategy, SUPRA's advice to the Scottish Executive (SUPRA, 2000) focused on the following points:

i. In the definition of 'science': there is a tendency to assume that there is a one-way flow of ideas, from academic and other public research institutions to innovative industries, but important fundamental scientific advances often arise in industry itself and the knowledge generated there can be transferred back to the academic community; if we are too restrictive in our assumptions about what constitutes science or where it takes place we are in danger of stifling innovation rather than fostering it.

[3] In considering policy integration the Science Strategy Document (p45) refers to the scope for more co-ordination of policy and spending across the Executive to ensure effective delivery of overall objectives.

ii. Many kinds of knowledge are needed for a successful advanced economy and both the generation of basic knowledge and wealth creation need to be supported by research, underpinning a shift from exclusive concern with natural sciences to including social science and other academic disciplines.

iii. We should not lose sight of the expectations on science to deliver outcomes for the public good, including products or processes which are not sufficiently profitable to attract industry or other commercial funders, and also research carried out to support regulation which may restrict industry's activities.

iv. In considering the needs of the Scottish economy, science policy and innovation policy are often developed in separate compartments. In keeping with the new integrated policy approaches it is important to develop linked policy strands to cover a wider range of science-related purposes.

v. An effectively integrated Scottish science strategy will need greater co-ordination of science issues within the Scottish Executive than we currently have, including a stronger base of technical expertise, better policy development capacity and more resources to conduct or commission their own policy-relevant research.

vi. A Scottish science strategy should also include mechanisms for integration with policy making in the UK and EU.

4.3 Scottish Foresight

Pre-devolution, at the inception of the UK Foresight initiative, there was a strong uptake of Foresight in universities and research institutes in Scotland. Many PSRIs, for example, began to re-structure their research programmes to coincide with the research areas identified by Foresight as important. The Scottish Higher Education Funding Council published and implemented a Foresight Action Plan in 1995 and requires the higher education institutions it supports to provide annual reports outlining their Foresight-related activity. The Royal Society of Edinburgh also had a prominent role in the promotion of Foresight and organised a series of Foresight Seminars reflecting the issues identified as important by the national Foresight Programme.

4.3.1 The Scottish Foresight Forum

In Scotland, Foresight is co-ordinated by the Scottish Foresight Forum established in 1996 to develop Foresight awareness and understanding in Scotland and to ensure complementarity with related policies and programmes, chaired by the Scottish Executive. A Scottish Foresight Co-ordinator was appointed in January 2000, based at Scottish Enterprise to work with the Enterprise Network and other business intermediaries to encourage companies to be more pro-active in anticipating future economic, technological and social change and in taking action to increase their long-term competitiveness (Scottish Executive, 2000).

According to the DTI (DTI 2000) Foresight activity in Scotland has led to innovative new measures that encourage companies and universities to be more forward-looking and is '…firmly rooted in collaboration between public and private sector partners, so that the Executive and its main Non-Departmental Public Bodies are happy to lead by example'.

The Head of Lifelong Learning in the Scottish Executive's Enterprise and Lifelong Learning Department and Chair of the Foresight Forum, describes it as '…an initiative which started to foster a dynamic, collaborative and cross-cutting approach before that became fashionable. In a country the size of Scotland you really can get all the key players in one room at the same time.'

In Scotland, Foresight activities for business are being channelled through a wide range of business intermediaries including industry and sectoral representative bodies; National Training Organisations; professional institutes and associations; and other business support bodies such as Local Enterprise Committees; and Chambers of Commerce. The stated

objective (Mearns 2001) is to influence business intermediaries by encouraging them 'to adopt as part of their mainstream activities a stronger focus on future issues and challenges'.

Recent activities of the Scottish Foresight Coordinator (Mearns 2002) have been focused on continuing to connect Foresight Panel outputs with relevant initiatives and interest groups in the context of the current transition of Foresight from a broad-based future change programme to one focused on a smaller number of science- and technology-related priorities. The current work of the Foresight Coordinator encompasses:

- ongoing strategic liaison with business intermediaries and the Scottish policy community, to increase awareness of and participation in Foresight among key business intermediaries, including CBI Scotland, Scottish Council Development and Industry, Federation of Small Businesses, the cluster teams, Scottish Enterprise Network and others
- a programme of Foresight events which have recently focussed on Nanotechnology, Chemicals and Bioinformatics
- helping to develop the Network of UK Foresight Coordinators

Among future directions, four UK regions (Scotland, Northern Ireland, NE England and SE England) are working together with a view to piloting and jointly funding new techniques for engaging business in Foresight during 2002/03. It is intended that these new processes will be applied to mainstream regional development activities as well as to Foresight, and also offered to business intermediaries (Mearns 2002).

Consideration is also being given to developing a stronger connection between Foresight and the strategic policy community in Scotland in order that Foresight thinking can provide the longer-term perspective often missing in a political climate with a strong focus on short term delivery (Mearns 2002). Given the recent review of UK Foresight which is likely to result in a restructured, more narrowly focussed approach with four main themes, as opposed to the 13 original themes, discussion is underway within the Scottish Executive and with the Scottish Foresight Forum to consider how best to take Foresight forward as Scotland begins to identify its own 'futures' priorities through the Scottish Science Advisory Committee and development of the Scottish Science Strategy.

4.3.2 The Role of Scottish Enterprise (SE)

The Scottish Enterprise Network, currently funded by the Scottish Executive but with a long history pre-devolution, includes Scottish Enterprise National based in Glasgow and 12 Local Enterprise Companies (LECs) with regional locations within Scotland, together employing approximately 1600 staff (see www.scottish-enterprise.com). The LECs provide the main access route to the services provided by Scottish Enterprise and its partners and following a recent inquiry by the Scottish Parliament there is now a greater degree of integration between Scottish Enterprise and the LECs.

Scottish Enterprise also has offices in North America, Germany, France, Italy, Japan, Taiwan, South Korea and Singapore, as part of their mission to heighten Scotland's profile overseas.

They regard themselves, with some justification, as being among the world's top economic development agencies, working in partnership with the public and private sectors to secure the long term future of the Scottish economy. A recent estimate (2000) claims that they expect to contribute approximately £900 million per year in the following three years to the Scottish economy and to create 25,000 jobs.

Scottish Enterprise works in close partnership with those who are developing Foresight in Scotland, and indeed hosts the Foresight Co-ordinator in Scotland. However, the activities on which it has taken a lead including, for example, the Proof of Concept Fund and the

Clusters Initiative, are described by SE as being part of 'regional development' rather than Foresight-related. However, it is clear from their descriptions below that they could equally be considered as part of a Foresight programme in other contexts.

Proof of Concept Fund

Among the Foresight-related services which they provide is the Proof of Concept Fund which supports leading edge technologies in academic institutions and aims to help budding entrepreneurs to export innovation from the laboratory to the global market place. Supported projects should have reached patent level and have the potential to lead to the creation of new businesses or the licensing of innovative technologies. From an initial available amount of £11 million, it has now been increased to £33 million, with £13 million already committed to 82 projects, having created 207 new jobs. Thirty eight new projects were announced in March 2002.

The prime focus of the fund was initially on priority areas identified by SE in consultation with the research base and industry (see 'clusters' below) but eligibility for support has been extended to include 'other emerging technology' to provide greater flexibility in the allocation of funding.

Clusters

Scottish Enterprise is widely regarded in Europe and the USA as a leading exponent of the clusters approach. While the USA does not use Foresight under that name (OST, 1998), many of the activities which we would call Foresight are done there under the heading of clusters. In its report on *Biotechnology Clusters* based on the work of a team led by Lord Sainsbury, Minister for Science (DTI, 1999) SE was described as the only regional agency noted as already developing a cluster strategy for biotechnology.

Scottish Enterprise has 'cluster teams' operating in the following areas:

- biotechnology
- communication technologies
- creative industries
- energy
- forest industries
- food and drink
- microelectronics
- optoelectronics
- tourism

SE has defined a cluster as "… a group of organisations that are linked together because they buy and sell from each other and/or because they use the same infrastructure and skills base" (*Biotechnology Scotland*, Issue 12, Summer 1999). The clusters approach, developed originally from the ideas of Michael Porter (Porter, 1990), has considerable support among development agencies and has been very influential in the United States. However, it is not without its critics. For example Abell has noted that "Nations are not usually competitive across the board … even (for) the most prosperous national economies, one is struck by the patchiness of their performance – they are relatively good at some things but not at others"; and "… the diamond model … is formulated at such an abstract and general level that it is capable of accommodating almost any empirical evidence" (Abell, 1999). It has also been pointed out that, given the processes of globalisation it is no longer necessary for the components of a so-called cluster to be located in the same town, far less the same country (City Profile, Oulu, Financial Times, 1/7/99).

The early clusters, e.g. in San Diego, happened because of a fortunate coincidence of circumstances in California in the 1970s. They were not 'planned' in the sense that clusters approaches are now being implemented in several European countries. We could question whether it is valid to expect to repeat the original success in Europe at the beginning of the next millennium, with a totally different set of cutting edge technological options in an external operating environment that now functions much more effectively at the global level? Restricting the clusters concept under these new conditions to emulation of the Porter

model, is likely to condition those developing it to remain ‘followers’ in the technological sense, rather than ‘leaders’.

Molina and Kinder (2001) have criticised SE's implementation of the clusters approach in the electronics area, in that its vision has not been informed by a holistic, proactive constituency building perspective and networking between firms has been rather superficial. One reason given for this deficiency is that SE was not a unified body as the LECs at that time had considerable autonomy (prior to the recent review by the Scottish Parliament) and that this led to the lack of a common goal. The authors conclude that there are deep rooted cultural, structural and institutional policy factors and practices which will require substantial changes to create the most conducive environment for clustering.

On the other hand, in creating a Scottish Biotechnology Cluster SE's efforts seem to be bearing fruit. Their 4-year strategy focuses on:

- building critical mass through new firm formation, foreign direct investment and engaging companies which are not currently in the cluster
- improving performance to strengthen skills and competitiveness in the global market
- building strategic linkages and value added networks to develop a community with added economic strength and real competitive advantage.

Indicators of success in this area are:

- the growth of the sector, in terms of companies, at 30% per annum, with more than 400 organisations within the community
- employment of 20,000 people in the Scottish biotechnology sector
- the breadth of technologies and application areas covered
- the level of foreign investment attracted
- the development of new facilities, e.g. the £100 million dedicated biomanufacturing campus, the first phase of which is already under way
- the quality and numbers of individuals attracted to events managed by SE

A recent review of SE by the Scottish Parliament recommended a change of focus by SE, away from foreign direct investment and the clusters policy. Where such policies are working effectively, it could be counterproductive and wasteful of resources already committed to abandon them. In the case of the clusters policy it would probably be possible to carry on a similar range of activities under another name. In the case of growth based on foreign investment, there has been concern in the past about the tendency of electronics companies engaged in assembly rather than research and development to invest on a very short term basis and to move on if circumstances changed even marginally. However, in an area like biotechnology, particularly given the rapid changes in the global economy, no development strategy can afford to ignore the importance of foreign investment.

5. Regional Foresight and Multi-level Governance (MLG)

Cooke *et al.* (2000, pp 98-119) have analysed multi-level governance of regional innovation systems with examples from several different types of European region. Although not discussed by them, Scotland would come into the category of a 'region with a high capacity for developing regional innovation systems'. They conclude, among other things, that:

- in an MLG system, the ability to interact at all appropriate levels, upwards and downwards, is a distinct advantage
- support from EU policies for regional innovation systems is needed, in preference to existing piecemeal policies

- regional innovation requires a package of measures covering finance, management, training, marketing and competitiveness advice, as well as more conventional technology transfer
- different regions have different innovation and MLG models and this may take time to change (if indeed change towards a European norm is seen as desirable)[4]
- each regional innovation system must have at its core a strong university-industry innovation and networking system.

Our analysis has looked at issues of multi-level governance mainly from the perspective of policy integration. Horizontal integration of issues, polices and initiatives has in some cases been lacking altogether and where it has been attempted is being modified because of difficulties in its implementation. For example, at EU, UK and Scottish levels, there is so far a general lack of integration between the modern approaches to governance being developed in the social policy arena and policies for science, technology and innovation which still seem to be driven by an old-fashioned, linear conception of innovation systems (Tait and Williams, 1999). Even within the area covered by science, technology and innovation policies, as demonstrated by Scotland's Science Strategy, these linear assumptions seem likely to discourage the flexible approach needed to encourage effective development of new knowledge.

However, our analysis of the approaches being adopted in Scotland could imply that the relative lack of integration between the strategy for science and research and similar initiatives being developed by the Scottish Executive and the regional innovation policies developed by Scottish Enterprise, has in fact allowed Scottish Enterprise to achieve greater success, for example with their Clusters Initiative, than would otherwise have been the case. An analysis of Foresight in the USA claims that, of the range of Foresight-related initiatives adopted there, the most successful approaches have been those driven by business or trade associations with the strong unifying motivation of economic survival, which academic or government-run exercises lack (OST, 1998).

Further research would be needed to elaborate such relationships but if this interpretation is justified, care would be needed in attempting to integrate the top-down science-driven approach underlying much of Foresight and science policy with the bottom-up business and industry-driven approach of organisations such as Scottish Enterprise. In the multi-level governance agenda, this interface requires particularly careful and sensitive treatment.

Much has also been made of the difficulties facing regions in developing competitive innovation systems in a global economy. However, perhaps such difficulties have been exaggerated and seem more daunting if viewed from the perspective of the policy maker who is focused on the superstructure of national and European policies and constraints that overlay regional structures. From the perspective of an innovative company, large or small, and also of regional development agencies like Scottish Enterprise, both innovation systems and markets operate globally, and the route to these global networks is a direct one - it does not operate hierarchically through the national and EU levels.

Thus, in attempting to facilitate regional innovation, we should resist the tendency to place artificial boundaries around science and innovation as this serves to reinforce the linear model of innovation and ignores the fact that innovation does not simply result from research undertaken in universities. The model of technology transfer adopted by the Scottish Science Strategy seems unduly focused on this 'treasure trove' model. While the pharmaceutical and life science sectors most closely resemble this model it is far from typical of innovation as a whole. Industrial R&D is a key knowledge source for new technical

[4] Our experience would reinforce this question whether such change is desirable. A diversity of regional approaches is likely to lead to the greater flexibility and resilience needed to cope with rapid technological advance in a global trading environment.

advances and the knowledge contributions of public sector research are more often indirect (SUPRA 2000; Bechhofer *et al.* 2001). We need an integrated strategy for research and innovation not just one that focuses on the science base, however welcome additional resources for this long under funded sector might be.

6. Policy Integration, Interdisciplinary Approaches and the Role of Communication

Our analysis has covered two radically different types of policy integration :

i. *Vertical Integration*

Policy integration across levels of governance, for example from EU to UK to Scotland, depends mainly on the ability to communicate effectively across system boundaries and the institutional structures determined by government policy making at the highest levels has a major influence on the effectiveness of such communications. For example, we noted above that integration and communication across the EU/UK boundary are relatively effective, while the situation is much less satisfactory across the UK/Scotland boundary. The comments from Charles and Benneworth (2001) discussed in section 2.1.1 also emphasise this point.

Vertical integration is thus mainly a function of the institutional structures determined by policy making at senior government levels and its most important constituents are effectiveness of communications across levels of government. Ideally, vertical communication across these boundaries should be a two-way process, leading to accommodation by higher levels to the needs of the lower levels as well as the reverse process. However, human nature being what it is, effective vertical integration often implies top-down control with some form of sanction imposed where higher level policies are ignored or flouted. In the context of Foresight initiatives this raises questions about how effectively stakeholders at the regional level can engage in the Foresight process – the danger is that Foresight just becomes an activity of the public sector.

ii. *Horizontal Integration*

Horizontal integration takes place across departmental boundaries, for example the ideal, but so far patchy, integration between science and technology policy and social policies in the UK in the development of new approaches to governance (see Section 2.1.1). Integration in this case poses similar challenges to that of interdisciplinary research in academic organisations.

Institutional structures are important here but they do not determine the effectiveness of integration. In the UK there have been numerous examples of amalgamation of government departments, with integration as one of the main aims, where the staff involved have continued to operate within their pre-existing boundaries, with little interaction across these old boundaries.

Communication is also important but the focus of the communication is different and it imposes different challenges. As with interdisciplinary research in academia, each policy area has its own specialist language and this leads to difficulties in effective communication across boundaries. Likewise, career structures for public servants reward those who specialise and it is difficult to make a career by 'trespassing' across traditional boundaries.

Most important, the impact of effective horizontal integration is a *loosening* of control and the introduction of greater complexity into policy implementation processes.

Horizontal policy integration, despite the importance we would attach to it, is therefore much more difficult to achieve than vertical integration. It cuts across the career structures of public servants, raises communication difficulties and lessens the ability of individual departments to exercise control in their own spheres. However,

having said this, in the case of Foresight in Scotland it seems that the Foresight Forum has achieved a certain degree of integration across Scottish agencies but has been less successful at the vertical integration with industry and other Foresight stakeholders.

In addition to the similarity of the challenges exercised by horizontal policy integration in Foresight and by interdisciplinary research in academia, interdisciplinary research itself has an important role to play in Foresight processes at the level of science and technology policy. As recognised by the Fifth Framework Programme, integration of socio-economic research, where appropriate, into science and technology based RTD programmes makes an important contribution to the delivery of Foresight-related policy objectives where the pitfalls in implementation lie as much in the social sphere as in science and technology themselves.

To date, experience of interdisciplinary integration in the Fifth Framework Programme has been mixed, but it is important that the EC learns from experience and adapts future programmes accordingly, rather than abandoning the experiment. Discussions with scientists who have worked in both Europe and the USA has led to the conclusions that America manages academic interdisciplinary integration much more effectively than we do in Europe, and this could be a significant component of their relative competitive advantage in many areas.

In this context, academic interdisciplinary research has a variety of important roles to play in foresight processes. Again this is related to the linearity of the assumed model of innovation. Current assumptions see 'society' entering the picture as a market for the products of innovation at the end of the development pipeline, but not as a partner in their development. Innovative companies may engage in sophisticated market forecasting techniques, but they often have a very restricted understanding of what constitutes their market. Likewise, many of them fail to consider the policy environment into which their products will be launched. For example, if agrochemical companies developing GM crops has listened to the advice of interdisciplinary researchers (Tait, 1993) they would have been in a better position to avoid the public rejection of the technology which they are now experiencing. Given the difficulties they are now undergoing they are, much too late, reassessing the nature of their markets, considering the consumer rather than the farmer as the end-user of their products, and the ability of socially motivated policy developments to frustrate their intentions (Tait *et al*. 2001). This provides just one example of the need to consider socio-economic aspects of STI at a very early stage in many, but not all, cases, and of the potential benefits of doing so.

References

Abell, P. (1999) The Times Higher, July 2, 1999, p29

Bechhofer, F., L. Rayman-Bacchus, et al. (2001). 'The Dynamics of Social Science Research Exploitation.' Scottish Affairs **36**(Summer): 124-155.

Braczyk, H.-J. and M. Heidenreich (1998). Regional Governance Structures in a Globalized World. Regional Innovation Systems. H.-J. Braczyk, P. Cooke and M. Heidenreich. London, UCL Press.

Branscomb, L. M. and J. H. Keller, Eds. (1999). Investing in Innovation. Creating a Research and Innovation Policy that Works. Cambridge MA, MIT Press.

Cabinet Office Performance Innovation Unit (2000). Wiring it up. Whitehall's Management of Cross-cutting Policies and Services, Cabinet Office.

Cabinet Office Strategic Policy Making Team (1999). Professional Policy Making for the Twenty First Century. London, Cabinet Office.

Charles, D. and P. Benneworth (2001). 'Are We Realizing our Potential? Joined up Science and Technology Policy in the English Regions.' Regional Studies **35**(1): 73-79.

Commission of the European Communities (2001). European Governance: a White Paper. Brussels, COM (2001) 428 Final.

Cooke, P. (1998). Introduction. Origins of the Concept. Regional Innovation Systems. H.-J. Braczyk, P. Cooke and M. Heidenreich. London, UCL Press.

Cooke, P., Boekholt, P. and Todtling, F. (2000) The Governance of Innovation in Europe: Regional Perspectives on Global Competitiveness. London: Pinter.

Coombs, R., P. Saviotti, et al. (1987). Economics and Technological Change. Basingstoke, Macmillan Education.

Diederen, P., P. Stoneman, et al. (1999). Innovation and Research Policies. Cheltenham, Edward Elgar.

Dodgson, M. and J. Bessant (1996). Effective Innovation Policy: A New Approach. London, International Thomson Business Press.

Dosi, G. (1982). 'Technological paradigms and technological trajectories.' Research Policy **11**: 147-162.

Dosi, G. (1988). The Nature of the Innovative Process. Technical Change and Economic Theory. G. Dosi. London, Pinter.

DTI (1999) *Biotechnology Clusters* Report of a DTI team led by Lord Sainsbury, UK Minister for Science.

DTI (2000) *The Foresight Effect: How Foresight is helping the public sector to prepare for the future* September 2000. Department of Trade and Industry DTI/Pub 4997/1k/9/00/NP. URN 00/1001 http://www.foresight.gov.uk/servlet/DocViewer/doc=2030/

European Commission (2002) Science and Society Action Plan. Luxembourg, Office for Official Publications of the European Communities.

Foresight case studies (Actis Technology, Tritech International Ltd, Johnstone Castings and Engineering Ltd, Berg Product Design, Quadstone Ltd) http://www.foresight.gov.uk/default1024.htm

Giddens, A. (1998). The Third Way : the Renewal of Social Democracy. Cambridge : Polity Press

Giddens, A. (1999). BBC Reith Lectures http://news.bbc.co.uk/hi/english/static/events/reith_99/.

Goldsmith, M. (1992). 'The OST: a New Stage in S&T Policy?' Science in Parliament **49**(3): 1.

Gummett, P. (1991). 'The evolution of science and technology policy: a UK perspective.' Science and Public Policy **18**(1): 31-37.

HM Government (1999). Modernising Government White Paper. London.

House of Commons Science and Technology Committee (2000). Government expenditure on research and development: the forward look, fifth report 1999-2000. London, Stationery Office.

Ince, M. (1986). The Politics of British Science. Brighton, Wheatsheaf Books.

Jacobs, D. (1998). 'Innovation policies within the framework of internationalization.' Research Policy **27**: 711-724.

Kerley, R. (1999). Economic Intervention and Devolved Institutions: Parliaments, Assemblies, Chambers and Business. New Regional Strategies: Devolution, RDAs and Regional Chambers. Conference proceedings of the Regional Studies Association Annual Conference. November 1999, Regional Studies Association.

Latouche, D. (1998). Do Regions Make a Difference? The Case of Quebec. Regional Innovation Systems. H.-J. Braczyk, P. Cooke and M. Heidenreich. London, UCL Press.

Lyall, C. (1993). The 1993 White Paper on Science and Technology: Realising Our Potential or Missed Opportunity? MSc Thesis SPRU. Brighton, University of Sussex.

Martin, B.R. & Irvine, J. (1989) Research Foresight. Priority Setting in Science, Pinter, London and New York.

Martin, B. R. & Johnston, R. (1998) “Technology Foresight for Wiring up the National Innovation System: Experiences in Britain, Australia and New Zealand”, *SPRU Electronic Working Papers Series*, Paper No 14.

Maskell, P. and e. al (1998). Competitiveness, localised learning and regional development: specialisation and prosperity in small open economies. London, Routledge.

Maskell, P. and G. Tornquist (1999). Building a cross-border learning region - emergence of the North European Oresund Region. Copenhagen, Copenghagen Business School Press.

McKelvey, M. (1991). How do National Systems of Innovation Differ?: A Critical Analysis of Porter, Freeman, Lundvall and Nelson. Rethinking Economics. G. M. Hodgson and E. Screpanti. Cheltenham, Edward Elgar**:** 117-173.

Mearns, Ewan (2001) *An Overview of Foresight in Scotland*, 26 June 2001 http://www.foresight.gov.uk/default1024.htm

Mearns, Ewan (2002) *Foresight Forum. Progress report on Foresight implementation*, February 2002

Miller, A. (2000). Research - A Scottish Perspective. CVCP 21st Century Research: New Challenges for Universities, London, Unpublished (copy of speech).

Molina, A. and Kinder, T. (2001) National systems of innovation, industrial clusters and constituency building in Scotland's electronics industry. Int. J. of Entrepreneurship and Management, 1/2 241-275

Nicholson, R., C. M. Cunningham, et al. (1991). Science and Technology in the United Kingdom. Harlow, Longman.

OST (1993). Realising our Potential. A Strategy for Science, Engineering and Technology. London, HMSO.

OST (1998) The Future in Focus: a summary of national Foresight programmes Department of Trade and Industry DTI/Pub 3333/4k/3/98/NP

OST (1998b) *Foresight. Consultation on the next round of the Foresight Programme*, DTI, March 1998, DTI/Pub 3284/50k/3/98/NP.URN 98/628.

OST (1998c) *Blueprint for the next round of Foresight*, DTI, December 1998 DTI/Pub 3733/65k/12/98/NP.URN 98/1032.

Pavitt, K. and M. Sharp (1993). Technology Policy in the 1990s: Old Trends and New Realities. Europe and Global Economic Interdependence. L. Bekemans and L. Tsoukalis. Bruges, College of Europe**:** 57-78.

Pierre, J. and B. G. Peters (2000). Governance, Politics and the State. Basingstoke, Macmillan.

Porter, M. (1990). The Competitive Advantage of Nations. London, Macmillan.

POST (1997) *Science Shaping the Future*, POST Summary Report, June 1997.

Ronayne, J. (1984). Science in Government. Caulfield East Victoria, Edward Arnold (Australia).

Save British Science (2001). Science policies for the next Parliament. London, Save British Science Society**:** pp60.

Scottish Executive (2000) *Materials Futures: Report of the Foresight Consultation Seminar*. Stirling Management Centre 16th October 2000 http://www.scotland.gov.uk/library3/enterprise/matf-00.asp

Scottish Executive (2001). A Science Strategy for Scotland. Edinburgh, The Stationery Office**:** 48.

Scottish Executive News Release (2001). Wendy Alexander Launches First Ever Scottish Science Strategy.

SHEFC (1995) *Addressing Technology Foresight* http://www.shefc.ac.uk/content/library/circs/96/1396b.htm

Scottish Universities Research Policy Consortium (1997) *Interdisciplinary Research: Process, Structures and Evaluation*. SHEFC-funded Regional Strategic Initiative, Research Support Section, University of Edinburgh, Old College, Edinburgh EH8 9YL.

Sloat, A. (2000). 'Scotland and Europe: Links between Edinburgh, London and Brussels.' Scottish Affairs **31**(Spring 2000): 92-110.

SUPRA (2000). Response to Science Strategy Review Group, SUPRA.

Tait, J. and Bruce, A. (2002, in press) Global Change and Transboundary Risks. (Commissioned by Society for Risk Analysis for the International Symposium on *Risk and Governance*, Warrenton, VA, USA, June 2000.) To be published by Cambridge University Press. (available on www.supra.ed.ac.uk)

Tait, J., Lyall, C. and Williams, R. (2001) Does Scotland Need its own Science Policy - Strategy Hierarchies in Scotland, the UK and Europe. Paper presented to the British Association Science Festival, Glasgow, September 2001.

Tait, J., Chataway, J. and Wield, D. (2001) PITA Project (Policy Influences on Technology for Agriculture: Chemicals, Biotechnology and Seeds) Final Report. (available on www.supra.ed.ac.uk)

Tait, J. and Lyall, C. (2001) Investigation into ESRC-funded Interdisciplinary Research. Report to ESRC. (available on www.supra.ed.ac.uk)

Tait, J., Williams, R. and Lyall, C. (2000) Roadmapping Foresight: Monitoring and Evaluation of Complex Programmes. SUPRA Report to the Office of Science and Technology, May 2000. (available on www.supra.ed.ac.uk)

Tait, J. and R. Williams (1999). 'Policy approaches to Research and Development: Foresight, Framework and Competitiveness.' Science and Public Policy **26**(2): 101-112.

Tait, J. (1993) Written evidence on behalf of ESRC to Report of House of Lords Select Committee on Science and Technology on *Regulation of the United Kingdom Biotechnology Industry and Global Competitiveness*, 7th Report, Session 1992/93. London: HMSO HL Paper 80-I, pp187-196.

UK Office of Science and Technology (2000) Excellence and Opportunity: A Science and Innovation Policy for the 21st Century (Government White Paper), London, The Stationery Office.

Walker, W. (1993). National Innovation Systems: Britain. National Innovation Systems. A Comparative Analysis. R. Nelson. New York and Oxford, Oxford University Press.

Walsh, V. (1988). Technology and the Competitiveness of Small Countries: Review. Small Countries Facing the Technological Revolution. C. Freeman and B.-A. Lundval. London, Pinter**:** 37-66.