Policy Mix Peer Reviews

The Report of the CREST Policy Mix Working Group

Second Cycle of the Open Method of Coordination for the Implementation of the 3% Action Plan

Prepared by Ken Guy, Wise Guys Ltd.

March 2006

Contents

Executive Summary

The Peer Review Process

The main objective of the Policy Mix Group in 2005 was to pilot and develop a peer review process capable of acting as an instrument of mutual learning within the context of the Open Method of Coordination. The aim of the peer review process was to help countries better understand the policy mixes needed to raise R&D intensity by improving overall innovation system performance. In contrast to 'conventional', resource intensive peer reviews aimed primarily at producing specific policy recommendations for individual countries, the emphasis in this 'light' exercise was to encourage the sharing of information about policy-related issues between senior policymakers and to generate generic lessons for the formulation and implementation of effective policy mixes.

The overall process commenced with the self-nomination of three 'review' countries and interested 'examiner' countries. This was followed by the preparation by IPTS of a background report on each of the review countries, utilising publicly available information and updated and amended as necessary by representatives from the review countries. In turn, these reports were made available as background material to the examiner countries, in preparation for a visit to each review country by teams composed of representatives from at least three examiner countries, IPTS, DG RTD and an independent consultant. These teams held a series of discussions with a variety of R&D and innovation policymakers and key stakeholders in each country. The commentaries of these teams were then recorded in three country reports and discussed with the review countries in a series of feedback missions designed to validate the findings of the country reports and deepen understanding and mutual learning. All three reports were then presented and discussed by CREST representatives at a formal Peer Review Meeting in Brussels. Subsequently, the key issues to emerge concerning the formulation of effective policy mixes were summarised for presentation to CREST and incorporated in this final synthesis report.

During the course of the whole exercise, a simple analytical framework linking different domains of an innovation system was used to structure both discussions and reports. Policy mixes were conceived as the aggregate of policies affecting four major domains: Human Resources; the Science Base; Business R&D and Innovation; and Economic and Market Development. The governance system linking policies in all these domains was also of central interest. Using this scheme, the background reports concentrated on the major innovation system performance indicators in each domain; the major challenges facing each innovation system; the governance structures within which policies were formulated and implemented; major policy objectives and implementation strategies in each domain; and, if available, evidence of policy effectiveness. The reports of the review teams then focused on overviews of the three national innovation systems and policy mixes; the commentary of the review teams on these mixes; and generic lessons for the formulation and implementation of effective mixes. In this final synthesis report, the results of the country reports are presented, followed by a separate section focusing specifically on broader, generic lessons. A concluding section contains recommendations concerning the future of the Peer Review exercise.

Highlights of the Peer Reviews

Sweden

Sweden has a strong R&D system and policy formulation is informed by an overt, holistic innovation system approach. Current preoccupations are on countering external threats (market liberalisation and the threat of footloose R&D capacity) and internal threats (the Swedish equivalent of the 'European Paradox' and the relatively low formation of New Technology Based Firms (NTBFs)). The policy response has been to adopt a comprehensive policy mix spanning initiatives focused on Human Resources and the Science Base (to counter the threat of footloose capital by making Sweden an attractive knowledge-based environment); on Science-Industry-Market linkages (to improve the efficiency of the exploitation of knowledge and counter the 'Swedish Paradox'); on procurement policies in order to strengthen public-private partnerships (again as a counter to the 'Swedish Paradox'); on policies focusing on NTBF formation in order to ensure the continuous renewal of R&D and innovative capacity; and a continued focus on, and commitment to, policies promoting liberalisation, deregulation and competition.

Policy suggestions include greater efforts to strengthen the science base by increasing the proportion of funds available to universities via competitive processes; developing the relatively small Research Institute sector as a means of improving linkages between the science base and industry; broadening the range of policies focused on the task of stimulating R&D and innovation activities in SMEs and encouraging the formation and growth of New Technology Based Firms (NTBFs); and reconsidering the use of fiscal incentives as a means of stimulating R&D activities, particularly amongst SMEs.

Spain

Spain's R&D and innovation system has improved significantly over the last decade, especially in terms of strengthening human resource development and the science base, though there is still room for improvement if performance indicator levels are to reach EU average levels. Business R&D and innovation performance in particular is still relatively weak. Policies designed to build on past efforts are now firmly embedded within a national reform agenda that recognises the central importance of R&D and innovation and is based on a perceptive diagnosis of the R&D and innovation system and national needs. The current goal is to maintain a 25% per annum increase in the civil R&D and innovation budget and reach a target for R&D of 2% of GDP by 2010 (45% public expenditure; 55% private expenditure), though there has also been a marked increase in the emphasis put upon the need to improve the innovative performance of industry, particularly SMEs. Large-scale investments in actions designed to promote the diffusion of ICTs and improve the information society infrastructure are also foreseen.

Policy suggestions include not letting the shift in emphasis to innovation detract from continued efforts to strengthen the science base; improving the prospects for research excellence by expanding the use of international peer review in proposal selection procedures; seeking a balance between satisfying the needs of the R&D community and concentrating scarce resources in areas of most relevance to the future prosperity of the country; improving the prospects for higher BERD by expanding measures aimed at increasing the demand for R&D in

industry; and ensuring that adequate mechanisms are in place to align national and regional interests in the development of appropriate policies at these levels.

Romania

Romania has a relatively weak R&D and innovation system that suffered during the early transition years and has only recently shown signs of recovery. Most R&D is performed in a Research Institute sector that consists of a large number of sector-based organisations performing applied R&D, many of which are state-owned. Most suffered during the transition years from low state funding and limited demand for their services. Despite the fact that industry performs little R&D, it is primarily low- to medium-tech and is not attuned to innovation. Recent policy initiatives, however, have demonstrated that Romania is strongly committed to reaching the Barcelona targets by 2010, and public policies have focused on strengthening human resources and research capacity in the Research Institute and University sectors, with fewer measures geared towards the development of innovative performance in industry. On a macroeconomic level, however, although many of the legal and institutional frameworks necessary for the effective operation of a market economy and entry to the EU in 2007 are in place, progress has been slow and obstacles still remain.

Policy suggestions include maintaining a strong focus on the framework conditions needed for the establishment of a fully functional market economy; raising the profile of R&D and innovation across the Romanian system of governance, stressing in particular their importance for industrial and economic development; rationalising the structure of the Research Institute sector and improving the research capacity of universities; and involving key stakeholders in a vision building exercise and setting ambitious but realistic targets.

Generic Lessons

A series of generic lessons pertinent to the formulation and implementation of effective policy mixes emerged from the country reviews. One cluster of lessons concerned the process of policy formulation itself. Not unexpectedly, these focused on the importance of adopting holistic approaches to policy development; utilising sophisticated analyses of strengths, weaknesses, opportunities and threats; and building on strategic intelligence furnished by comprehensive monitoring and evaluation systems and inclusive, vision-generating initiatives such as foresight exercises.

Another cluster of lessons concerned the governance of innovation systems. Here it was clear that the tasks and responsibilities of the different ministries and agencies involved in the development and implementation of policy mixes have to be clearly delineated, with adequate mechanisms in place to ensure coordination and avoid conflicts and overlaps. Equally crucial was the need to secure high-level commitment to the central importance of R&D and innovation in future growth strategies and to ensure that this commitment was effectively communicated to all relevant quarters of the governance system.

A number of key issues concerning the balances that have to be struck in the formulation of policy mixes also emerged. These included the need to strike a balance between competitive and non-competitive R&D funding in the science base in order to promote both excellence and stability, and the need to find a balance between concentrating funds on areas of strategic importance and satisfying the funding needs of a broad spread of researchers. Balancing the respective roles of universities and research institutes within innovation systems

is also likely to become increasingly important as R&D performing organisations in the science base strive to fulfil educational, research and industrial linkage missions. At a different level, it will also be important to ensure that regional policies concerning R&D and innovation, when considered in aggregate, are in alignment with national priorities and policies.

Looking across all three countries, a set of common priorities emerged – issues that are likely to be important for many other countries too. Foremost amongst these were: the need to improve the overall effectiveness of R&D and innovation systems by supporting improved linkages between the science base and industry; the need to encourage R&D and innovation activities in SMEs; and the need to stimulate R&D via effective procurement policies linking supply and demand.

Finally, the importance of starting positions in the choice of development paths was strongly highlighted by the experiences of the three countries under review. Despite the existence of some common priorities, the exact composition of the policy mixes chosen in different settings is strongly contextual, with historical starting positions largely determining the choice of development options open to countries and the likelihood of their success.

Next Steps

Based on the warm reception given to the exercise by members of the Policy Mix Working Group, in particular by representatives of the 'review' and 'examiner' countries, the Group recommends that the peer review exercise be repeated in future cycles of the OMC. If this is acceptable to CREST, Member States should again be invited to participate as 'review' and 'examiner' countries. The aim should then be to keep the exercise light, but to offer review countries options such as a continued focus on mutual learning and the search for generic lessons, or a greater focus on the production of country-specific recommendations. Consideration should also be given to the structure of the 'examiner' teams. One option would be to involve both high-level and more junior policymakers in these teams in order to assist high-level members in their tasks and to spread learning within their own systems. Other improvements to the process might include field visits during the preparation of the background briefing documents, the establishment of 'feedback' and 'deepening' missions as intrinsic parts of the review process, and spreading the process over a complete 12-month period. It would also be advisable to link the OMC peer review activities with the peer reviews of national policy mixes scheduled to take place under the auspices of the OECD.

Introduction

The Aim of the Exercise

This document constitutes the report of the Policy Mix Group set up by CREST within the context of the Open Method of Coordination (OMC). The overall remit of the group is to encourage mutual learning amongst Member States concerning the policy mixes needed to improve overall R&D and innovation system performance. This is seen as a necessary step if the targets set by Heads of State at the European Council meetings of Lisbon (2000) and Barcelona (2002) are to be met.

The main objective of the Policy Mix Group in 2005 was to pilot and develop a peer review process capable of acting as an instrument of mutual learning within the context of the OMC. The aim of the peer review process was to help countries better understand the policy mixes needed to raise R&D intensity by improving overall innovation system performance. In contrast to 'conventional', resource intensive peer reviews aimed primarily at producing specific policy recommendations for individual countries, the emphasis in this 'light' exercise was to encourage the sharing of information about policy-related issues between senior policymakers and to generate generic lessons for the formulation and implementation of effective policy mixes.

The Process Involved

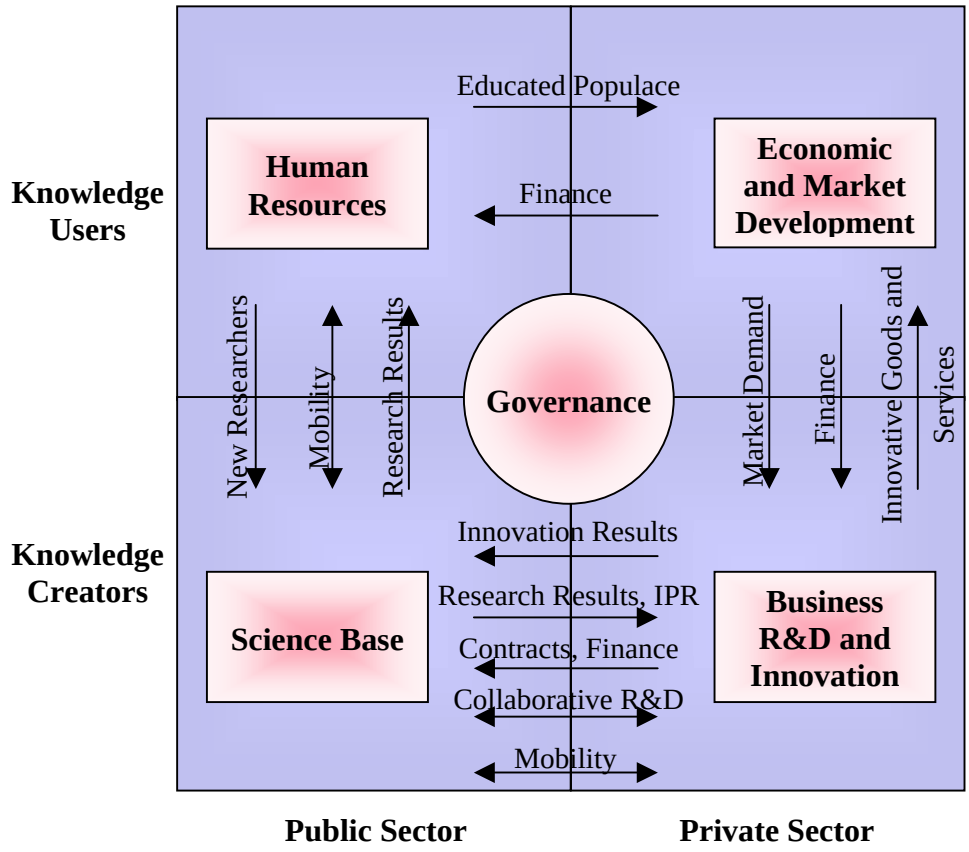
The overall process commenced with the self-nomination of three 'review' countries and interested 'examiner' countries. This was followed by the preparation by IPTS of a background report on each of the review countries, utilising publicly available information and updated and amended as necessary by representatives from the review countries. In turn, these reports were made available as background material to the examiner countries, in preparation for a visit to each review country by teams composed of representatives from at least three examiner countries, IPTS, DG RTD and an independent consultant. These teams held a series of discussions with a variety of R&D and innovation policymakers and key stakeholders in each country. The commentaries of these teams were then recorded in three country reports and discussed with the review countries in a series of feedback missions designed to validate the findings of the country reports and deepen understanding and mutual learning. All three reports were then presented and discussed by CREST representatives at a formal Peer Review Meeting in Brussels. Subsequently, the key issues to emerge concerning the formulation of effective policy mixes were summarised for presentation to CREST and incorporated into this final synthesis report.

The Analytical Framework

During the course of the whole exercise, a simple analytical framework linking different domains of an innovation system was used to structure both discussions and reports. Policy mixes were conceived as the aggregate of policies affecting four major domains: Human Resources; the Science Base; Business R&D and Innovation; and Economic and Market Development. The governance system linking policies in all these domains was also of central interest. The Exhibit

below depicts all these domains and some of the more important links and flows between them.

Exhibit 1 A Simple Model of an Innovation System



Although innovation systems are typically much more complex than depicted here, this simple model provides a convenient way of visualising some of the more important domains within an innovation system and the relationships between them. It also provided a useful framework within which to ask questions during the peer review exercise relating to:

- The relative scale of the challenges nations confront both within each of the four innovation system domains and across them.
- The range of policy responses to these challenges and their 'location' within the innovation system, e.g. 'reinforcement' policies to strengthen particular domains such as the science base or business R&D and innovation, or 'bridging' policies designed to improve the links or flows between domains, e.g. policies to enhance university-industry interactions or to improve the flow of capital from capital markets to innovative high-tech firms and start-ups.
- The match between problems and policy responses within and across domains.
- The conflicts and synergies between policies within and across domains.
- The governance of policies within and across domains.

The Background Reports

Using the above scheme, the background reports concentrated on the major innovation system performance indicators in each domain; the major challenges facing each innovation system; the governance structures within which policies were formulated and implemented; major policy objectives and implementation strategies in each domain; and, if available, evidence of policy effectiveness.

The Peer Review Reports

After the initial visits by the review teams to the three countries under review, draft reports summarising the findings of the teams were prepared. These reports contained:

- Overviews of the three national innovation systems and policy mixes, based on the initial background reports and supplemented by material gathered on the visits.
- The commentaries of the three separate review teams on the policy mix in each country, with specific suggestions for future policy in these countries where appropriate.
- A series of generic lessons for the formulation and implementation of effective mixes in a broader set of contexts.

The Synthesis Report

In this final synthesis report, the country specific elements of the peer review reports are presented in the form of three country reports. These contain background information on each country's innovation system and recent policy developments, plus the commentaries and specific policy suggestions of the review teams. A separate section then draws together the broader generic lessons from each of the review teams, clustering them into four groups relevant to:

- The process of policy formulation.
- The governance of R&D and innovation activities.
- The policy choices and balances that pervade contemporary policy debates.
- Common priorities in modern innovation systems.

Next Steps

The final section of the synthesis report comments on the peer review process itself, summarising the lessons learned from this pilot exercise and suggesting ways forward during the course of the next cycle of the OMC process.

Country Reports

Introduction

As part of the policy mix peer review process instigated by CREST during the second cycle of the Open Method of Coordination, three review teams[1] Tcomprised of representatives of EU Member States, the European Commission and an independent consultant visited Sweden, Spain and Romania according to the following schedule:

Sweden:	Main fact finding-mission	June 8-10 2005
	Feedback mission	September 1 2005
Spain:	Main fact finding-mission	June 20-21 2005
	Feedback mission	October 13 2005
Romania:	Main fact finding-mission	June 16-17 2005
	Feedback mission	September 5 2005

During the main fact-finding missions, the Swedish, Spanish and Romanian representatives on the Policy Mix Expert Group arranged interviews with a variety of stakeholders in their respective R&D and innovation policy systems.[2] Three country reports based on the experiences of the review teams[3] were then prepared and discussed with key stakeholders in each country during the course of a series of feedback missions. Suitably amended, these country reports then became inputs to a Policy Mix Peer Review Meeting held in Brussels on September 16 2005[4], during which delegates from all countries represented on the Policy Mix Expert Group had an opportunity to discuss the reports and absorb the lessons learned during the exercise.

The sections that follow on Sweden, Spain and Romania are based on the first two sections of each of the country reports discussed at the Policy Mix Peer Review Meeting. In the first instance, these comprise thumbnail sketches of the R&D and innovation systems in each country and descriptions of the associated policy mixes. As revealed by the indicators in Exhibit 2, the innovation systems of these countries show marked differences. The sketches are then followed by accounts of some of the most important impressions gained by the review teams in each country, together with suggestions for future policy that might be considered appropriate in each setting.

The final parts of the original country reports highlighted some of the generic lessons suggested by each country's experience with policy mixes. In this synthesis report, these are discussed in a separate section that analyses these lessons and draws upon the discussion at the Policy Mix Peer Review Meeting in Brussels.

---

[1] Full details of the review teams are presented in Appendix 1.

[2] Full details of the interview schedules are presented in Appendix 2.

[3] These also drew heavily on a series of background reports prepared in June 2005 by IPTS on the R&D and innovation policy mixes in Sweden, Spain and Romania (and subsequently updated in December 2005).

[4] Due to logistical problems, the feedback mission to Spain took place after the Policy Mix Peer Review Meeting in Brussels.

Exhibit 2 R&D and Innovation System Indicators

R&D Indicators

	Romania	Spain	Sweden	EU 15	EU 25
GERD as a percentage of GDP	0.40	1.11	4.27	2.00	1.95
Industry (% of total)	48	47	72	56	55
Government (% of total)	43	40	21	34	35
Abroad (% of total)	8	8	3	8	8
Others (% of total)	1	5	4	2	2
SE graduates (% of 20-29 years age class)	9.4	11.3	12.4	11.3	..
Total R&D personnel as % of active population	0.33	1.18	2.43	1.39	..
HRST-core as a % of active population	10	17	23	17	16
Scientific publications per million population	1198	310	940	462	..

Innovation Indicators

	Romania	Spain	Sweden	EU 15
Employment in medium-high and high-tech manufacturing (% of total workforce)	5.5	5.4	7.3	7.4
Employment in high-tech services (% of total workforce)	1.6	2.5	5.2	3.6
Innovation expenditures (% of all turnover in manufacturing/services)	1.4	2.4	7.0	3.7
SMEs innovating in-house (% of manufacturing SMEs and % of services SMEs)	13	17	36	44
SMEs involved in innovation co-operation (% of manufacturing SMEs and % of services SMEs)	3	7	28	11
Share of manufacturing value-added in high-tech sectors	4.8	7	16	14
Sales of 'new to market' products (% of turnover in manufacturing and % of turnover in services)	8	10	7	7
Sales of 'new to the firm but not new to the market' products (% of turnover in manufacturing and % of turnover in services)	2	26	24	19

Market Indicators

	Romania	Spain	Sweden	EU 15
Internet access/use	0.10	0.25	0.97	0.51
ICT expenditures (% of GDP)	2.2	4.4	9.8	7.0
Labour productivity per hour worked relative to EU 15 (EU 15 = 100)	..	87.2	96.5	100.0

Human Resource Indicators

	Romania	Spain	Sweden	EU 15
Public expenditure on education as a percentage of GDP	3.3	4.4	7.3	5.1
Population with tertiary education (% of 25-64 years age class)	10.0	24.4	26.4	21.5
Participation in life-long learning (% of 25-64 years age class)	1.1	5.0	18.4	8.4
Employment in medium-high and high-tech manufacturing (% of total workforce)	5.5	5.4	7.3	7.4
Employment in high-tech services (% of total workforce)	1.6	2.5	5.2	3.6

R&D and Innovation Policies in Sweden

Overview of the Swedish R&D and Innovation System and Policy Mix

Sweden has a strong, stable economy with relatively high GDP per capita, a well-educated population and a stable social and political framework. Trade in global markets and high exports have been a feature for many decades. It also has an extremely strong and well-developed innovation system, as evidenced by most indicators. As a percentage of the active population, the share of science and engineering graduates is above the EU average and the proportion of R&D personnel is considerably higher. In the public sector, most of these are located within universities, since there is only a very rudimentary Research Institute (RI) sector, with universities tasked to educate, conduct research and interact with industry (the 'third task'). Funding for research within universities is higher than in most EU or OECD countries and comprises direct state allocations (42% in 2003), state funds for which universities compete (15% from Research Councils and 20% from other sources), and the remaining 23% from other non-governmental sources (industry, non-profit organisations and sources abroad)[5]. Despite the 'third way' remit of universities, however, research revenue from private sector companies only amounts to 6% of the total[6]. In output terms, the Swedish science base is also prolific, with scientific publications per million of the population double the corresponding figure for Europe as a whole.

The strength of the public sector science base is complemented by an extremely strong, R&D intensive private sector. Forty out of the top 500 high R&D spenders in the EU have headquarters based in Sweden, with large R&D performing subsidiaries of other MNCs also located there too. Leading sectors include ICT (Ericsson), engineering and machinery (Volvo, Scania, Atlas Copco, ABB) and pharmaceuticals (AstraZeneca). Employment in medium-high and high-tech manufacturing is around the EU average and employment in high-tech services considerably greater than average. R&D personnel figures are substantial and the high R&D intensity in the public sector is surpassed in the private sector, making the ratio of overall R&D expenditure to GDP one of the highest in the world. On the output side, patent applications rose steeply over the 1990s and, in terms of overall innovation performance, as measured by the European Innovation Scoreboard, Sweden is also a world leader, with sales of 'new to market' products and 'new to the firm but not to the market' products as a percentage of turnover at and above the EU average respectively. The absorptive capacity of the economy for innovative goods and services is also considerable. Progress towards a knowledge-based society, for example, is highly advanced in Sweden, with Internet access and use double that of the EU average.

Public policies undoubtedly underpinned Swedish success in terms of establishing a successful educational infrastructure and public sector science base. They also helped shape the development of the industrial sector over time. Public procurement policies in the defence sector played their part, as did similar policies in the telecommunications arena, where the interaction between the state telecommunications agency and Ericsson (especially between their

[5] All figures provided by the Swedish Ministry of Education, Research and Culture.
[6] Swedish Universities and University Colleges, Short version of annual report 2004, p21

respective R&D arms) helped pave the way for Ericsson's current success on the world stage. The dynamism of the private sector, however, also contributed greatly to the successful functioning of the overall innovation system, and for many years policymakers were primarily preoccupied with 'fine-tuning' the system and incremental improvement rather than with efforts to initiate radical change or stimulate step-change performance improvements.

In recent years, however, there has been a growing policy debate about the continued health of the innovation system. One element of concern was a manifestation of the so-called European paradox – or the Swedish paradox in this context. Although innovation performance was high, it was not commensurate with the very high levels of R&D intensity in Sweden. Similarly, although GDP was relatively high, growth rates were sluggish and overall levels again not commensurate with the input side of the equation. Unemployment levels were a problem too and the debate focused on the suggestion that the innovation system as a whole was not as efficient as it could be in 'translating' R&D into economic performance.

Another concern that exercised policymakers was related to globalisation. Many Swedish-owned companies had become subsidiaries of MNCs with headquarters based in other parts of the world, while others had large proportions of their shares held by foreign stakeholders. There was also a shift in terms of the R&D performed by these companies, with the loss of some capacity to facilities in other countries (especially in pharmaceuticals), down-scaling by others (ICT), and more overt foreign control over research agendas. The fear, therefore, was that Sweden might lose footloose R&D capacity and fail to capture other foreign direct investment.

The associated waves of liberalisation and deregulation of markets that accompany globalisation also created other tensions within the innovation system. While undoubtedly a factor in the overall Swedish success story in recent years, these waves also led to the erosion of highly successful public-private partnerships and procurement relationships between state and private sector institutions, especially in the telecommunications and defence sectors.

All these concerns and debates, coupled with a desire to meet new societal goals related to sustainability, the environment, ageing populations and the creation of an advanced knowledge-based society, led to a re-examination of the policies in place to maintain and improve the health of the innovation system. Adopting an explicit national innovation systems approach, a White Paper published in June 2004 set out a framework for the revision of public policy in this sphere (see Exhibit 3). The policy mix it advocated called for actions in four broad areas:

- Knowledge Base for Innovation.
- Innovative Trade and Industry.
- Innovative Public Investment.
- Innovative People.

Responding to many of the concerns being voiced in contemporary debates, the comprehensive range of instruments and measures discussed in the paper included policy packages aimed at:

- Strengthening the education and research base in order to maintain the required throughput of qualified personnel and continue to act as a magnet for the co-location of high-R&D intensive industry, thus helping to retain existing footloose R&D capacity and attracting further foreign direct investment via the creation of 'attractive knowledge environments'.

- Improving the linkages in the system – particularly between the science base and industry and within the context of regional innovation clusters – in an attempt to improve the overall efficiency of the system.
- Revitalising public procurement as a driver of innovation and a link between R&D, innovation and the market.

The review also recognised and attempted to deal with a critical perceived weakness in the overall innovation system, namely its limited capacity for 'renewal' via the creation and subsequent growth of high-tech SMEs. Although Sweden has many large R&D intensive firms, it has a relatively small high-tech SME sector and a weak entrepreneurial culture, with individuals accustomed to seeking employment in the public sector or large company environments rather than embarking on the high risk road of starting and growing their own companies. The White Paper thus suggested the need for a number of instruments aimed at stimulating entrepreneurship and supporting the formation and growth of new commercial initiatives. One possibility being considered is the co-funding of R&D activities via a Small Business Innovation Research (SBIR) initiative, to be operated by Vinnova, the state agency with responsibility for innovation systems. This is a fairly radical suggestion in a Swedish context given that – unlike in many other countries – there is no overt tradition of direct (as opposed to indirect) financial support to firms for R&D on an industry-wide basis,[7] though there is a strong tradition of funding firms to perform R&D in particular sectors such as defence, space, energy and, formerly, telecommunications.

The intention behind the White Paper's policy mix framework was that it would inform the development and implementation of future policy instruments. This translation process commenced in 2005 with the publication of a Government Bill entitled 'Research for a Better Life'. This announced measures designed to increase investment in R&D, improve its quality and concentrate efforts in key areas likely to lead to social development and business growth. Appropriations to universities for postgraduate education and research were increased, as were appropriations to the Research Councils, and R&D funding allocations were increased in the strategically important areas of medicine, technology and environment and sustainable development. Funding was also increased for the development of critical masses in key centres of excellence. In terms of linkages, initiatives designed to improve the transfer of knowledge between academia and industry were also announced. These included holding companies at universities, cooperative R&D programmes, greater R&D support for SMEs and long-term strategic funding for industrial research institutes.

Traditionally, the spheres of R&D and innovation had been handled separately within the Swedish system of governance, but the White Paper was developed jointly by the Ministry for Education, Science and Culture and the Ministry for Industry, Employment and Communication. This represented a shift towards a more coordinated and integrated approach to policy development in these spheres. A parallel opportunity to establish a permanent body responsible for the coordination of policies across the whole R&D and innovation system, however, was not grasped. An Innovation Policy Council, chaired by the Minister of Industry and Trade, was set up in 2004 to advise on innovation policy matters, but this complemented rather than incorporated the pre-existing Government Research Advisory Board, chaired by the Minister of Education, Science and Culture, which continues to advise on research issues. Both, it should be noted, are responsible for advice, not coordination.

[7] State support for collaborative R&D projects, for example, generally goes to universities, research institutes and other organisations rather than to firms, which are expected to pay their own way.

Exhibit 3 The Framework for Swedish R&D and Innovation Policy, 2004

Knowledge Base for Innovation			Innovative Trade and Industry		Innovative Public Investment			Innovative People	
Ensure that Swedish education and research are of world class	**Concentrate efforts in Swedish profile areas**	**Utilise the opportunities of globalisation**	**Strengthen existing small and medium sized enterprises' innovative capacity**	**Increase commercialisation of research results and ideas**	**Use the public sector as a motor for sustainable growth**	**Promote renewal and efficiency in the public sector**	**Develop infrastructure that promotes renewal and sustainable growth**	**Stimulate entrepreneurship and enterprise**	**Allow people's competencies to be utilised**
Promote mathematical knowledge and interest in scientific and technical education	Prioritise strategic areas in research and industry	Promote good language skills	Strengthen strategic co-operation between business networks and universities, higher education institutions and research institutions	More effective application of research results and ideas in the business world	Publicly financed activities should contribute to creating products and services for export	Public sector services should be performed more efficiently and innovatively	Develop effective transport and logistics systems	Promote positive attitudes to business enterprise	Develop work organisations that promote renewal
Promote lifelong learning	Increase interaction between research, industry and the public sector	Promote Swedish companies' business establishment in strategically important markets	Develop support for product development and design	Increase financing in the early stages of business and corporate development	Utilise the industrial and technological potential in the fields of defence and security for civil applications	Develop new solutions to meet new social needs	Increase mobility within and between local labour market regions	Ensure that there are simple and practical regulations that make it easier to run a business	Better utilise the skills of all people
Ensure internationally competitive universities and higher education institutions	Promote regional specialisation in combination with national priorities	Promote Sweden's attractiveness as a co-operation partner for research and development	Develop production technology and production systems	Design good rules and promote the use of intellectual property protection	Develop more powerful and demanding public procurement		Develop an IT infrastructure for the future		Increase personal mobility between business and academia, public and private
Stimulate international student and researcher mobility		Attract foreign direct investments and top competence	Stimulate small and medium sized enterprises' investments in R&D	Create competitive conditions that favour the growth of new companies	Develop rules that drive renewal forward				
Continue to invest in research and graduate studies		Ensure an internationally competitive corporate tax rate	Promote small and medium sized enterprises' capacity to act in international contexts						
Strengthen industrial research institutes		Develop the image of Sweden as a country of innovation							

Sweden has a 'veneer' model of governance in which a thin ministerial layer charged with policy formulation is overlaid onto a complex array of agencies responsible for the design and implementation of policy instruments. The main agency supporting the science base, the Swedish Research Council, receives funding from the Ministry of Education, Science and Culture and is responsible for the funding of research across the fields of natural and social sciences, medicine and education. This is primarily response-mode funding to individuals, but funding for groups and institutions is set to increase in the future. Two other Research Councils fund, respectively, research on welfare, the labour market, health and social services (the Swedish Council for Working Life and Social Sciences – FAS – funded by the Ministry of Health and Social Affairs); and research on ecological, conservation, natural resource and construction issues (the Swedish Council for Environment, Agricultural Sciences and Spatial Planning – FORMAS – funded by the Ministry of Sustainable Development and the Ministry of Agriculture, Food and Consumer Affairs. Independent foundations such as the Swedish Foundation for Strategic Research (SSF) also support strategic research in science and engineering.

R&D geared towards industrial needs is supported by Vinnova, constituted in 2001 as the Swedish Agency for Innovation Systems. This receives its funding from the Ministry for Industry, Employment and Communication, but reports in addition to the Minister for Science and Education. Vinnova's activities include funding problem-oriented R&D at universities, often with co-funding from industry; supporting Competence Centres at universities to encourage long-term collaboration with industry; supporting the development of Industrial Research Centres to assist SMEs; and promoting the development of regional innovation clusters via support for networks and collaborative R&D projects. Vinnova is also involved in other regional development programmes in conjunction with the Invest in Sweden Agency (ISA) and the Swedish Business Development Agency (NUTEK), all of which co-operate with ALMI – the state-owned umbrella organisation for the 21 regional subsidiaries – to develop and support regional growth strategies. In addition, an important new institution, the Innovation Bridge, was constituted in 2005. This handles incubator and seed capital programmes that were formerly the responsibility of Vinnova and builds and complements the work of the Technology Bridge Foundations, set up in 1994 to support the commercialisation of university-based knowledge and co-operation between SMEs and universities.

A bewildering array of other organisations also play a part in the governance and conduct of R&D and innovation-related activities in Sweden's highly developed national and regional innovation systems – too many to cover within the context of a thumbnail sketch of the domain – but one in particular has to be mentioned. The Ministry of Defence contributes the second largest share of annual government funding for R&D after the Ministry of Education and Science. Much of this is performed by the Swedish Defence Research Agency (FOI), but large amounts are also conducted by external firms and universities.

Commentary by the Review Team

Policy Competence

Sweden has one of the most highly developed and successful R&D intensive innovation systems in the world. Its 'problems' are those of maintaining high standards rather than those associated with achieving success or remedying failure, i.e. they are problems that many other countries would willingly exchange

for their own. Swedish policymakers have nevertheless recognised that the changing global context in which R&D, innovation, industrial development and trade take place offers both potential opportunities and threats to the way all these activities are supported, conducted and regulated. This sensitivity to changing circumstances has to be congratulated, as does the precautionary wisdom of conducting a comprehensive policy review, especially one adopting an innovation systems perspective and conducted by two of the most important ministries concerned with R&D and innovation.

Informed Response

The review team was also impressed with the analysis underpinning the review and the scope and focus of the policy mix it prescribed. Although the so-called Swedish paradox can probably be explained as a natural consequence of localised investments in R&D leading to non-localised returns in a globalised context, the policy prescription still contained many elements geared towards improving the overall efficiency of the system by strengthening the links between various domains (e.g. between the public sector science base and industry). The threat of loosing footloose R&D capacity also seems to have prompted a shift towards policies capable not only of countering this threat but also of attracting further foreign direct investment. Notable amongst these are the emphases placed on strengthening the human resource and science bases, the attempt to grow strong regional innovation systems and growth poles and the focus on exploiting the opportunities presented by globalisation.

University Research

Despite successful efforts in recent years to build Competence Centres in universities and to increase the share of Research Council funds available to groups and institutions rather than to individuals, many of the stakeholders interviewed – particularly industry representatives – painted a picture of university research conducted by PhD students under the supervision of individual professors, with little scope for (or interest in) developing the strong, often multi-disciplinary research groups and teams that are characteristic of US (as opposed to European) universities. The increased focus on measures to concentrate resources and build critical masses in universities is thus particularly welcome. The review team noted with interest, however, that the percentage of research income reaching universities direct from the state (42%) is relatively high compared with the amounts received from the state as the result of competitive peer-reviewed processes (35%) and from other non-governmental sources (23%). Direct funding can provide universities with much needed security and autonomy, but it can also foster complacency and have a deleterious effect on quality levels, whereas competition for funds rewards excellence and often helps to improve overall quality. Increasing the share of the competitive funding stream by raising the budgets of the Research Councils and decreasing the share of direct funding is an option that deserves consideration, and the review team was pleased to hear that steps have already been taken in this direction in recent government research bills.

SMEs and Renewal

The focus on renewal via strategies to promote spin-offs and start-ups and support SMEs recognises a key weakness in the Swedish innovation system, commented upon on numerous occasions by various stakeholders during the interviews conducted by the peer review team. One of the suggestions being

mooted, namely the setting up of a Small Business Innovation Research initiative, promises to provide a much needed source of funds for SMEs to conduct R&D and a keen incentive for them to develop their own R&D capabilities. This is an option that should be given serious consideration. The emphasis on policies designed to encourage start-ups is also admirable, though many of the discussants during the interview sessions remarked that there might also have to be changes in the tax regime in order to encourage entrepreneurs to continue to grow their companies after the start-up phase. The biggest challenge, however, is to counter many of the risk-averse attitudes in Swedish society and foster an entrepreneurial culture throughout Sweden.

R&D Tax Incentives

The most prominent omission from the R&D and innovation policy mix in Sweden is the absence of any system of R&D tax incentives for either small or large firms. These were common in Sweden until 1982 but have not been used since, though it should be noted that comparatively low corporate income tax levels (28% in 2004) compensate to some degree for their absence. Given the relatively high levels of expenditure of R&D by large R&D intensive companies, the absence of incentive schemes aimed at such performers is understandable. New efforts to encourage SMEs to invest in R&D, however, might warrant a closer look at the potential efficacy of R&D tax incentive schemes. Certainly there is pressure for such schemes from organisations such as SwedenBio, the Swedish Biotechnology Industry Association.[8]

Industrial Relevance and Access

The efforts to strengthen industrial research institutes and to develop the research institute sector in general are also merited, for the impression gained by the review team was that much remained to be done, first in terms of enhancing the relevance of research in the science base to industrial needs, and second in terms of improving the access of firms, particularly SMEs, to this knowledge base. In particular, the relatively small amount of industry funding for research in universities suggested that the 'third task' mission of universities was not being fulfilled.

Public Procurement

An intriguing emphasis in the White Paper is that placed on the role of public procurement as a means of stimulating R&D and innovation in lead markets. This is a topic being keenly debated across Europe, and the outcomes of the planning discussions now being held in Sweden and their manifestation in terms of concrete policy instruments are keenly anticipated. At the time of the review visit, however, only good intentions were observable.

Boosting Confidence

The gap between intention and implementation raises a number of issues. One concerns the confidence that stakeholders have in the ability of the Swedish

8 Growth Creation by Tax Incentives for R&D - A SwedenBIO Benchmark Study, February 2005. See Hwww.swedenbio.com/upload/Publications/Presentations/R&D%20tax%20incentives_Web_SwedenBIO_050516.pdfH

system to translate "a good slideshow in the Ministry" into effective actions. Although the review team came across enough evidence to suggest that the White Paper had led to the introduction of some changes and new instruments (witness the contents of the subsequent Government Bill in early 2005), some stakeholders – particularly industry – were more sceptical, arguing that the government had been slow to respond to external pressures for a shift in policy focus[9] and that complacency was not an option. There is scope, therefore, for further reassurance, with actions, as ever, speaking much louder than words.

Ministries and Agencies

Another issue connected with the gap between policy formulation and implementation concerns the respective roles of ministries and agencies. In the Swedish system, ministries provide the policy direction and the agencies are responsible for designing appropriate mechanisms – with the ministries having very little formal say in, or authority over, the form and content of these instruments. In part this accounts for the gap between the publication of policy frameworks and concrete actions. It also explains why some members of the review team, notably those from administrations in which policy formulation and implementation are the responsibility of single ministries, were surprised at the lack of any firm indications in the White Paper of how policy objectives might be met, what instruments might be deployed, and how they might all interact to alter the dynamics of the Swedish innovation system. In theory, however, the separate roles of Swedish ministries and agencies do not pre-empt the publication of single documents – or the parallel publication of complementary documents – specifying policy frameworks, directions and concrete action plans, as is the case in some other countries. Such a strategy might even soothe some of the more sceptical stakeholders and reassure them that rhetoric is being translated into reality.

Coordination

The separate roles and responsibilities of different ministries and their associated agencies, especially when considered in conjunction with the 'thinness' of the ministerial 'veneer', also raise issues concerning the coordination of policies and policy initiatives. Given the size and complexity of the Swedish innovation system and the number of actors involved in its governance, any attempt at coordination is likely to be extremely onerous.[10] Members of the review team were thus not envious of the task facing lightly staffed ministries. They were also curious as to how activities in the spheres of R&D and innovation might be coordinated given the continued separation of 'horizontal' coordination across ministries, with the Minister for Education, Science and Culture responsible for the coordination of research policy across different ministries (advised by the Government Research Advisory Board), and the Minister for Industry, Employment and Communication responsible for the coordination of industry (and hence innovation) policy across different ministries (advised in this instance by the new Innovation Policy Council). Given that ministries also lack any formal authority to interfere with decisions taken by agencies regarding the application of established laws, the review team was also struck by the potential difficulties

[9] Although the Swedish Government was one of the first to adopt an explicit innovation system approach in the policy formulation process, this only occurred in 2004 despite initial attempts in 1996-7 to involve multiple ministries in the evolution of a "Coordinated Growth Policy".

[10] A major reorganisation in 2000 reduced the number of organisations responsible for the governance of RTD and innovation, but the system is still very complex.

associated with 'vertical' coordination between ministries and agencies, and with 'horizontal' coordination between agencies, since the restrictions on the authority of ministries imposes a huge constraint on their ability to coordinate actions, as opposed to policies, across the innovation system. All these issues warrant serious attention given the increasing need to improve coordination in the formulation and delivery of efficient and effective policy mixes. They are also of extreme interest to all nations considering the adoption of a ministry/agency split along Swedish lines.

Vinnova

Vinnova is specifically designated as the Swedish agency for innovation systems. It grew primarily out of NUTEK, the former national agency for industrial and technology development, and its re-branding and reconfiguration in 2000 constituted an explicit recognition of the growing importance of innovation systems thinking within the Swedish policymaking milieu. The commitment of the agency to the concept of innovation systems and to actions likely to improve the Swedish innovation system was also obvious to the review team during its visit. The team was surprised to learn, therefore, that many of the innovation-related activities with which NUTEK was formerly associated did not now fall under the umbrella of Vinnova but had been delegated to other bodies (e.g. the Innovation Bridge and the re-constituted NUTEK), and that its relative sphere of influence had actually shrunk over time. In comparative terms, too, the budget of Vinnova is far less than that of its nearest equivalent in Finland (Tekes). The hidden logic underpinning these decisions may be sound, but the need for effective coordination is obviously increased and the symbolic significance of Vinnova's title correspondingly devalued.

Defence

Given the historical importance of the defence sector in Sweden, the large share of R&D funding it receives from the state and the potential impact that innovation in this sector has had and could have on both defence and civil markets, the peer review team was surprised by the lack of coverage of this issue in the R&D and innovation policy documentation it received. Naturally this might just be a reflection of the limited ground the review team was able to cover, but if it is not then the potential contribution of the defence sector to the future development of the Swedish innovation system deserves further attention. Defence procurement practices may hold valuable lessons for civil practices, and civil and defence strategies within the overall policy mix will need to be coordinated.

Regional Development

Coordination is also an issue in terms of the development of strong regional innovation systems in Sweden. The review team noted and reacted positively to the strong emphasis on strengthening regional capabilities within the White Paper. Once again, however, the sheer number of national and regional bodies with (overlapping?) responsibilities in this sphere gave cause for concern. To some extent this may be inevitable given the nature of regional innovation systems and the range of activities warranting support at this level (i.e. the same set which preoccupies R&D and innovation policymakers at a national level), but the ways in which bodies such as Vinnova, the Innovation Bridge, NUTEK, Invest in Sweden, ALMI and regional authorities themselves interact were not immediately clear to the review team. Again this may be a limitation of the peer

review exercise itself, but the impression persisted that there was scope for further clarification of the responsibilities of all the bodies involved in the development of regional innovation systems.

Concentration *versus* Cohesion

One issue related to regional development that has yet to be confronted properly within the Swedish system is the potential conflict between policies designed to concentrate resources in order to build critical masses and attempts undertaken in the spirit of cohesion to build effective regional innovation systems in multiple settings, which often call for resources to be distributed much more evenly. As one discussant put it, this is "the issue that dare not speak its name". One manifestation of this tension can be found in the university sector. Policies in the recent past have led to a considerable increase in the number of universities across the Swedish regions, all with hopes and aspirations for the future. The White Paper, however, makes it quite clear that efforts in future are likely to focus on the development of a much more limited number of high-performing centres of research (and teaching) excellence, with obvious repercussions for many of the newer universities in the regions and their ability to act as technological growth poles in regional innovation systems. This is an issue that many countries are now having to confront, and there are few indications as to how tensions of this nature will resolve themselves, but they will only do so if they are faced squarely by policymakers courageous enough to "speak their name".

Europe

During its mission, the peer review team was struck by the general enthusiasm for EU R&D initiatives such as the EU RTD Framework Programmes and the European Research Council (ERC). Amongst academic research funding organisations, there is support for the ERC on the grounds that its introduction will stimulate excellence within the Swedish university system. Within industry, the Framework RTD Programmes are appreciated by SMEs in particular because they provide a source of direct funding for R&D, while representatives of larger firms emphasised that Swedish participation in some of the key Technology Platforms being established was an imperative for both large and small firms. They also argued that priorities in Sweden had to be consistent with those being developed within the context of the EU RTD Framework Programmes in order for Sweden to remain at the leading edge of both European and global developments. Swedish policymakers would do well to bear in mind the enthusiasm for such alignment during priority setting exercises.

R&D and Innovation Policies in Spain

Overview of the Spanish R&D and Innovation System and Policy Mix

The Spanish economy witnessed strong growth over the past decade or so as a consequence of structural reforms and a sound macroeconomic policy framework.[11] Employment increased and GDP growth rates were high, though low productivity gains remain the main problem to be tackled. Within this overall context, there have also been marked improvements in specific domains of the Spanish innovation system. In terms of human resources, the percentage of science and engineering graduates in the active population rose, as did the percentage of R&D personnel. Most of these researchers can be found in the public research sector, either in universities or other public research organisations (PROs). In line with these changes, funding for this sector also improved considerably over the decade, as did performance, with increases in scientific publications per head of the population and an increase in the number of Spanish publications in the Science Citation Index.

In comparative terms, however, the Spanish public sector science base still lags someway behind EU average levels for funding, publications and citations. Research funding per researcher and scientific productivity levels (in terms of publications per head of the population) remain low, and quality in an international context remains an issue despite improvements in this area.

In the private sector, R&D and innovation capabilities are particularly weak, though there have been improvements in this domain too. The private sector is largely composed of SMEs in traditional industries, with only a limited number of 'islands' of high-tech competence and relatively few large companies performing and investing in R&D, but the number of R&D personnel in the private sector has doubled over the last decade, largely as a result of dedicated schemes to promote mobility from the public to the private sector. The overall figures remain low compared with those in many other EU economies, however, and the proportion of total employment in medium- and high-tech manufacturing is also below the EU average, as is employment in high-tech services.

Business R&D expenditure is limited, as is patenting activity, and both innovation and technological diffusion are constrained, though there are signs that this situation is improving given that sales of 'new to market' and 'new to the firm' products have increased in recent times. There is also considerable scope for expanding the absorptive capacity of the economy for innovative goods and services via continued investment in the infrastructure needed for a knowledge-based economy. Investment growth rates in this sphere are now higher than in many other parts of the EU, but the starting point was low and progress towards a knowledge-based economy, as exemplified by the diffusion and use of ICT, still lags behind the EU average.

Many of the improvements to the human resource situation and to R&D activity levels in the public sector science base over the last ten years or so can be attributed to policy developments. Recognition of a substantial gap between Spain and the leading EU economies led to an increase in funding levels for R&D (with a 27% increase in 2005) and to numerous initiatives aimed at improving the stock of qualified scientists and engineers and R&D personnel, all within the

[11] OECD, Public-Private Partnerships for Research and Innovation in Spain: Background Issues for Discussion, DSTI/STP/TIP(2004)11

context of National R&D Plans. Some initiatives were geared towards improving R&D capabilities and innovation capacities in the private sector, but expected results were not realised and more emphasis is being placed on these in the context of the Fifth National Plan for R&D and Innovation (2004-2007) – a rich mix of initiatives geared towards strengthening the public sector science base, improving the links between this base and the private sector, enhancing technology diffusion and the innovation capacities of firms and improving the climate for entrepreneurial activities and new firm formation generally. Enhancing the leverage effect of public research expenditure on the private sector, however, remains a challenge for the future.

Recently, in June 2005, as a response to the adoption of the new Lisbon Strategy, the Spanish Prime Minister announced a new plan for R&D and innovation (INGENIO 2010) – itself part of a broader reform programme aimed at stimulating the economy, increasing employment and boosting productivity. This reform programme involves efforts to improve competition policy; stimulate labour and capital markets; reform the markets for goods and services; improve the quality and efficiency of public financing; and introduce regulatory reforms encouraging greater transparency and lighter regulatory burdens. Within the reform agenda, efforts to stimulate R&D and innovation are based on a diagnosis of the Spanish R&D and innovation system emphasising below EU average investment in R&D and innovation; low private sector contributions to this investment; and a continued need to build critical masses of research excellence and improve quality levels. The action plan thus prescribes an overall goal of maintaining a 25% per annum increase in the public non-military R&D and innovation budget until at least 2007, with a target of 2% of GDP to be invested in R&D by 2010, 45% of this by the public sector and 55% by the private sector.

In order to achieve these goals, the action plan focuses on four key strategic areas, all of which fit within a policy mix framework of continuing to enhance human resource and science base capabilities ('Raising critical mass and research excellence') while putting an even stronger emphasis on building up the technological and innovation performance of the private sector via improved links with the science base ('Promoting public-private collaboration') and measures to encourage the creation of new technological firms ('Creation of new technological firms'). Critically, the plan also calls for large-scale investment in actions designed to promote the adoption and diffusion of information and communication technologies and improve the information society infrastructure ('Information society action plan'). Greater efforts to improve the efficiency of the management of policy instruments are also promised, together with the introduction of an *ex post* evaluation system for R&D and innovation programmes – the Integrated Follow-up Assessment System (SISE).

The commitment of the Prime Minister to these reforms constitutes acknowledgement at the highest level of the importance of R&D and innovation in Spain's efforts to improve employment and productivity. This commitment has been growing steadily since the mid-1980s, when the Inter-ministerial Commission for Science and Technology (CICYT) was set up under the Science Law – the legal basis of the Spanish RTD system – to coordinate and monitor both national R&D programmes, which support R&D in strategic areas, and the mission-oriented R&D programmes of various ministries. Further rationalisation, designed to improve coordination between all the different ministries involved in R&D activities, followed in 2000, when the Ministry of Science and Technology was created to oversee the coordination of research, technology development and the regulation of communication.

When the new government took office in 2004, however, these responsibilities were shared between two new ministries. The Ministry of Education and Science (MEC) assumed responsibility for university education, scientific research and technological development – undertaking both policy formulation and programme implementation tasks – while the Ministry of Industry, Tourism and Commerce took over responsibility for commerce, tourism and industrial development, including responsibility for developing innovation policy and overseeing the Centre for Industrial Technological Development (CDTI), an entrepreneurial innovation agency charged with promoting innovation and technological development in firms. More recently, the Economic Office of the President has taken the lead in the preparation of the new reform policy agenda, with the ministry of Education and Science drafting those parts primarily concerned with science and scientific education, and the Ministry of Industry, Tourism and Commerce drafting those sections concerned with innovation policy and industrial development. The Inter-ministerial Commission on Science and Technology continues to have overall responsibility for coordination and now meets on a very regular basis to fulfil this duty.

Finally, in terms of governance, the role of the regional governments of the Autonomous Communities has to be mentioned. These are responsible for overseeing universities (primarily their educational activities) and some public technological institutes, and a number of regional science and technology policies have been developed to cater for them, though the vast majority of research is still funded on a competitive basis from national sources. The regional governments also have an increasingly important role to play in the development and implementation of regional innovation policies. The General Council on Science and Technology (created in 1986 by the Science Law) is the advisory body responsible for the coordination of the science and technology related activities of the Autonomous Communities and their interaction with the national administration.

Commentary by the Review Team

Policy Competence

The review team was impressed with the level of political commitment in Spain to the primacy of the notion that developments in science, technology and innovation are key to the drive to enhance productivity, improve economic growth and establish knowledge-based societies. Equally impressive was the level of sophistication now being demonstrated in terms of the need for R&D and innovation policies to be centrally embedded within broader frameworks of reform and to be based on sound, comprehensive analyses of 'the big picture' necessary for the formulation of effective policy mixes spanning multiple domains.

Starting from a very low base, Spain has exploited its improved economic position to nurture its overall R&D and innovation system, concentrating first on the development of the human resources to fuel the system, then on developing its public sector science base, and latterly shifting the emphasis to efforts designed to strengthen the innovative capacity of the private sector and establish the conditions necessary for the widespread diffusion of technology, particularly ICTs.

This demonstrates a keen awareness of, and responsiveness to, current thinking in terms of the development of healthy innovation systems. It also indicates a fine appreciation of the changing strengths and weaknesses of its own innovation

system, an appreciation that can only be enhanced once its new *ex post* evaluation scheme (SISE) is fully operational – especially if this system taps international expertise in the area of programme evaluation and strategy development.

Policy Balance

Spain is to be congratulated for identifying weaknesses in its innovation system and shifting the emphasis of its R&D and innovation policy mix towards strengthening the innovation capacity of the private sector and developing the infrastructure of a future knowledge-based society. This shift, however, should not be at the expense of a continued drive to improve the quality of the science base. The review team noted improvements in this sphere, but also the need to improve scientific productivity and quality if Spain is to establish itself as a leading centre of scientific excellence. One suggestion would be to increase the involvement of international experts in the evaluation and selection of projects in national programmes.

Coordination between Ministries

The structures currently in place to effect the coordination of policy efforts in the R&D and innovation domain are, on the face of it, impressive. The CICYT has three levels of meetings: biannual meetings of ministers headed by the President; 3-5 meetings per year of key ministers headed by the Vice-President; and the bi-monthly meetings of the Secretaries of State. The General Council on Science and Technology is also in place to ensure coordination between national and regional efforts, and there are a number of other advisory bodies and coordination mechanisms feeding into the system, e.g. the Advisory Council on Science and Technology (also created in 1986 by the Science Law), which acts as a conduit for the views of the business sector and civil society to influence science and technology policy formulation.

One area where the need for coordination is an imperative concerns the link between science and innovation, especially since responsibility for these two domains is now divided between two ministries, with the MEC primarily responsible for science activities and the MITYC primarily responsible for innovation. In such situations, the coordination of initiatives attempting to link science and innovation is critical and calls for both a clear allocation of responsibilities between ministries and efficient mechanisms to facilitate communication between them.

Some countries have responded to this challenge by giving industry ministries responsibility for all linkage programmes that are intended to be industry-led or oriented primarily to the needs of industry, including collaborative R&D programmes and mobility initiatives designed to stimulate the flow of researchers into the private sector. The view underpinning strategies of this nature is that industrial demand rather than science push should be the primary factor affecting the shape and direction of linkage initiatives, but this perspective is only viable in situations where industry (and industry ministries) can clearly articulate industrial innovation needs and the inputs required from the science base. In Spain, the relatively low historical level of industrial innovation and the emphasis on non-technological innovation where it does occur argues against such a division of responsibilities and for a situation closer to the one currently in place. At present, responsibility for the planning and implementation of linkage schemes is divided between the MEC (which manages that part of the PROFIT programme concerned with the collaborative R&D and the generation of new knowledge) and

the MITYC (which is responsible for the management of those parts of the PROFIT programme concerned with the application of knowledge and its commercial exploitation), with joint committees responsible for policy formulation and the design of implementation schemes. This governance structure is appropriate given the current state of development of Spain's innovation system, but may need to be revised in future if industrial innovation capacity increases in line with expectations.

Coordination between National and Regional Levels

Another aspect complicating the overall coordination of R&D and innovation-related activities is the broader need for co-ordination between national and regional governance structures. Although national-regional coordination mechanisms exist, there are limits to the extent to which centralised initiatives can shape regional activities, especially when regions have distinct cultural and political identities. This is particularly acute for efforts geared towards the stimulation of innovation-related activities, which have primarily been the responsibility of regional authorities. Most research funding is channelled from national sources via competitive schemes, but the Autonomous Communities play a critical role in the formulation and implementation of regional innovation policies. In such a situation, centralised initiatives have to 'bend with the wind' rather than struggle against it, and the Spanish government is to be congratulated for its latest plans to adopt a 'cluster' approach to innovation policy in order to reconcile and link national and regional interests. These cluster schemes will hopefully exploit the potential of regional technology centres to act as key nodes in regional networks and regional growth poles. Mechanisms may still need to be found, however, to assert the primacy of national interests over regional priorities if regional development policies look likely to lead to duplication of effort and the over-fragmentation of scarce science, technology and innovation-related resources.

Prioritisation

The OECD has characterised the Spanish science and technology system as 'bottom-up' and inclusive in the sense that the priority areas included within the National R&D and Innovation Plan are only decided after widespread consultation with all the major R&D stakeholders in the country.[12] This has the decided advantage that the areas spanned by the national programme tend to reflect the interests of multiple stakeholders, but the comprehensiveness of the resulting portfolio does then appear to lack focus and to comprise many small, sub-critical elements which satisfy user needs but do not always fit with overall strategic needs.

This was a common criticism of the National R&D and Innovation Plan amongst the interview partners of the review team, and the team thus welcomes recent announcements that suggest that future plans will emphasise the importance of establishing critical masses of research excellence, with initiatives moving away from the funding of short-term projects and focusing instead on longer-term, large scale actions involving public research groups, centres and consortia of excellence within thematic research areas. Even with projected increases in funding for R&D, such a shift is almost inevitably bound to lead to a greater concentration of effort in fewer strategic areas. It is not yet clear, however, how these areas will be chosen or how the research community will react once the

[12] OECD, Public-Private Partnerships for Research and Innovation in Spain: Background Issues for Discussion, DSTI/STP/TIP(2004)11

implications of a greater focus on key areas are fully comprehended. The shift nevertheless represents an opportunity for Spain to orient its science base towards areas of great relevance for the future needs of Spanish industry and to enhance the predisposition of Spanish researchers to work in such areas.

The Creation of an External R&D Agency

In Spain, most industrial research projects and innovation-related activities are administered by CDTI, an intermediate Agency of the Ministry of Industry, though some programmes within the PROFIT initiative are still managed by the Ministry of Industry. In contrast, The Ministry of Education and Science is responsible for the formulation of R&D and technology policy; for the implementation of its own initiatives; and for overseeing aspects of the National R&D and Innovation Plan implemented by some other Ministries. This is a tough remit, especially when the annularity of operational reporting cycles detracts from the time available and necessary for the demanding task of debating, discussing and contributing to the formulation of new policies.

In many countries, external agencies or research councils handle the task of administering research initiatives, while policy is handled within ministries. The review team supported the wisdom of giving serious consideration to this alternative option and was subsequently gratified to hear that Spain intends to follow this path.

Research Proposal Selection Mechanisms

Competition for research funding is at the heart of the Spanish R&D system and the proposal selection procedures operated by the Ministry of Education and Science involve a peer review system described to the review team as 'state-of-the-art'. That said, proposal success rates are high by international standards while output and quality indicators, e.g. publications per head of the population and citation levels, remain lower than the corresponding EU averages. The share of projects captured by Spanish teams in the EU Framework Programmes is also lower than one might expect on a pro rata basis. All these factors suggest that the efficacy of the proposal selection system is perhaps compromised by what is known in Spain as the "coffee for all" syndrome. Research funding has typically been spread over many small programmes catering to the needs of correspondingly small research communities, and since all researchers are totally dependent on funding from competitive sources, there has been a tendency for these resources to be spread very thinly across the whole community, with high proposal success rates and, in all likelihood, a consequent dilution of the quality of funded research.

Current plans to rationalise R&D funding and concentrate resources in larger programmes and projects should help counter the effects of the "coffee for all" culture, but some improvements to overall proposal selection procedures could also be contemplated. At the moment, only proposals advocating budgets greater than 250,000 € are subject to international peer review, and one way of aspiring to international levels of excellence is to reduce the size of this threshold. A corollary is that such proposals would also then have to be produced in English, as they are now in many EU Member States. At first sight this might be seen to penalise Spanish researchers and to act as a disincentive, but in reality it might be a hard but necessary step to take.

Increasing BERD

The Spanish policy system correctly recognises that private sector R&D (BERD) needs to increase and has devoted more resources to this end in recent years. The main policy instruments deployed, however, have not been a total success. Both conditional loans and a very generous fiscal incentive scheme met with user resistance and were not effective, though recent changes to these schemes may alter this situation. Additional attention has also been given to more direct co-financing schemes, public-private partnerships, networking and other linkage schemes. One way of strengthening private sector R&D capability is to create links with the public science base, either by implementing programmes of joint research or via programmes designed to encourage mobility between the public and private sectors. Initiatives of both types exist, and both have a vital role to play in exploiting past efforts to nurture the development of the science base, but there is also scope for a greater emphasis on complementary measures that stimulate the demand for R&D within industry. These include additional awareness campaigns designed to sensitise firms to the benefits of accessing and conducting R&D and hiring researchers, often using companies with R&D experience as mentors or examples of good practice, but other less direct, preparatory measures are needed too. Even before many SMEs can contemplate R&D activities, one of the first tasks is to increase their absorptive capacity for technology, often via schemes designed to help them acquire in-house technical expertise (e.g. by hiring an engineer). The need for trained researchers will only arise later, when a research function has been established, but it will not arise at all if absorptive capacity remains low or non-existent.

Other Issues

Some issues confronting many countries in the construction and configuration of their R&D and innovation policy mixes were not covered, or only briefly alluded to, during the review exercise.

One was the possibility of encouraging firms with high R&D capabilities in the Spanish defence sector (the Spanish defence budget is relatively high in EU terms) to exploit these capabilities in civil markets or to encourage partnerships with organisations in the civil sector. Another issue not adequately addressed was how Spain intends to cope with the challenge of increased globalisation and the opportunity to capture foreign direct investment and footloose R&D capacity.

This lack of coverage may have been due to the limited nature of the review exercise itself, but the review team gained the impression that these issues were not high on the national (or even regional) policy agenda. This impression may be wrong, but if it is not then such issues warrant closer scrutiny in the future.

R&D and Innovation Policies in Romania

Overview of the Romanian R&D and Innovation System and Policy Mix

Romania's adjustment to a market economy after 1990 – involving large-scale downsizing and restructuring – has been slow, with GDP declining dramatically to a very low base during the period 1996-99 before recovering in 2000, after which GDP grew at three times the EU average, largely as a result of the increased contributions of an expanding private sector and a transformed service sector. The corollary, however, is that the contribution of manufacturing industry fell from 40.5% in 1990 to 29.1% in 2002, and overall levels of GDP per capita remain appreciably lower than the EU average even today.[13]

Exports have grown since 2000, but continue to reflect the dominance of traditional, labour-intensive industries competing on the basis of low labour costs (textiles, machinery, iron and steel) and the relative absence of technology-driven industries. In turn, this is a reflection of an R&D and innovation system that went into serious decline during the first years of the transition period and, despite recent policy initiatives, is still weakly developed, with low performance scores in terms of most indicators. The share of science and engineering graduates in the 20-29 age class, for example, is less than half the EU average, while the percentage of R&D personnel in the active population is about a quarter of the EU average. Funding for R&D stands at only 0.4% of GDP, with the public and private sectors contributing approximately half each. It should also be noted that these levels are much lower than those in the early 1990s. GERD as a percentage of GDP halved over the decade 1993-2003, with a nadir in 2000. During this period the government-funded share of GERD fell most steeply but recovered in 2000. The rate of decline in industry-financed GERD was less severe but continued after 2000. The number of R&D personnel in the working population also fell as a consequence of lack of funding, brain drain, migration to other employment categories and the restructuring of R&D activities during the transition period. Despite the low levels of GERD, BERD and GOVERD, however, Romania is committed to substantial increases. As part of its EU accession agreement, Romania committed itself to an attempt to raise GERD to 1% of GDP by 2007, and there has since been a commitment to approach the Barcelona target of 3% of GDP by 2010, with 1% coming from public sector and 2% from the private sector. In consequence, the state budget for R&D in 2005 increased by 60% over the figure for 2004 and was set to rise again in 2006, taking the state budget for R&D to 0.4% of GDP compared with the 2005 figure of 0.26%. At current rates of increase, the target figure of 1% of GDP will be met in 2010.

Familiarity with the structure of R&D activities pre- and post-1990 is crucial to an understanding of the strengths and weaknesses of the Romanian R&D and innovation system and the challenges it now confronts. During the late 1960s and early 1970s, Romania concentrated much of its R&D activities in state-owned Research Institutes in specific industry branches (with a strong bias towards applied R&D and the replication, in local industry, of technological developments in the West) and institutes of the Romanian Academy (with a bias towards the humanities) rather than in either universities or industry. Post-1990, some institutes fragmented and most lost large numbers of staff, but all had to readjust to the drastic decline in public funding for R&D, the lack of demand for R&D in the radically new setting of a market economy, and the necessity for the institutes themselves to establish a new *modus operandi* in this unfamiliar

[13] TrendChart, Annual Innovation Policy for Romania 2003-4

environment. Some remain as public institutions affiliated to different ministries while others operate as private companies (though still associated with certain ministries in some instances), but all now have to compete in one way or another for resources and many have to derive their income from both public and private sector sources – "forced to juggle R&D, technical services, and small-scale production" in an attempt to survive, with the results of their activities often "produced in the form of specification sheets for new products and processes, collected in catalogues and distributed to industry".[14] The current structure, therefore, is one in which there over 600 research organisations, including 264 public institutions associated with various ministries (of which 37 are designated as National R&D Institutes in 19 specific fields, and a further 65 fall under the auspices of the Romanian Academy); 270 state or privately owned companies which have R&D as their primary activity; and 74 universities which, in reality, undertake only a modest amount of research.[15] In addition, it is estimated that as few as 5% of firms in the Romanian manufacturing sector undertake R&D activities.[16]

The overall picture, therefore, is very different from that in many other EU countries, where it is common to have a strong tradition of basic research in universities and more applied R&D in industry, complemented – on occasion – by the activities of a mix of public and private research institutes. In contrast, the Romanian university sector performs only a small amount of mainly basic research (accounting for only 4% of R&D expenditure in 1998, rising to 14% in 1993[17]); an Academy structure dominated by the humanities; an industry with almost no R&D capacity whatsoever; and a very large and heterogeneous mix of public and private sector research institutes competing for scarce resources and attempting to survive in relatively novel and often hostile market economy.

Just as there have been changes in the configuration of R&D actors since 1990, there have also been changes in industrial structure. Restructuring post-1990 led to employment loss as large companies were broken up into smaller units, production was modernised and work organisation and management practices amended. By 2004, Romanian industry comprised some 1,127 large companies and 345,056 SMEs (of which 305,182 were micro-enterprises).[18] Very few, however, were R&D intensive or high-tech. By volume, manufacturing accounted for 80% of Romanian industry. The major sectors were: iron and steel (27% by volume); consumer goods (26%); chemicals (20%); automotives (11%); electronics and electromechanical (4%); others (12%).

The lack of an R&D base in industry and the low to medium-tech sectoral composition is matched by low innovation performance. Innovation does occur – to a limited extent – but it is not driven by indigenous developments in science and technology. According to the European Innovation Scoreboard for 2004, Romania lagged the EU-25 averages for all performance indicators other than

[14] Radosevic, S. *et al* (1999), Restructuring and Reintegration of Science and Technology Systems in Economies in Transition, TSER Report ERB-SOE1-CT95-1008

[15] University Professors, however, often hold posts at both universities and other research institutions.

[16] Vass, A. (2005), Private Sector Interaction in the Decision Making Processes of Public Research in Romania, Draft document provided to the policy mix peer review team

[17] This appreciable rise over such a short time span was facilitated by loans from the World Bank and a subsequent increase in the funding available to academics via the initiatives of the Ministry of Education and Research (MER).

[18] Romanian Ministry of Economy and Commerce (2005), 'Experience of MEC in Developing and Open Business Environment', Paper provided to the review team

non-technological change and new-to-market products.[19] This is characteristic of an economy pre-occupied with restructuring traditional industries and finding its way in a new market setting, not with one firmly on the path to the establishment of new R&D intensive industries and a technologically-led future. As noted in a report by the Romanian Economic Society:[20]

- Low costs continue to be the main source of competitiveness, and not product innovation or the introduction of new technologies.
- To a large extent, new technologies are derived from imports and foreign direct investment, not from local efforts.
- Most enterprises in manufacturing are engaged in assembly activities.

Thus, despite the pressing need to improve technologies and products in order to compete successfully once EU accession becomes a reality, Romanian industry remains wedded to a techno-economic regime ill suited to the realities of its new situation.

The low- to-medium tech orientation of industry and the prospect of future lock-in have major consequences for the viability of the research institute sector. They also have consequences for the ability of the Romanian manufacturing sector to provide for the increasingly sophisticated needs of both indigenous and export markets. These are developing apace as the Romanian economy becomes increasingly aligned and integrated with EU markets. Definite progress has been made in this area in terms of the establishment of many of the legal frameworks and institutions needed for a market economy, though the application and operation of these has been criticised as ponderous and crucial obstacles remain to be overcome, e.g. "poor financial discipline, weak enforcement of market regulations, low transparency and stability of the regulatory framework, inefficient public administration, unsatisfactory judiciary, and so on".[21] Progress towards the development of the infrastructure required for a knowledge-based society has also been slow, with Internet access and usage and ICT investment levels well below EU averages.

Accession to the EU in January 2007, however, is likely to see a firm policy commitment to a revitalised economy, with R&D and innovation as a central plank of the proposed National Development Plan for 2007-13 (NDP 2007-13). Currently being coordinated by the Ministry of Public Finances (MPF) and the Ministry of Economy and Commerce (MEC), this has an overall emphasis similar to many of the main strands of EU policy expressed in the new Lisbon Agenda. It is likely to focus on:

- Improvements in the competitiveness and capacity of the R&D and innovation system (involving widespread upgrading of scientific and technical competence, including equipment and facilities; a focus on key centres of scientific and technological excellence; collaborative R&D projects involving research institutes, universities and firms; and the development of clusters and networks of key innovation system actors).
- Improvements in the compliance of products and services with EU quality and environmental standards (involving substantial investment in new technology; stronger links between firms and research institutes; and the development of firms' own innovation capacities).

[19] ICT expenditure was just above average, too, but loosing momentum. All others were below average – the majority of them considerably so.

[20] Romanian Economic Society (2004), 'Romania's Performance in terms of the Lisbon Strategy'

[21] TrendChart, Annual Innovation Policy for Romania 2003-4

- Improvements in the business infrastructure and environment for enterprises, especially SMEs (involving improved access to R&D and technological services; greater networking between innovation system actors; assistance with technology transfer and absorption; the establishment of incubators and science parks; and improved access to seed and venture capital via loan guarantee and risk capital measures).
- Progress in terms of the development of the information society (involving the development of a broadband infrastructure; improving the provision of public services related to e-government, e-health and e-learning; and developing the national ICT industry for products and services).

In addition, the plan is also scheduled to embrace the further development of the energy infrastructure and the tourist sector.

The NDP recognises that R&D and innovation are key drivers of economic growth and its contents are redolent of a national innovation system approach in that a comprehensive policy mix spanning human resources, the science base and industry is envisaged. These policies are currently being elaborated in the updated National Plan for R&D and Innovation (NPRDI) 2007-13, which in turn builds on previous formulations. The first version of this plan was introduced in 1999, updated in 2001 to cover the period 2001-04, and updated again in 2004 to cover the period up to 2006. The latter two versions were prepared by the Ministry for Education and Research (MER), which is also responsible for preparing the new version for 2007-13. MER was created in 2001 out of the former Ministry of National Education and the National Agency for Science, Technology and Innovation. The two bodies were integrated in order to improve the mutual sustainability of R&D and innovation objectives and infrastructures and to align them "to the European practice of an integrated approach to R&D and innovation activities"[22], with MER responsible for the formulation, implementation, monitoring and assessment of R&D and innovation policies. In July 2005, the National Authority for Scientific Research (NASR) was established under the auspices of MER in order to undertake the ministry's specific responsibilities in the field of research, technological development and innovation. MER-NASR also ensures the coordination of the NPRDI, which is evolved in conjunction with several other relevant ministries, e.g. the Ministry of Economy and Commerce (MEC) and the Ministry of Information and Communications Technology (MICT).[23]

In developing its policies, MER-NASR is advised by a number of bodies, one of which is the Advisory Board for R&D and Innovation, comprised of representatives from the science, technology and industrial communities. At a higher policy level, the Inter-Ministerial Council for Science, Technology and Innovation, which provides a framework for an inter-ministerial policy dialogue on R&D, is responsible for ensuring the compatibility of R&D and innovation policies with other social and economic policies and evolving the legislative framework for implementing R&D and innovation activities. Another body, the National Council for Science and Technology Policy, to be chaired by the Prime Minister, will have the task of analysing long-term strategic R&D priorities.

The first NPRDI comprised four national R&D and innovation programmes, expanded by MER to 14 in 2001. These included eight national programmes aimed at modernising and re-launching the Romanian economy. Four were

[22] TrendChart, Annual Innovation Policy for Romania 2003-4

[23] In reality, this governance structure is not as commonplace in Europe as structures that allocate responsibility for education and public sector R&D to Ministries of Education and Science and responsibility for business R&D and innovation to Ministries of Industry.

aimed at specific areas (agriculture and food; health; energy and environment; transport), while the other four focused on the generic development of new processes, products and services and improvements to product quality. Another four national programmes were aimed at launching and consolidating a knowledge-based society and were targeted at ICTs, biotechnologies, new materials and nanotechnologies, and aeronautic and space technologies. The remaining two programmes were set up to stimulate the integration of the Romanian S&T community in the EU and international community and to conduct socioeconomic and cultural research.

These programmes are co-financed from public funds and economic units interested in the exploitation of results (with public funds accounting for 65% of the budget in 2002), and these funds are available on a competitive basis to Romanian R&D and innovation stakeholders – primarily the research institutes. It should be noted, however, that these are not always grants for specific, relatively small, R&D and technology transfer projects, as is the case in many programme contexts within the EU.[24] In contrast, national programme funding is allocated to groups of researchers within individual institutions, or to whole institutions, in order to carry out a range of R&D and innovation activities related to the main technology development aims of programmes, with the recipients accorded an appreciable degree of autonomy as to how the money is actually spent after the funds have been allocated. Programme funding, even though it is awarded on a competitive basis, is thus closer to 'institutional funding' than it is to specific 'project grants', with the mechanism effectively subsidising the overall activities – including the commercial activities – of the selected institutions.[25]

Subsequent to the launch of the full set of 14 programmes within the NPRDI, MER continued to launch and/or coordinate a series of smaller complementary measures. In 2003, for example, MER initiated a number of 'Nucleus' research programmes designed to provide further institutional support for the R&D activities of the 37 National Research Institutes, designated as such after a 're-accreditation' process in 2001-2002. All of the institutes 'compete' for a share of the Nucleus budget by submitting strategies in line with national requirements and the objectives of the EU's Seventh Framework Programme (FP7). If successful – and all 37 institutes have been so to date – the Nucleus initiative can provide funding of up to 50% of an institution's R&D expenditure in the previous year, though the average award currently stands at around 15-20%.

The same year also saw the launch of a series of sectoral R&D plans financed by individual ministries and designed to complement the priorities expressed in the NPRDI. The following year, 2004, saw the introduction of the INFRATEH programme. This is aimed at the development of specialised infrastructures for technology transfer and innovation and focuses on development at a regional level, including support for technical assistance and information centres, technology transfer centres, incubators and science and technology parks.

In 2005, MER-NASR also launched a programme for 'Research of Excellence'. This is geared towards the improvement of research capacity and quality. Its

[24] The national programmes are, in fact, complementary to an existing programme of grants for scientific research, set up in 1996 to support the formation of scientific careers and the development of research teams around scientific personalities, especially within universities. See Predescu, R. (2005), 'R&D and Innovation in Romania: Direct Support for Economic Development', Presentation to the 8th Plenary Session of the United Nations Commission on Science and Technology for Development, UN-CSTD, Geneva, May 2005

[25] This type of phenomenon is described in Radosevic, S. *et al* (1999), Restructuring and Reintegration of Science and Technology Systems in Economies in Transition, TSER Report ERB-SOE1-CT95-1008

aim is to increase Romania's capacity to collaborate in European S&T programmes, as well as to support and accelerate the process of alignment with the regulatory framework of the EU. It is fully oriented towards the priorities of the European Research Area (ERA) and the Seventh Framework Programme for RTD (FP7). The programme involves four measures supporting:

- Complex R&D projects and integrated technological networks.
- The career development of young researchers.
- Efforts to improve the visibility of Romanian R&D institutions and programmes.
- Improvements to the test and measurement infrastructure.

Finally, in 2005, MER launched a campaign to promote the formation and coordination of technological platforms at a national level, with a view to their integration into similar platforms at an EU level.

While it is possible to see the NPRDI as the core support mechanism of MER (it accounts for over half of MER's budget) and the other programmes as complements, it is nevertheless difficult to differentiate between the separate initiatives given the breadth of activities spanned by each one and the extent to which they overlap each other. It is particularly difficult to assess the degree of overlap and complementarity with initiatives such as the sectoral plans financed by other ministries.

The extent to which MER-NASR can be expected to fulfil its overall role as a coordinator of R&D and innovation-related developments is also debatable, since some activities lie clearly outside its ambit and are the responsibility of other bodies. The Romanian Academy, for example, has a separate budget and governance structure for its activities and accounts for approximately 20% of the state budget for R&D. At the innovation end of the spectrum, too, initiatives to stimulate entrepreneurship and create a viable and open business environment favourable to start-ups and the further growth of SMEs, including new technology-based firms (NTBFs), are the responsibility of the Ministry of Economy and Commerce and the National Agency for Small and Medium Enterprises and Co-operatives. Similarly, the Ministry of European Integration and the eight Regional Development Agencies have responsibility for schemes such as the Romanian Network for Innovation and Technological Transfer, and the Ministry of Public Administration and Home Affairs has responsibility for an Industrial and Software Parks Programme. The Ministry for Information and Communications Technology also plays an active part in measures designed to stimulate the growth of the ICT sector and the diffusion of ICTs, and the Ministry of Finance, which currently does not operate any specific tax incentive schemes specifically related to R&D and innovation, is currently exploring this possibility.

Commentary by the Review Team

Conducting the Review

The ability of the review team to comment on the appropriateness and effectiveness of the Romanian R&D and innovation policy mix was curtailed to some extent by a number of factors. Despite the commendable efforts of our hosts to provide the team with adequate background information prior to, during and after its visit, the team's ability to comprehend the complexities of the Romanian R&D and innovation system was limited. In part this was due to the suspect nature of some of the statistical information made available to the team, the reliability of which was called into question in numerous quarters during the

review mission. The relative dearth of detailed qualitative information on some policy initiatives and programmes also made it difficult to comprehend their nature as opposed to their objectives, but the real obstacle was the unfamiliarity of most of the review team with the structure, organisation, history and dynamics of R&D and innovation activities in the transition countries. Rectifying this would have necessitated far more information and time for analysis and reflection than was available during the course of the review. To some extent, therefore, the review raised rather more questions than it provided answers. The commentary below thus focuses on those issues where the review team felt confident enough to offer comments and omits many topics where this confidence was lacking.

The Challenge Facing Romania

From the material to hand and the discussions that took place, the review team was able to build a picture of the main challenges facing Romania and the thrust of government policy in the science, technology and innovation arena. The team was impressed by the level of commitment the Romanian Government has shown to meeting the requirements for EU accession and to strengthening its R&D system in line with the Barcelona 3% target. It was also struck, however, by the daunting scale of the challenge Romania confronts in its quest to become a dynamic, innovation-oriented economy and society. Starting from a very low base, the most critical challenges are to develop the scientific and technological human resource base; to provide an adequate infrastructure in which the quantity and quality of R&D activities can be significantly expanded and improved; to sensitise industry to the importance of accessing and/or developing R&D capacities; to facilitate the growth of innovation-oriented industrial capacity; and to establish all the necessary institutional and legislative mechanisms needed to flourish and operate successfully within the EU market environment.

Ambition Levels

Romania committed itself to raising GERD to 1% of GDP by 2007 and to aspire to the Barcelona targets of 1% for publicly funded R&D and 2% privately funded R&D by 2010. Recent announcements, however, suggest targets of 1% for publicly funded R&D by 2010 and 2% for privately funded R&D by 2013-15. These aspirations are more realistic but may still be over-optimistic. Current R&D expenditure levels are inadequate if Romania is to prosper within the EU, but the absorption capacity of the system for the R&D increases contemplated within the specified timeframes is likely to be limited. In particular, human resource issues are likely to be a problem in both public and private sectors, and there are as yet few policy mechanisms in place capable of stimulating the levels of private R&D expenditure that increases in public R&D expenditure are expected to leverage. Aiming for more realistic targets is thus one possibility for Romania, though a more positive approach would be to increase its efforts to resolve human resource shortages and improve leverage.

EU Convergence

The desire for accession to the EU and the need to satisfy highly specific entry requirements has had a tremendous influence on the shape and pace of R&D and innovation-related developments in Romania, especially in terms of the adoption of broad EU targets; the gearing of R&D agendas to those mirroring the EU Framework RTD Programmes; and the adoption of policy mechanisms that are commonplace both at an EU level and in the context of other national settings. Many of these developments will undoubtedly have a beneficial effect on R&D

and innovation activities in Romania, especially in terms of the convergence with EU levels and practices and the ability of Romanian R&D and innovation actors to compete on a level playing field within the EU. There was some concern, however, that the desire for convergence might lead to the adoption of directions and practices unsuited to the particular configuration of actors within the Romanian innovation system and the needs of the Romanian economy and society in general. The choice of an appropriate policy mix is invariably context specific and demands a highly selective approach to the adoption of suitable policy instruments.

A Vision for the Future

Determining appropriate policy mixes can only be done within the context of comprehensive assessments of the strengths and weaknesses of individual innovation systems and keen analyses of the feasibility of grasping potential opportunities and avoiding imminent threats. Whereas assessments and analyses of this nature may have been conducted in the past (with accession to the EU identified as the opportunity to be grasped), the review team was unable to discern any extant, articulated vision that went far beyond this looming horizon. It was gratified to note, however, that an exercise of this nature had recently commenced.

Involving Stakeholders

In terms of constructing this future vision, it will be important to involve key stakeholders in the academic, research institute and industrial spheres in the process. In particular, given that the review team sensed a certain level of dissatisfaction within the industrial community with its lack of involvement in agenda setting and policy formulation (most tellingly within the relatively small industrial community displaying an interest in R&D and innovation-related matters), it will be imperative to involve these actors in the formulation of a vision and the determination of future policy. This is necessary if such actors are to evolve a sense of ownership of the process and, hence, a degree of commitment to the realisation of the vision.

Involving External Expertise

It will also be important to involve external expertise in both the formulation of future visions and the assessment of past activities and current strengths, weaknesses, opportunities and threats. The views and needs of indigenous actors of necessity have to be taken into account, but inputs from external agents is necessary at this juncture given the relative unfamiliarity of many actors within the Romanian R&D and innovation system with the scientific and technological milieu and the economic context in which they will have to operate in future, not to mention a lack of experience with processes such as foresight exercises and comprehensive reviews of overall innovation system performance.

Monitoring and Evaluation

Just as Romania lacks experience with macro-level assessments of innovation system performance and prospects, it also needs to improve its programme and policy evaluation mechanisms. Monitoring mechanisms are in place within MER to monitor the progress of individual R&D projects via technical reports prepared by external experts, and the aggregated results of these feed into annual programme reports prepared by the MER. These provide a great deal of

information about the composition of programmes in terms of the types of actors and projects involved in programmes, but they are monitoring reports rather than evaluation reports and do not correspond to the *ex post* programme evaluations and impact assessments now conducted in many EU countries. Many of these are performed by external agents with expertise in socioeconomic analysis as well as in technical areas, and although they use monitoring data as a starting point, they go much further in terms of exploring the impact of programmes on individual organisations and the environments in which they operate. They also provide an independent assessment of many aspects of programme implementation. Sophisticated evaluation systems such as these need to be installed if assessments of past performance are to feed into the formulation of future policies. Moreover, external expertise in the design and implementation of such systems should again be tapped.

Appropriate Development Paths

One of the issues to be confronted in the construction of future visions and the formulation of strategies capable of realising them is the choice of appropriate development paths. Some other countries faced with the challenge of starting from a very low base in terms of most R&D and innovation system performance indicators have chosen to focus on the development of select innovation system domains in the first instance, concentrating scarce resources, for example, on the education and training of scientific personnel and the development of public sector (university) research capacity prior to a subsequent focus on the development of private sector R&D capacity and innovation potential. Such staggered, sequential development paths are typically only feasible, however, if non-innovation oriented industrial and economic activity in the economy as a whole is generating sufficient wealth to underwrite the development of R&D capacity prior to the reorientation of industrial activity generally (as when a tourist bubble, for example, generates sufficient income for a reorientation strategy to be adopted). Romania, however, may not find itself in this position and may have to adopt a much more parallel, incremental and potentially slower approach to the development of multiple capabilities (e.g. human resource development, increased R&D capacity, improved industrial innovation performance etc.). Determining appropriate development strategies, however, will again involve considerable analytical effort and the involvement of multiple stakeholders and sources of expertise.

Specialisation

One alternative to the incremental development of multiple innovation system capabilities in all technology and market sectors is to develop holistic policy packages in a limited number of key areas, typically those corresponding to areas of existing strengths and/or great niche market potential. Research in areas in which industry needs to improve its performance in order to meet EU product quality criteria and environmental standards is also a priority. Again, however, the choice of appropriate techno-economic domains is likely to involve a good deal of analytical effort.

Direct versus Indirect Mechanisms

Within specific domains of the R&D and innovation system, choices will have to be made concerning the use or otherwise of particular policy instruments and the relative weight attached to them. One such choice concerns the use of direct or indirect fiscal measures to stimulate R&D activity and expenditure in the private

sector. At the moment reliance is put on direct measures, though the team was told that the Ministry of Finance is contemplating the use of fiscal measures in future. The review team was divided in its opinion of the efficacy of such measures in a Romanian context, but urged the Romanian authorities nevertheless to give careful consideration to assessments of their potential use given the low current levels of interest in conducting R&D in the private sector.

Research Institutes

Aspects of the Romanian system that the review team found most difficult to grasp were the structure and organisation of R&D activities across different types of organisation and the *modus operandi* of these organisations, Research Institutes in particular. This was partially due to unfamiliarity with institutional configurations in which R&D activities are concentrated in a Research Institute sector and (relatively) neglected in both academic and industrial quarters, and partly to a similar lack of familiarity with the problems these organisations have to face in coming to terms with the realities of a market economy, especially in terms of securing and generating income and finding 'markets' for their outputs. The ability of the team to understand the dynamics of the Research Institute sector was also exacerbated by a lack of transparency concerning the role of the state in both the governance and funding of such institutes. The team was aware, however, of an obvious degree of dissatisfaction amongst many of these bodies with the current state of affairs, particularly the relatively low levels of funding available for R&D activities, the lack of resources available to renew scientific and physical infrastructures, and the necessity to access R&D funding exclusively via competitive mechanisms (even though these mechanisms appeared to constitute a fairly secure form of 'institutional' funding for some organisations, particularly those designated National Research Institutes). The team was also struck by the huge range of institutes in existence, their disciplinary variety and their relatively low staffing levels (compared both with historical levels and levels in similar institutes in other countries). In turn, these factors gave rise to concerns about the absence of critical mass in some areas and the redundancy of some institutes in others. It was tempting, therefore, to call for a wholesale rationalisation of this sector in order to align it with structures and funding regimes commonplace in other parts of the EU and to equip it for the challenges ahead. Certainly the review team hoped that the privatisation of approximately 100 institutes currently being contemplated by the Romanian authorities is informed by a thorough review of the structure and funding of the Research Institute sector and its role within the Romanian R&D and innovation system as a whole.

Universities

According to official statistics, the level of R&D activity in the Romanian higher education sector rose from a very low base in 1998 to approximately 14% of overall R&D expenditure. This, however, compares unfavourably with an EU average of 24%, and even though the evidence available suggests that university participation in the initiatives launched by the MER is appreciable, the anecdotal evidence available to the review team painted a contrary picture of a university sector unfamiliar with, and generally uninterested in, research activities (though naturally there were notable exceptions, with some University Professors also holding parallel posts in Research Institutes or institutions of the Romanian Academy). The apparently low interest levels in research, however, do merit concern and suggest the need for a reappraisal of the incentives necessary to raise interest levels and hence research activity in the university sector. Greater efforts will also be needed to motivate Romanian academics to apply for EU

Framework RTD funding, since the Romanian share of the overall budget is much lower than the country's financial contribution warrants.

Human Resources

Raising interest levels in the conduct of research by academics will also be necessary as a complement to the main role of the higher education sector in the near future, namely the education and training of the scientific and technological personnel needed in both the private and public sectors as the funding for R&D increases and the innovation system expands. The required level of investment in the educational infrastructure, however, is likely to be huge (at both secondary and tertiary levels), and considerable ingenuity will be needed to attract and retain the interest of young people in scientific, technological and research careers given the relative attractiveness of the many other options likely to open up for them once Romania enters the EU.

Industry

One of the main challenges confronting Romania in the future will be to stimulate R&D and innovation-related activities in firms whose main activities currently lie in manufacturing or service provision (as opposed to firms whose primary activity is research). Although some of the statistics concerning the extent of R&D performed in the private sector and the number of firms conducting R&D are questionable, there is little doubt that overall activity levels are low and the number of organisations conducting R&D is small. Remedying this situation will probably require action on many fronts. One task will be to persuade existing industrial actors of the need to perform R&D and become innovative. Such 'conversion' approaches will require awareness campaigns and the expanded application of direct policy measures akin to those put in place over the last few years. Another task will be to ensure the 'renewal' of the industrial structure via mechanisms designed to stimulate the formation of new technology-based firms (NTBFs) in emerging technology trajectories. This will require a keen focus on instruments designed to enhance access to risk capital and provide the infrastructure necessary for start-ups and spin-offs to survive. Attempts to create viable science parks and the like have not succeeded in the past, due in part to a failure to maintain adequate investment levels, but a renewed focus on such facilities will be necessary in future. A third task will be to 'attract' R&D and innovation-intensive foreign direct investment, or at least to persuade existing foreign-owned firms to expand such activities in Romania. This is unlikely to be successful, however, without the drastic improvements in research capacity and human resource development needed to act as magnets for footloose R&D capacity.

Adaptation to a Market Economy

The review team noted the progress that had been made in terms of the establishment of the legal frameworks and institutions needed for the effective functioning of a market economy and integration with the EU. It also noted criticisms of the pace of change in this sphere and the obstacles that remain in terms of, for example, improving transparency and enforcing market regulations. Establishing these framework conditions is a necessity for the development of a well-functioning innovation system and should be a major priority at the highest levels of government.

Governance

The system of governance for R&D and innovation in Romania currently accords primary responsibility for both to the Ministry for Education and Research (MER) and primary responsibility for industrial development to the Ministry for Economy and Commerce (MEC), with various other bodies such as the Inter-Ministerial Council for Science, Technology and Innovation responsible for ensuring the compatibility of policies in different areas. This system of governance and division of responsibilities is not uncommon, and it can work well in certain situations, but the review team was not entirely convinced that this was the case in Romania. In particular, the team gained the impression that locating responsibility for 'innovation' with the MER rather than with the MEC has resulted in (or compounded) low levels of interest within the MEC in innovation *per se*. It also dictates that, as far as R&D and innovation are concerned, industry is expected to deal with a relatively unfamiliar agency rather than with one it deals with on a more usual basis. Both of these phenomena are unwelcome when a major priority in Romania has to be the cultural transformation of the industrial base and its reorientation towards an innovation-based mode of operation. That said, switching responsibility for innovation to a different Ministry, particularly one that has shown little historical interest in the topic, is not necessarily the way forward. What is clear, however, is that greater efforts are needed to evolve governance structures that ensure the hand-in-hand development of R&D capacity, innovation potential and industrial development via efficient linkages between the public and private sectors and the ministries concerned with their development.

Generic Lessons

The peer review exercise stimulated many suggestions concerning the ways in which policies and policy implementation in the three review countries could be improved. It also suggested a number of ways in which R&D and innovation policy developments might benefit in other contexts. In particular, generic lessons of broader applicability emerged concerning:

- The process of policy formulation.
- The governance of R&D and innovation activities.
- The policy choices and balances that pervade policy debates.
- Common priorities in modern innovation systems.
- Starting points and development paths.

Formulating Policy Mixes

The main lessons to emerge concerning the formulation of policy mixes can be summarised succinctly:

- Seize political opportunities to review policies and policy mixes.
- Adopt a holistic approach to policy formulation in order to balance policy efforts, avoid conflicts and duplication and encourage synergy.
- Conduct SWOT analyses, take external and internal threats and opportunities into account and aim to rectify weaknesses and build on strengths.
- Compare and contrast with policies and experiences in other countries.
- Consider all policy options – even those rejected on previous occasions.
- Formulate inclusive visions, establish monitoring and evaluation systems and improve strategic intelligence capabilities.
- Set realistic targets.
- Implement quickly and decisively.

All of these can be illustrated via contextual examples.

Seize political opportunities to review policies and policy mixes

Romania The need for Accession countries to converge towards EU norms and practices has had a strong influence on the shaping of policy mixes and the adoption of particular policy instruments. The context-specific nature of appropriate policy mixes, however, demands a more customised approach to their formulation and adaptation than may have been possible in Romania in the phase leading up to accession. Although many of the basic structures and approaches have been put in place within the New Member States, the time may be ripe to reappraise and fine-tune existing policy mixes.

> *Seize political opportunities such as that presented by accession to formulate new visions for the future and evolve customised policy mixes capable of achieving them.*

Adopt a holistic approach to policy formulation in order to balance policy efforts, avoid conflicts and duplication and encourage synergy

Sweden Despite its high investment in R&D and sound economic performance, Sweden has still felt the need to adopt an innovation system approach to the development of policies and the formulation of a comprehensive policy mix aimed at improving overall system performance. The dynamics of even the most successful innovation systems are subject to a multitude of both internal and external pressures to which policymakers have to respond. Even when the sea is calm a storm can be brewing, and vigilance is required at all times. Periodic reviews adopting a comprehensive innovation systems approach are increasingly becoming a prerequisite.

> *Conduct periodic reviews of the dynamics of the national innovation system, the factors affecting overall performance and the policies needed to ensure the continued health of the system.*

Spain Given the centrality of R&D and innovation to the development of modern knowledge societies, there is a now a clear recognition in Spain that policies dealing with R&D and innovation have to be embedded within broader programmes of reform and based on comprehensive analyses of innovation systems.

> *Formulate plans for the development of R&D and innovation capacities within broader policy frameworks designed to achieve high level goals concerned with targets such as increased competitiveness, productivity, growth and employment.*

Romania Choices concerning which development paths to take are not easy, especially when innovation systems display multiple weaknesses, few strengths and scarce resources. In such situations, there may be little alternative but to advance very slowly on many fronts or to focus on developing capabilities in just a select number of techno-economic domains. In both instances, however, the aim should be to evolve holistic policy packages that strengthen human resource development, enhance R&D capacity, increase innovation performance and facilitate the operation of well-functioning markets.

> *Maintain a focus on holistic policy packages even when resources are scarce.*

Conduct SWOT analyses, take external and internal threats and opportunities into account and aim to rectify weaknesses and build on strengths

Spain The complexity of innovation systems demands a certain level of sophistication in the formulation of appropriate policy mixes. Typically this demands consideration of the strengths and weaknesses implicit in innovation systems and the ability of individual policies and combinations of policies to take these into account and to grasp opportunities and avoid potential threats. In Spain, the rigour of the analysis underpinning recent policy announcements bodes was much appreciated by the review team.

> *Always attempt to base policy formulation on detailed analyses of strengths, weaknesses, opportunities and threats.*

Sweden Phenomena such as globalisation pose both threats and opportunities. Understanding how they might affect the performance of innovation systems by focusing on weak spots in the system is the key not only to countering threats but also to ways of improving system performance and grasping new opportunities. The actions needed in Sweden to prevent the loss of footloose R&D capacity, for example, are often those likely to attract even more foreign direct investment.

> *Prioritise the rectification of weak spots in innovation systems.*

Spain The overall performance of innovation systems is in large part constrained by the performance of its weakest links. Identifying and rectifying these is thus crucial to the satisfactory performance of the system as a whole. In Spain this means shifting policy attention to the development of industrial innovation capacity. This should not, however, be at the expense of parallel efforts to continually nurture and build on existing strengths, e.g. the science base in Spain.

> *Improve policy mixes via diagnostic approaches designed to identify weak spots in innovation systems and policy initiatives aimed at rectifying these deficiencies, but not at the expense of continued efforts to build on existing strengths.*

Sweden The R&D and innovation priorities being set within an EU framework increasingly represent the priorities of all major academic and industrial players in Europe, many of whom compete successfully in global markets. Alignment of national priorities with EU priorities – for which there is considerable support amongst Swedish academic and industrial stakeholders – is thus one way of assuring that national actors remain in touch with leading edge developments across the world.

> *Take external as well as internal considerations into account when developing national R&D and innovation priorities.*

Compare and contrast with policies and experiences in other countries

Spain Many countries tackle similar sets of issues when developing appropriate policy mixes for their own contexts. An awareness of these issues and the ways in which they can and have been tackled in other settings can avoid reinventing the wheel and sensitise national policymakers both to problems of which they were unaware and to potential solutions. In Spain, however, some issues high on the agenda of other countries did not appear to have a similar priority, e.g. meeting the challenge of globalisation and attracting footloose R&D capacity.

> *When contemplating future policy mixes, always consider the challenges and opportunities being confronted and considered in other countries and examine their relevance to one's own national interests.*

Consider all policy options – even those rejected on previous occasions

Sweden R&D tax incentives have not been used in Sweden since their use was rejected over 20 years ago. Many other countries use different forms of tax incentive to

stimulate R&D activity, but the appropriateness of their use and the likelihood of their success differs from one context to another. New circumstances and changed priorities, however, can demand a re-evaluation of their use. Given Sweden's expressed interest in 'renewal' via the stimulation of R&D and innovation activities in SMEs, it may be time to re-examine the case for targeted R&D tax incentives.

> *When contemplating appropriate policy mixes, consider all options – even those rejected in past situations.*

Formulate inclusive visions, establish monitoring and evaluation systems and improve strategic intelligence capabilities

Romania Romania has declared its intent to embark on a vision or foresight exercise as part of its policy formulation process. Involving relevant stakeholders in the process of building visions helps ensure commitment to their realisation and facilitates the development of the networks and relationships between R&D and innovation actors that are necessary if innovation systems are to flourish. Involving external sources of expertise also increases the familiarity of indigenous stakeholders with global trends and experiences and is particularly useful when assessing and comparing innovation system performance with accomplishments elsewhere.

> *Ensure the participation of all relevant stakeholders and foreign sources of expertise in the formulation of future visions and assessments of innovation system performance and policy mixes.*

Spain Spain has announced its intention to enhance policy formulation via the implementation of a new *ex post* evaluation scheme. Policy formulation demands strategic intelligence about both future options and past achievements. Comprehensive monitoring and evaluation systems can provide evidence of the latter and suggest options for the future.

> *Enhance policy formulation via the implementation of comprehensive ex post evaluation systems.*

Romania Although monitoring and *ex post* evaluation procedures are in place in Romania, these need to be improved if the results are to demonstrate the effectiveness of initiatives and feed into policy formulation and the design of future initiatives. There is little point, for example, in continuing to commit public funds to policy initiatives and programmes designed to improve R&D capacity and innovation performance if these initiatives fail to reach their objectives. To understand whether this is the case or not, adequate monitoring and evaluation systems have to be in place.

> *Install monitoring and evaluation systems capable of assessing the performance of individual initiatives and delivering results of relevance to broader assessments of overall policy mixes.*

Romania The compilation of adequate background information and statistics is an essential prerequisite of any policy formulation or assessment exercise (including peer review exercises). In Romania, doubts amongst some R&D and innovation stakeholders about the coverage and accuracy of official statistics persuaded the

review team that there was scope for improvement in the provision of reliable information on R&D and innovation activities.

> *Always ensure that the data provided to the actors involved in policy formulation and assessment exercises are sufficient to allow them to comprehend the way in which innovation systems are configured and function.*

Set realistic targets

Romania Romania faces a tremendous challenge on many fronts as it attempts to follow the Lisbon agenda and attain the Barcelona targets. However, while it is important to keep moving in these directions, these targets may be too ambitious within the time frame specified by the Romanian government. The setting of R&D and innovation-related targets such as the 3% Barcelona objective constitutes a useful discipline and spur to action. It was never intended, however, that all EU countries should aspire to this level by 2010, particularly those starting from a low base. For these countries, targets that take into account the absorptive capacities for R&D increases are more realistic and attainable, especially if additional funds and efforts are directed to policies designed to improve absorptive capacities.

> *Always set realistic and attainable R&D expenditure targets and accompany increases in public sector R&D budgets with parallel measures to improve absorptive capacity.*

Implement quickly and decisively

Sweden In Sweden, it is common practice for policy intentions and directions to be announced via government papers and bills, with agencies subsequently left to develop ways of implementing these plans. In practice, however, lengthy gaps between policy pronouncements and subsequent actions can try the patience of stakeholders keen to see governments tackle critical problems. Innovation systems function well when stakeholders have confidence in the competence of policy actors and their ability to act quickly and effectively. Large gaps between statements of intent on the part of policymakers and subsequent actions can undermine this confidence.

> *Ensure that policy pronouncements are quickly matched by concrete implementation strategies and actions.*

Governance

The lessons to emerge concerning governance span inclusion, the allocation of responsibilities, effective coordination mechanisms and high-level commitment:

- Involve as many relevant ministries as possible in policy formulation and, if appropriate, policy implementation.
- Consider carefully the benefits of governance structures in which the tasks of policy formulation and implementation are allocated to ministries and agencies respectively.
- Ensure that the tasks and responsibilities of different ministries and agencies are clearly delineated and reflect their respective abilities to satisfy the needs of relevant R&D and innovation system stakeholders.

- Ensure adequate coordination mechanisms are in place and operational across ministries and agencies.
- Ensure that high-level commitment is communicated and appreciated in all quarters of the governance system.

Involve as many relevant ministries as possible in policy formulation and, if appropriate, policy implementation

Sweden For many good and obvious reasons, defence policies are typically considered separately from civil policies. In reality, however, there is often interaction between the civil and defence sectors in terms of the development of dual use technologies and the crossover mobility of scientists, engineers and researchers. Such interactions can be synergistic and in the interests of both sectors, and policymakers should take them into account when formulating holistic policy mixes, especially when the resources devoted to R&D and innovation in the defence sector constitute a large share of national budgets, as is the case in Sweden.

> *Consider the interaction of civil and defence sectors when formulating holistic policy mixes.*

Consider carefully the benefits of governance structures in which the tasks of policy formulation and implementation are allocated to ministries and agencies respectively

Spain There is frequently a tension in systems of governance between the operational tasks of programme management, typically performed on a regular, often annual, basis, and the more *ad hoc* activities associated with policy development. This is especially so when these activities are conducted under the auspices of the same body, often by the same people. One solution is to countenance the complete separation of these activities in different bodies, e.g. ministries and agencies. Like many other countries, Spain is contemplating a division of responsibilities between ministries (which are responsible for policy formulation) and agencies (which are responsible for implementation).

> *Consider allocating the functions of policy development and policy implementation to different bodies (e.g. ministries and agencies) in order to avoid conflicting pressures on administrative personnel.*

Ensure that the tasks and responsibilities of different ministries and agencies are clearly delineated and reflect their respective abilities to satisfy the needs of relevant R&D and innovation system stakeholders

Spain The choice of where to place responsibility for different R&D and innovation system activities within governance systems is an ever-present dilemma, especially for activities lying at the science/industrial innovation boundary that need to be linked in some way. In countries that have separate ministries of science and industry, industry ministries often take responsibility for schemes designed to ensure that industrial innovation needs are well catered for by the science base. In Spain, however, it is not clear that industrial innovation needs are sufficiently well articulated for this to occur, leaving the door open for the ministry responsible for science to play a crucial role in linkage programmes.

> *Ensure that the allocation of ministerial responsibilities is based on rigorous analyses of the needs and capabilities of the actors served by different ministries.*

Ensure adequate coordination mechanisms are in place and operational across ministries and agencies

Romania Even if the relationship between R&D, innovation and industrial development were strictly linear and unidirectional, it would still be difficult to allocate responsibility for innovation within governance systems that conventionally contain two ministries broadly responsible for education and science on the one hand and industry and trade on the other, as is the case in Romania. In reality, the complex relationship that exists between these activities makes the division of responsibilities even more problematic. The symbiotic relationship between them, however, demands that careful consideration be given to their mode of governance, with communication between ministries and a mutual commitment to joint action the key to success.

> *Whatever the division of responsibilities between ministries for R&D, innovation and industrial development, always ensure that adequate mechanisms are in place to guarantee effective communication and joint actions.*

Sweden Governance systems that split ministry and agency functions, as is the case in Sweden, require mechanisms capable of ensuring horizontal coordination between ministries and vertical coordination between ministries and agencies. Horizontal coordination between different ministries is an important prerequisite for the successful formulation of appropriate policy mixes, while vertical coordination is needed to ensure effective implementation. The mechanisms needed to ensure adequate levels of communication and coordination, however, are often complex and difficult to maintain. In Sweden, for example, one ministry is responsible for the 'horizontal' coordination of research policy across ministries while another is responsible for the coordination of industrial innovation policy, and vertical coordination is limited to some extent by the lack of any formal ministerial authority over the courses of action determined by agencies. In addition, small ministerial staffing levels make the task of ensuring adequate coordination extremely onerous.

> *In complex innovation systems requiring complex coordination structures, ensure that sufficient resources are devoted to their efficient operation.*

Ensure that high-level commitment is communicated and appreciated in all quarters

Spain There is a constant need to ensure that all relevant ministries and agencies are committed to plans for the development of R&D and innovation capabilities. Placing overarching responsibility for their preparation in the hands of bodies close to the seat of power can help ensure this. In Spain, For example, the centrality of R&D and innovation to the future development of the country was both demonstrated and ensured via the involvement of the Economic Office of the Prime Minister in policy development.

> *Ensure commitment to such plans across ministries by placing responsibility for their development in the hands of bodies such as the Economic Office of the Prime Minister.*

Policy Balances and Options

Constructing an appropriate policy mix involves weighing up alternative options and balancing competing needs and interests. During the peer review, a number of key issues reoccurred in different settings. The resulting policy suggestions are as follows:

- Ensure a balance between competitive and non-competitive R&D funding in the science base.
- Consider modifying the structure and roles of the university and research institute sectors in order to improve innovation system performance.
- Find a balance between satisfying the needs of all R&D and innovation actors and concentrating resources on areas of strategic importance.
- Ensure that national and aggregate regional interests are in alignment.

Ensure a balance between competitive and non-competitive R&D funding in the science base

Sweden Competition for research funding is often the route to research excellence, while direct state funding of universities allows staff to pursue the autonomous research tracks which are an essential ingredient of the scientific endeavour. A balance between competitive and non-competitive R&D funding is thus often desirable. In Sweden, however, the state funds reaching universities as a result of peer-reviewed processes constitute a comparatively low proportion of overall university research funding (35%) compared to average levels across the EU.

> *Strike a balance between competitive and non-competitive funding which ensures both excellence and academic freedom.*

Consider modifying the structure and roles of the university and research institute sectors in order to improve innovation system performance

Romania Romania is not alone in having a large concentration of R&D capability in the public/private Research Institute sector. What is unusual in an EU context is the parallel lack of R&D capacity in the university and industry sectors and a Research Institute sector composed of a vast array of sub-critical, sector-based organisations forced to seek new survival strategies in an environment characterised by the absence of conventional sources of funds, an unfamiliar market setting and limited demand for their outputs. Such circumstances warrant special attention and careful consideration of the case for radical structural change. At the very least they demand appraisals of the ways in which Research Institute sectors are configured in other parts of the EU as potential development models for the future.

> *Look for radical solutions to the structure and organisation of R&D capabilities when there is a gross mismatch between historical legacies and new circumstances.*

Find a balance between satisfying the needs of all R&D and innovation actors and concentrating resources on areas of strategic importance

Spain In Spain, an attempt is being made to effect a balance between policies that attempt to satisfy the needs of a very broad church by spreading resources thinly across the R&D community (the so-called “coffee for all” syndrome), and

strategic initiatives designed to concentrate resources in particular areas and sectors deemed critical to future development.

> *Seek a balance between funding strategies that attempt to satisfy the needs of all researchers with those that concentrate scarce resources on areas of most relevance to the future prosperity of the country.*

Sweden The recent expansion of the university system in Sweden probably raised expectations concerning a more equitable distribution of research funding across the system. Recent policy pronouncements, however, suggest the need to concentrate funding. Prioritisation involving the concentration of resources on particular institutions, sectors or regions is often necessary in order to establish critical masses and viable innovation systems. The flip side of concentration, however, is that the share allocated to other institutions, sectors and regions is correspondingly less. This can lead to tensions and conflicts unless steps are taken to defuse or resolve them.

> *Explaining the rationale for prioritisation decisions in an open and transparent way can help defuse tensions and lead to the discussion of alternative development paths.*

Ensure that national and aggregate regional interests are in alignment

Sweden There is a strong emphasis in Sweden on regional development but a confusing array of actors and initiatives and no clear, publicly available overview of how regional and national development strategies are linked. When many different national and regional support bodies are involved in the development of regional innovation strategies, the potential for synergy is obvious, but so too is the potential for duplication and confusion.

> *Ensure mechanisms are in place to clarify the roles played by different bodies in the development of regional innovation strategies in order to avoid duplication and maximise synergy.*

Spain The regional governments of the Autonomous Communities in Spain exert a strong influence on innovation developments in particular, but there is little evidence of any overt synergy between national and regional policies in this sphere. This is a pity, since the development of regional R&D and innovation clusters can benefit from both national and regional policy initiatives, and the fora in which cluster strategies are developed should consider exploiting both. Doing so may even help lessen the antipathy towards centralised initiatives that is often found in regions with a strong tradition of independence and self-determination. Mechanisms will still be needed, however, to ensure that the separate paths taken by different regions are in the collective national interest and do not lead to an unnecessary and wasteful duplication of activities and capabilities.

> *Consider cluster policies as a way of reconciling national and regional interests, but seek ways of avoiding duplication between regions that is not in the national interest.*

Common Priorities

A common set of themes and policy priorities occurred in various guises in the countries reviewed. These led to a number of generic recommendations of interest to all countries:

- Strengthen the science base via a continued focus on excellence.
- Improve the effectiveness of R&D and innovation systems by supporting improved linkages between the science base and industry.
- Encourage R&D and innovation activities in industry, particularly in SMEs, via the choice of appropriate policy mixes.
- Stimulate R&D via a mix of supply and demand side policies, together with effective procurement policies linking supply and demand

Strengthen the science base via a continued focus on excellence

Spain Rigorous selection criteria and processes for R&D projects are the key to research excellence, and it is often necessary to include foreign experts in selection processes in order to ensure that global standards of excellence constitute the relevant touchstone for the assessment of research proposals. In Spain, a greater role for international experts in proposal selection procedures could improve the competition for research funding and enhance overall quality levels.

> *Strengthen the prospects for research excellence via proposal mechanisms involving international peer review.*

Romania The role universities are expected to play within modern innovation systems and the synergistic relationship between leading-edge research and teaching competence almost demand a keen interplay between research and teaching functions in at least a core group of universities. In Romania, greater efforts are needed to stimulate research activities within Romanian universities; to enhance the quantity and quality of scientific and technological education and training activities; and to attract young people to enter into S&T and research careers. Encouraging both research and teaching excellence within the academic sector, however, often demands more than an increase in financial resources, though the correct mix of incentives is rarely easy to identify.

> *Seek incentive structures capable of stimulating both research and teaching excellence within key academic institutions.*

Improve the effectiveness of R&D and innovation systems by supporting improved linkages between the science base and industry

Sweden Research institutes, both public and private, play an important role in many national innovation systems, but not in countries like Sweden where organisations such as universities are expected to act as the primary 'knowledge conduits' between the public and private sectors. Fulfilling this 'third task', however, is never easy for universities given the necessity and importance of their two primary tasks (education and research). Dedicated research institutes constitute an important alternative option.

> *Consider the possibility of dedicated research institutes as a means of helping to bridge the gap between the science base and the R&D and innovation needs of the private sector, particularly SMEs.*

Encourage R&D and innovation activities in industry, particularly in SMEs, via the choice of appropriate policy mixes

Romania Stimulating industrial innovation in Romania constitutes an enormous challenge and great care will be needed when choosing between different potential development paths. Attempts to stimulate the innovative capacity of industry often take three distinctive forms:

- The *conversion* of existing non-innovative capacity.
- The *renewal* of innovative capacity via the formation of new, innovative firms.
- The *attraction* of external sources of R&D and innovation capacity.

All of these require subtly different policy prescriptions and care has to be taken when constructing appropriate policy mixes to ensure that the policy measures chosen tackle the most pressing problems.

> *Consider adopting a three-pronged approach when constructing policy mixes designed to stimulate the innovative capacity of industry.*

Sweden Sweden has recognised that the continued success of innovations systems in the long term is a function of their capacity for renewal. New firm formation and the subsequent growth of innovative companies are vital ingredients of the renewal process, as are efforts to ensure that SMEs can either access or develop R&D and innovation capabilities. Encouraging all these phenomena, however, typically requires policy actions on many fronts.

> *Ensure that policy prescriptions geared towards renewal via the formation and nurturing of innovative SMEs comprise a mix of instruments tackling, for example, cultural attitudes to entrepreneurship, access to R&D, funding for R&D activities and access to seed capital.*

Stimulate R&D via a mix of supply and demand side policies, together with effective procurement policies linking supply and demand

Spain Efforts to increase private sector expenditure on R&D often focus on supply side measures providing support for R&D projects, often in collaboration with universities and research institutes. In Spain, for example, efforts to increase BERD have focused on direct co-financing schemes, public-private partnerships, networking and other linkage schemes. There is also considerable scope, however, for complementary measures designed to stimulate the demand for R&D in industry.

> *Improve the prospects for raising BERD via the implementation of policy mixes that stimulate the demand for R&D as well as those that attempt to re-orientate and connect the science base to existing industrial R&D capacity.*

Sweden Like a number of other countries, Sweden has shown a renewed interest in technology procurement schemes. In the past these have been a mixed blessing, leading to the existence of strong and successful relationships between

technology suppliers and government agencies in some countries, but to far less symbiotic relationships in others. If applied with care, however, they can link supply with demand and stimulate the development of lead markets in critical techno-economic areas.

> *Seek to complement supply side policies aimed at increasing public sector investment in R&D with demand side policies and procurement mechanisms linking supply and demand.*

Starting Points and Development Paths

Although it was possible to detect a common set of themes and policy priorities across the countries under review, there were also marked differences in terms of emphasis and approach. To a large extent, the development paths taken by different countries are determined by their starting points.

Make sure development paths are in line with contextual capabilities and needs

Sweden In terms of all the conventional indicators, Sweden has had a strong R&D and innovation system for many years. It's priority therefore, is to maintain this situation via fine-tuning and, critically, renewal – ensuring that mechanisms exist to maintain the dynamism of the system via the continual replenishment of key resources. Key to all of this is an efficient and effective system of strategic intelligence that is capable of analysing R&D and innovation system strengths and weaknesses and identifying threats and opportunities.

Spain Spain has made determined strides over the past two decades to develop its science base. Starting from a fairly low base, sound economic progress largely unrelated to technological innovation allowed funds to be channelled to the development of scientific and technological capabilities. In terms of the future development of its R&D and innovation system, therefore, the priority is to continue to strengthen the science base while paying greater attention to the enhancement of technological and innovation performance within industry.

Romania The early days of Romania's transition to a market economy saw an erosion of its scientific and industrial base from which it is still recovering. In terms of all conventional indicators, the Romanian R&D and innovation system is weakly developed and the dilemma facing policy makers is where to start in terms of strengthening the system as a whole. Contemporary efforts have focused and continue to focus on the development of the science base, but the need to develop industrial innovation capabilities in parallel is strong given the relatively weak economic performance of the country as a whole and the need to move quickly to an innovation-based economy.

> *Always take starting points into consideration when considering future development paths. They dictate or constrain the options available and the likelihood of their success.*

Next Steps

The Peer Review Process in Hindsight

The Peer Review Process in 2005 was a pilot exercise. As such it needs to be assessed and lessons learned concerning the desirability and conduct of similar exercises in the future.

The acid test for the success of any intervention is whether it makes a positive difference. For the pilot review exercise, it is far too early to say whether or not the process has had any impact in terms of the overall goal of the exercise, i.e. improved R&D and innovation performance leading to increased investment in R&D in line with the Barcelona 3% target. In terms of the main intermediate objective, however, namely that of improved mutual learning, it is possible to say something positive. At the Peer Review meeting held in Brussels on September 16 2005, and again at the CREST meeting in Manchester on October 19 2005, representatives of all three reviewed countries acknowledged that their involvement in the exercise had been beneficial. Members of the examining review teams also expressed similar sentiments, as did other participants at the Peer Review meeting in Brussels. **The general view of the Policy Mix Group, therefore, is that the exercise should be repeated in future cycles of the OMC**.

As always, however, there is scope for improvement, responding in particular to the following comments:

- The exercise was effectively condensed into nine months, commencing in April and finishing in December. This was too short a period. In particular, not enough time or resources were allocated to the preparation of the initial background reports, which would have benefited from field visits to the reviewed countries.
- The main visits of the review teams took place in mid-summer, shortly before people left on vacation. This was not ideal.
- The initial plans for the exercise made no provision for feedback visits. These were requested by the review countries after the initial visits by the examiner teams and proved to be of great value. They should therefore be incorporated into the basic model for future reviews.
- Although the exercise was deliberately geared towards the production of generic lessons of broad applicability, at least two of the reviewed countries would have appreciated a greater focus on context-specific policy suggestions.
- Similarly, although the exercise was deliberately designed to be 'light', some of the reviewed countries would have liked more resources and effort devoted to the production of these context-specific suggestions, including an additional round of visits to deepen the analysis and focus policy recommendations.
- All the review countries organised discussions with high-level officials and stakeholder representatives. To maximise mutual learning in exercises of this nature, examiner teams should ideally contain members of comparable status, though this is often difficult given competing demands on their time, and it would certainly not be possible if teams are expected to devote more time to enhanced peer review exercises. One suggestion, therefore, would be for high-level team members to be

supported by more junior staff during and after the peer review visits. This would also have the advantage of spreading learning amongst the ranks of the examiner countries.

- The peer review exercise has to some extent been developed in tandem with a similar exercise being undertaken by the OECD, sharing much the same conceptual framework and a similar *modus operandi*. In future it makes sense for the links between these two initiatives to continue. Given that there is a limit to the number of reviews which either CREST or the OECD can support in any one year, the existence of both initiatives provides a greater opportunity for members of both CREST and the OECD to participate either as 'review' or 'examiner' countries.

The Way Forward

In the next cycle of the OMC, Member States should again be invited to participate as 'review' and 'examiner' countries. The aim should be to keep the exercise light, but to offer review countries options such as a continued focus on mutual learning and the search for generic lessons, or a greater focus on the production of country-specific recommendations. Consideration should also be given to the structure of the 'examiner' teams, perhaps involving both high-level and more junior policymakers in these teams in order to assist high-level members in their tasks and to spread learning within their own systems. Other improvements to the process might include field visits during the preparation of the background briefing documents, the establishment of 'feedback' and 'deepening' missions as intrinsic parts of the review process, and spreading the process over a complete 12-month period. It would also be advisable to link the OMC peer review activities with the peer reviews of national policy mixes that have now commenced under the auspices of the OECD.

These recommendations can be summarised as follows:

- Repeat the Peer Review exercise in the next OMC cycle.
- Invite Member States to participate as 'review' and 'examiner' countries in the next round of peer reviews.
- Keep the exercise light but offer review countries options
  - A continued focus on mutual learning and the search for generic lessons.
  - A greater focus on country-specific recommendations.
- Consider involving both high level and more junior policymakers in the 'examiner' teams in order to assist the high level members in their tasks and spread learning within their own systems.
- Amend process to incorporate field visits during the preparation of the background briefing documents for the 'examiner' teams.
- Establish feedback missions as an intrinsic step in the review process.
- Spread the process over a 12-month period, avoiding holiday periods.
- Continue to link activities with the OECD peer review exercises.

Appendix 1

Policy Mix Peer Review Teams

Review Teams for Policy Mix Interviews

Sweden 8-10 June Review Mission
Policy Mix Working Group Representatives
Pierre-Paul Baskevitch, Ministry of Education, France
Sigrid Johanisse, Ministry of Economic Affairs, Netherlands
Patrick Robinson, Department of Trade and Industry, UK
Lauri Tammiste, Ministry of Economic Affairs and Communications, Estonia
European Commission Representatives
Andries Brandsma, IPTS, Seville
Henry Varga, European Commission, DG Research, Brussels
Independent Consultant
Ken Guy, Wise Guys Ltd, UK
Swedish Members of Policy Mix Working Group
Ann-Katrin Berglund, Ministry of Industry, Employment and Communications, Sweden
Susanne Moberg, Ministry of Education, Research and Culture, Sweden
Sweden 1 September Feedback Mission
Policy Mix Working Group Representatives
Pierre-Paul Baskevitch, Ministry of Education, France
Sigrid Johanisse, Ministry of Economic Affairs, Netherlands
Patrick Robinson, Department of Trade and Industry, UK
Independent Consultant
Ken Guy, Wise Guys Ltd, UK

Spain 20-21 June 2005 Review Mission
Policy Mix Working Group Representatives
Diana Demkova, Ministry of Education, Slovak Republic
Michael Fitzgibbon, Forfás, Ireland
Kristin Hauge, Ministry of Education and Research, Norway
Petra Lipnicka, Ministry of Education, Slovak Republic
European Commission Representatives
Patrick Eparvier, IPTS, Seville
José Ramón Tiscar, European Commission, DG Research, Brussels
Independent Consultant
Ken Guy, Wise Guys Ltd, UK
Spanish Member of Policy Mix Working Group
Luis Delgado, Ministry for Education and Research Industry, Spain
Spain 13 October Feedback Mission
Policy Mix Working Group Representatives
Tim Goodship, Department of Trade and Industry, UK
European Commission Representatives
Isi Saragossi, European Commission, DG Research
Patrick Brenier, European Commission, DG Research
Independent Consultant
Ken Guy, Wise Guys Ltd, UK

Romania 16-17 June Review Mission
Policy Mix Working Group Representatives
Wendy Brosius, Ministry of Economic Affairs, The Netherlands
Bernard Delhausse, Belgian Office for Science Policy, Belgium
Boris Pukl, Ministry of Education, Science and Technology, Slovenia
Frank Zuijdam, Netherlands Organisation for Scientific Research, The Netherlands
European Commission Representatives
Tania Friedrichs, European Commission, DG Research, Brussels
Independent Consultant
Ken Guy, Wise Guys Ltd, UK
Romanian Member of Policy Mix Working Group
Rolanda Predescu, Ministry of Education and Research, Romania
Romania 5 September Feedback Mission
Policy Mix Working Group Representatives
Boris Pukl, Ministry of Education, Science and Technology, Slovenia
Independent Consultant
Ken Guy, Wise Guys Ltd, UK

Appendix 2

Policy Mix Peer Review Schedules

Review Schedules for Policy Mix Interviews

Sweden

Date/Time	Location	Focus	Participants
8 June			
10.30-10.45	Ministry of Education, Research and Culture	Welcome and introduction to the programme	Ann-Katrin Berglund, Susanne Moberg, Members of Policy Mix Group
10.45-13.00	Ministry of Education, Research and Culture	Preparations and sandwiches	Peer Review Team
13.00-13.45	Ministry of Education, Research and Culture	Statistics about Swedish Research	Mats Johnsson, Senior Advisor, Ministry of Education, Research and Culture.
13.45-15.00	Ministry of Education, Research and Culture	The Swedish research system and Swedish research policy	Mariann Samuelson, Director, Division for Research Policy, Ministry of Education, Research and Culture.
15.00-16.00	Ministry of Education, Research and Culture	Recent developments in innovation policy	Gunnar Blomkvist, Director, and Linda Sterner, Head of Section, Coordination Secretariat, Ministry of Industry, Employment and Communications.
16.00-17.00	Ministry of Education, Research and Culture	Priorities in FORMAS research funding	Lisa Sennerby Forsse, PhD, Secretary General of the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS)
9 June			
08.30-09.30	Ministry of Education, Research and Culture	Priorities in the Swedish Research Council's research funding	Pär Omling, Director General, Swedish Research Council
09.30-10.15	Ministry of Education, Research and Culture	Priorities in FAS research funding.	Rune Åberg, Secretary General, and Erland Bergman, Administrative Director, Swedish Research Council for Working Life and Social Research (FAS).
10.30-11.30	Ministry of Education, Research and Culture	Mission and priorities of the Swedish Foundation for Strategic Research	Staffan Normark, Executive Director, Swedish Foundation for Strategic Research
11.40-12.50	Restaurant	Lunch	Peter Strömbäck, Director, Division for Information Technology, Research and Development, Ministry of Industry, Employment and Communications, and Mariann Samuelson, Director, Division for Research Policy, Ministry of Education, Research and Culture

13.00-14.30	Ministry of Industry, Employment and Communications	Industry's views on research and innovation policy.	Carl Bennet, Chairman of the Board, Getinge and Elanders; Hans Henzell, Executive Director ACREO; Thomas Johannesson, Executive Director, STFI Packforsk; Gösta Jonsson, Vice President, Global Discovery Affairs, Astra Zeneca; Ulf Pehrsson, Vice President, Public Affairs, Ericsson; Lars-Göran Rosengren, President, Volvo Technology; Thomas Sätmark, Vice President Corporate Affairs, Volvo Aero Corporation
15.00-16.00	Ministry of Industry, Employment and Communications	Results from recent studies (distributed before the meeting)	Hans Löf, Royal Institute of Technology, Centre of Excellence for Studies in Innovation and Science and Pär Hansson, FIEF, Trade Union Institute for Economic Research
10 June			
09.00-09.30	Vinnova	Guided tour of Vinnova	Leif Callenholm, Director, Head of Administration Division, Swedish Agency for Innovation Systems (Vinnova)
09.30-10.30	Vinnova	Priorities in Vinnova's research funding.	Per Eriksson, Director General, Swedish Agency for Innovation Systems (Vinnova)
11.00-11.45	Ministry of Industry, Employment and Communications	Development of innovation policy in Sweden	Sven-Eric Söder, State Secretary of the Minister of Industry and of the Minister of Research in questions concerning business enterprise development, state-owned companies, primary industries, competition and research and development.
12.00-12.30	Ministry of Industry, Employment and Communications	Preliminary summing-up, plus arrangements for later interview with State Secretary Kerstin Eliasson, responsible for research policy	Susanne Moberg, Ann-Katrin Berglund, Members of Policy Mix Group
September 1, Feed-back Mission to Sweden			
15.00-16.30	Ministry of Education, Research and Culture	Swedish research and innovation policies	Kerstin Eliasson, State Secretary of the Minister for Education, Research and Culture.

Spain

Date/Time	Location	Focus	Participants
20 June			
11.00-11.30	Ministry of Education and Science (MEC)	Introduction to the Meetings	Peer Group plus Spanish representative of Policy Mix Working Group
11.30-14.00	Ministry of Education and Science (MEC)	The Overall Policy Mix Overview (at MEC): National Plan Structure, Governance, Policy Instruments	Peer Group plus representatives of SGPCT, DG Research (MEC)
14.30-15.30	Ministry of Industry, Tourism and Commerce (MITYC)	Lunch	Peer Group plus representatives of SGPCT, DG Research (MEC)
15.30-17.30	Ministry of Industry, Tourism and Commerce (MITYC)	The Overall Innovation System: Business R&D and Innovation, Good Practices, Obstacles & Problems	Peer Group plus representatives of DG SMEs, DG Industrial Development, CDTI (MITC)
17.30-18.30	Ministry of Education and Science (MEC)	Summing up Session of the Peer Group	Peer Group plus Spanish representative of Policy Mix Working Group
21 June			
09.30-11.00	Economic Office of the President (OEP)	Economic and Competitiveness Aspects: Framework Conditions for R&D and Innovation	Peer Group plus representatives of the Economic Office of the President (OEP)
11.30-13.30	Ministry of Education and Science (MEC)	Knowledge Creators & Users	Peer Group plus representatives CSIC, COTEC, FEDIT, Users
13.30-15.30	Lunch		
15.30-17.00	Ministry of Education and Science (MEC)	Summing Up Session. Discussion of the Peer Review Report	Peer Group plus Spanish representative of Policy Mix Working Group
October 13, Feed-back Mission to Spain			
10.00-12.00	Economic Office of the President (OEP)	Spanish research and innovation policies	Pedro Marin Uribe, Director General del Dept. de Sociedad del Bienestar, OEP Carlos Mulas Granados, Deputy Director, OEP Antón García Díaz, Advisor, OEP
12.30-14.00	Ministry of Industry, Tourism and Commerce (MITYC)	Spanish research and innovation policies	Joan Trullén, Secretary General of Industry (SGI) Marisa Poncela, Head of Cabinet, SGI
16.30-18.00	Ministry of Education and Science (MEC)	Spanish research and innovation policies	Salvador Barberá, Secretary General of Scientific and Technological Policy (SGPCT) Violeta Demonte, Director General of Research

Romania

Date/Time	Location	Focus	Participants
16 June			
10.00 -13.00	MEdR – Research Dpt.	General presentation and open debate on R&D capacity, science base, human resources, business R&D and innovation	MEdR – Research Dpt. representatives plus high level members of the S&T community: - Advisory Board on R&D and innovation - National Council of Academic Research (approx. 25-30 persons) *
14.30-16.00	Ministry of Economy and Trade (MET)	Discussions on business R&D and innovation and absorptive capacity in the context of industrial and financial policies	Experts from MEdR, MET, Ministry of Public Finances (approx. 10 persons) *
16.30-18.00	Polytechnic University of Bucharest (PUB) – Rector's Office	Visit – University	Professor Dr. Ecaterian ANDRONESCU, Rector of Polytechnic
16 June			
09.00-10.30	The Romanian Academy – Presidium Office	Discussions on R&D capacity, science base, human resources	Professor Dr. Florin FILIP, Vice-president of the Romanian Academy
11.00-13.00	The National R&D Institute for Microtechnologies (IMT-Bucharest)	Visit – National R&D Institute	Professor Dr. Dan DASCALU, Director General of the National R&D Institute for Microelectronics
14.30-16.30	Chamber of Commerce (CCIRB)	Discussions on business R&D and innovation and absorptive capacity	Prof. Dr. Nicolae VASILE, Vice-chairman of CCIRB, members of the business community, experts from MEdR, MET
September 5, Feed-back Mission to Romania			
10.00-13.00	SOCEC Hall, Chamber of Commerce	Romanian research and innovation policies	Approximately 40 representatives of key ministries and R&D and innovation stakeholders