Final Synthesis Report

For the Specific Contract:

Identification and analysis of policies to promote investment in research in non-EU countries

Submitted to the IPTS

by the ERAWATCH NETWORK ASBL

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EXECUTIVE SUMMARY

This report summarises the findings of the five-month project ‘Identification and analysis of policies to promote investment in research in non-EU countries’, which aimed at improving the understanding of key developments and trends regarding research investment policy in nine non-EU countries (Australia, Brazil, Canada, China, India, Japan, New Zealand, South Korea and the US) and drawing conclusions relevant to the Lisbon strategy in support of research policy-making. The specific objective of the contract was to identify the lessons that EU policy makers can draw from research investment policy developments elsewhere and the impact which the research strategies of major non-EU countries can have on their own competitive position and that of the EU. The project management was ensured by the Newcastle University Triple Helix Group, which established a 21-people international project team consisting of high-level experts in R&D and innovation policies, working in close collaboration with the ERAWATCH Network Office in Brussels and the IPTS team in Seville.

The EU’s goal of increasing R&D expenditure to 3% of the GDP, is reflected, although with no set quantitative targets in the countries examined, in a universal concern about the level of R&D spending and even more importantly, about the translation of research results into economic utility. Although the increase of R&D expenditure to levels around 3% has been adopted as an EU goal, it is still short of realisation; there is no figure that is generally recognized as sufficient, let alone as too much. In such circumstances, deficits in human resources (e.g. USA, Japan) are perceived to be the problem and measures are instituted both to increase brain gain from abroad and to expand representation of under-represented groups in S&T, such as women and minorities.

In this report, research investment policies in the nine countries of concern have been examined from four main perspectives that reflect the structure of the EU’s 3% Action Plan: a) research policy coordination; b) public support to research and innovation; c) redirecting public spending towards research and innovation; and d) improving framework conditions for private investment in research. The main conclusions arising from the analysis are briefly presented below:

a) Research policy coordination
Increasing coordination between different levels of research and innovation policy-making (public administration, sectoral, stakeholders, regional and international) appears to be a common feature in all the countries examined, as an institutional and policy response to emerging pressures arising from more dynamic and more complex economic and social developments. Coordination mechanisms encompass a variety of institutional set-ups that are relatively distinct, as a result of historical developments and path dependencies. However, in all cases there seems to be a clear move towards increasing co-ordination and integration between and across institutions, as an implicit pre-requisite for releasing the potential for innovation embedded in the various sectors. Research and innovation policies are no longer considered to be the exclusive remit of agencies in charge with science and technology development, but are increasingly integrated in other policy fields, such as enterprise, taxation, competition, regional policy, education, intellectual property rights, employment, trade and environment, which suggests significant advancements towards the so-called ‘third generation innovation policy’.

At the **public administration** level, a dual approach seems to be at work: on the one hand, some governments promote broader framework policies to create a better and more comprehensive agenda for innovation policy (e.g. China’s 2006-2020 National Long- and Medium Term S&T Development Guiding Vision, or New Zealand’s strategy paper ‘Science for New Zealand - An Overview of the Research, Science and
Technology System). In some cases, these framework policies aim to establish links with industrial policy or social inclusion policies, giving innovation policy a specific role in increasing horizontal coordination between strategic economic areas (e.g. Brazil’s Ministry of Science and Technology involvement in the elaboration of the 2004 Industrial Policy for Industry, Technology and Foreign Trade PITCE). On the other hand, some governments have refocused on their S&T and innovation-related institutions. Korea, for example, has elevated the Minister of Science and Technology to the level of deputy prime minister and has strengthened the powers of the Ministry of Science and Technology with a view to creating a broader and more focused innovation policy agenda. In both cases, the effectiveness of the co-ordination mechanisms is closely related to the clarity and legitimisation of the policy objective, which in their turn increase the public support for R&D and innovation.

Although the institutional set-up for the coordination of research and innovation policy is very complex in many countries, a common pattern seems to emerge, including: 1) a lead ministry/agency in STI policy formulation and implementation in the national/federal government, which collaborates with other ministries/agencies involved in STI policy-making, 2) inter-ministerial coordination agencies, and 3) various forms of advisory bodies to the prime-minister or the government. Variations in the specific features of this institutional setup arise from the “centralized” vs. “decentralized” nature of the administration, ranging across a continuum from highly centralised (China, Brazil) to highly decentralised (USA, Australia), with various degrees of centralisation in between (Canada, India, Japan, Korea, New Zealand). Such variations often emerge from differences in the broader or narrower remit of the respective institutions, the strength of their executive and advisory powers, as well as from the nature of stakeholder representation in the inter-ministerial coordination agencies (e.g. government representatives only vs. a mixed representation of government and other stakeholders). This top-down approach is often complemented by bottom-up initiatives that draw together various mission-oriented S&T agencies in different sectors of industry and economy to reach a common objective.

At the sectoral level, priorities are a common feature of virtually all R&D systems, emerging top-down in centralized countries and bottom-up in decentralized ones. They are expressed through various forms, ranging from thematic/sectoral priorities (e.g. Australia, Brazil, South Korea) to strategic technology roadmaps (Japan, New Zealand) or clusters development (Canada, India). There seem to be significant commonalities in terms of prioritised areas (usually ICT, environment, health, biotechnology, nanotechnology, etc.) in both “large” and “small” countries, in terms of focusing on existing resources and investing in high growth technology areas. In large countries, sub-priorities relating to special local themes and resources can be identified, belying the general perception that a few themes rule. For instance, one can remark here the Brazilian government’s effort to link innovation policy with industrial policy and to use innovation developments for increasing social inclusion and development opportunities, particularly in the poorest regions. Furthermore, it is also worth noting the selective investments in areas with high potential for growth, such as Canada’s Technology Clusters policy, Japan’s Strategic Technology Roadmap or the Korean government’s investment in biotechnology and nanotechnology, that led to rapid advances in the international arena (Korea has outperformed Britain and France in nanotechnology development, and now ranks fourth behind the US, Japan, and Germany).

At the stakeholder level, there appears to be an increasing trend towards enhancing stakeholder participation in a policy advisory capacity. Stakeholder involvement is often seen as a way to legitimise public action, build consensus and appropriate understanding of the respective countries’ long-term challenges, and improve co-ordination and coherence, e.g. through frequent use of external committees and separate action programmes in which outsiders have increasingly a steering role.
Some notable differences have been observed in the stakeholder representation, ranging from a rich mix of actors from industry, research and higher education, government and civil society, to predominantly government agencies, or industry and civil society. A continuum may be constructed from intensive to less intensive stakeholder involvement, but with a clear focus on this issue in all countries. For instance, in some countries, the policy focus is to foster industry leadership and helping industries develop strategies for growth, prioritise and make commitments to change (e.g. Australia’s Action Agendas or the growing trend in China to enhance industrial leadership by establishing technology development centres in firms). In others, such as India, stakeholder involvement is broadened to include private industry and civil society groups represented by NGOs, and aims at strengthening public-private partnerships and the human resource base in specific areas, particularly in high-tech sectors. In yet another group of countries, stakeholders’ participation is much broader, encompassing not only industrial actors, but also research and higher education institutions, as well as civil society groups, such as Canada’s Technology Road mapping exercises, Brazil’s Social Technology Network, which is meant to develop sustainable development technologies and is complemented by other social inclusion programmes, New Zealand’s Roadmaps for Science or the National Forum ‘Capitalising on research Summit’, or Japan’s ad hoc committees of industry and university representatives.

Policy entrepreneurs at the regional and national government levels, in universities and industry associations often take the lead in inventing new programmes and measures that are later generalised. An example in this sense is the application of the high-tech incubator format in Brazil to employment generation and poverty reduction through development of cooperatives as initiated by university-NGO cooperation that then became a national programme for social innovation - a kind of bootstrapping. Cross-agency collaborations initiated by entrepreneurial programme officers to aggregate complementary resources to accomplish macroscopic projects in emerging S&T fields and reduce inter-agency competition have become a mainstay of US R&D policy since the inception of the Human Genome project (DOE/NIH). Such initiatives tend to break the bounds of previously seemingly coherent division of labour, roles and remits among different agencies and levels, but auger potentially important new trends that may later be seen as the model for a new policy paradigm. M. Rocca and the US nanotechnology initiative is the latest example of US cross-agency initiative (e.g. DOE and NSF); SBIR is an earlier instance form the early 1980’s. Policy entrepreneurship in government is an extension of entrepreneurial tradition in academia, introduced through a flow of academics into the government research management system.

At the regional level, decentralisation and accountability of regional agencies appear as an increasing trend towards the so-called process of ‘agencification’\(^1\). This reflects a changing division of labour between the upper and lower levels of government, leaving the upper levels (ministries) responsible for policy and the lower levels charged with co-ordinating a number of instruments often financed by separate ministries. In some cases, this is seen as a measure to reduce complexity and redirect the roles of institutions, while in others, it actually contributes to increased fragmentation. The regional focus is increasingly present in research and innovation policy priorities. Some countries have recently refreshed their regional policies to make them better suited to the economic needs. For instance, in 2006 New Zealand’s cabinet adopted the policy paper ‘Boosting the Impact of Regional Economic Development: Detailed Changes’, which encourages regions to develop robust economic development strategies, and enhanced the regional autonomy, including through the reform

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in the tertiary education sector. Also notable is Japan's initiative to introduce the legal obligation (Article 4 of the Science and Technology Basic Law) for local governments to formulate and implement policies that promote S&T according to the national initiatives, as well as to own priorities. Furthermore, the 2004 Law on National University Incorporation encouraged regional universities to develop stronger links with firms and to engage in regional development strategies and clusters, as key sources of skilled workforce and strategic knowledge. These developments are also accompanied by further devolution of funding towards regional governments.

In fact, the growing involvement of universities in regional economic development appears as a common feature for all the countries examined, with various types of institutional mechanisms and strategies to achieve this objective, from a 'government-pulled' development model in China to decentralised, bottom-up policies and initiatives in the US, such as the Georgia Research Alliance. The combination of top-down and bottom-up approaches is present in various degrees in all the countries examined, ranging from regional development programmes initiated and funded by the central governments (e.g. China, Brazil, Japan) to local initiatives proposed and implemented by the regional governments (Australia, Canada, USA). An increasing interaction between the central and regional levels of coordination has been observed, with central governments tending to give stronger powers to the regions, and federal governments tending to intervene to correct regional imbalances.

Another notable development is the increasing involvement of S&T in reducing regional disparities, which can be observed in countries like China or Brazil, where a relevant component of human resources training was added to regional development programmes.

A growing emphasis on international cooperation in research has been identified in all the countries examined, and it is usually promoted through various bilateral programmes and scientists exchange programmes funded at national or regional level (e.g. Australia's International Science Linkages Programme, Canada's Going Global and International S&T Partnerships programmes, China's International S&T Cooperation Programme for Priority Projects, Japan's International Cooperative Research Projects, Korea's International Joint Research Programme, etc.). Also worth noting are the Agreements on S&T collaboration between the EU and some of these countries, such as the US (document signed in 1985 and renewed in 2004), New Zealand (document signed in 1991), India (which is a partner in several EU-funded programmes). A notable recent trend towards the development of more strategic international consortia was observed, which can be exemplified by Japan's Strategic Fund for Establishing International Headquarters in Universities (JSPS) or Canada-California Strategic Innovation Partnership (CCSIP), which currently focuses on high-speed connectivity, IT-supported audiovisual collaboration, cross-border investment barriers, and research on stem cells, nanotechnology, transportation, energy, and infectious diseases.

b) Public support to research and innovation
The development of human resources for S&T is a key policy issue in all the countries examined, which adopted a broad range of policy measures in this area starting from the improvement of the higher education system to the provision of skilled workforce for industry, attracting young scientists and improve women's participation in S&T related careers. A strong emphasis is placed on the improvement of the higher education system, with increasing contributions for universities both from the public budget and from the industry (e.g. South Korea's 2006-2010 Basic Plan for Promoting S&T Human Resources, which gives universities a central role and encourages the partnerships with business). Early identification of talent and full support for training needs, at least through the PhD, is becoming commonplace. A notable development is some countries' efforts to provide support for the training of scien-
tists at very early career stages, such as China’s programmes for excellent scientific youth, India’s 15 year Career Support Programme that provides scholarships to bright 15 year-old students after high school until PhD and post-doctoral training, or Australia’s programmes to promote an innovation culture in schools.

The supply of trained human resources for S&T takes a specific dimension in the context of Japan’s ageing population or the USA’s concern for declining flows of international scientists after the 9/11 events, and is often combined with initiatives to attract foreign researchers or increase women’s participation in S&T related careers.

The initiatives meant to strengthen the links between the public research base and industry typically involve various forms of support for university-industry-government links or small businesses. Some relevant examples include: Australia’s National Innovation Awareness Strategy and Pre-Seed Fund, Brazil’s programmes to foster university-industry cooperation and SMEs competitiveness (COOPERIA, Brazilian Technology Network, Yellow-and-Green Fund, PAPPE), India’s programmes for S&T Parks and Software technology Parks, or the SME and cluster development programmes, Japan’s Technology Transfer Law at Universities and Law on Special Measures for Industrial revitalisation (widely seen as the Japanese version of the US Bay-Dole Act), New Zealand’s Partnerships for Excellence, Growth and Innovation Pilot initiatives, Technology for Industry Fellowships or the Pre-Seed Accelerator Fund, South Korea’s Daedok Innopolis and the US Advanced Technology Programme.

The increasing inability to distinguish R&D from industrial policy is reflected in disputes over “subsidies” to industry and how they are to be defined. As the innovation process takes a graduated approach, without clear distinction between stages, the remaining point of contention will be the appropriate role of government in promoting the utilization of advanced technology to revive declining industries. An activist trend in this direction may be discerned, especially when one country’s emerging industry may be another country’s mature industry.

Another trend consists of initiatives designed to fill gaps in the innovation process, whether forward linear from the science base or reverse linear from firm needs, whether expressed by the players themselves, imputed to them by policy-makers, or increasingly through interaction. The common emerging objective, whether implicit or explicit, is to create a “seamless web” from enhancement of the science base to economic growth. Thus, the emergence of relatively new categories/gaps such as translational research, entrepreneurship encouragement and IPR reform are increasingly prominent in the R&D and industrial policy landscape and become issues for policy entrepreneurs, in and out of government, to address.

Policies meant to improve the mix of public financing instruments and their effectiveness appear to be characterised by two main approaches:

(1) making funds available directly to firms to assist in the commercialisation of new technology, either through grants, loans or some combination of the two, with differing emphases on funding approaches in different countries and
(2) making funds available for collaborations with universities and/or other intermediaries and quasi-intermediaries, including not-for-profit Institutes and government labs to assist the innovation process.

These two basic approaches are not mutually exclusive. They may be combined in various mixes, with sectoral emphases and other priorities mandated or left open-ended to take advantage of new possibilities that may not be foreseen in advance. What is remarkable is that across our nine countries, irrespective of their stage of development, there is an efflorescence of publicly inspired venture capital instruments targeting different phases and stages of firm formation and growth. Indeed,
this implicit similarity in focus on aggressively filling gap in the translation of R&D into economic goods may be the driving force that reaches back and stimulates the increase in R&D spend as the pump priming mechanism for these emerging venture capital industries.

The prominence of the venture industry in the formation of growth firms in the US and Europe, from Google to Skype, also provide exemplars that stimulate emulation. Moreover, public venture capital instruments have gone through an evolution, carefully balancing mixes of public and private funds, with the weighting coming out differently in various financial environments, depending upon the readiness of private capital to act. The Israeli Yozma model, in which these lessons were embodied, has, for example, been diffused to Brazil and Italy. The next step is the diffusion of networked angels that both group expertise and funds, while also providing mentoring mechanisms, both from more to less sophisticated investment arenas and within them as well.

c) Redirecting public spending towards research and innovation
The increase in the proportion of GDP devoted to R&D is a general objective within a stronger trend of linking R&D more directly to innovation and commercialisation. There is a related trend toward identifying and focusing on niche areas within broad technology themes, relevant to current national issues. A sub-theme of the above is increased partnering between national and regional authorities in federal systems; especially since strengths in niche areas are typically location-specific. The increase in R&D spend is virtually universally viewed as subsidiary to the issue of (1) attaining economic value from R&D spend, and; (2) appropriate mechanisms to aggregate research collaborations across distance, looser than large-firm R&D structures but tighter than EU networks e.g. the Canadian Network Centres of Excellence Programme.

Identifying key themes building upon local strengths and/or creating new ones that a broad range of stakeholders can rally around is an emerging trend. A shift from incremental to discontinuous innovation may also be discerned in these broader projects that typically rely on an emerging S&T area, even when building them upon traditional knowledge as in India, and create “hype” and hope around them. Narrower policies focused on specific firms as “national champions” may be ebbing at least by contrast with the growing trend to focus on new technology-based firms and clusters and how to promote their growth.

The state aid appeared to be interpreted in different ways in the countries examined, but is generally understood as industrial policies and government subsidies to firm R&D that may be limited by competition policies. Encouraging university-industry partnerships is generally viewed as a mechanism to resolve that issue while also bringing firms together to co-operate around pre-competitive themes when action is believed appropriate.

There is a general, although not universal trend, to using public procurement to promote innovation in advanced areas of technology that have been identified as foci of interest. Unified information policies and programmes have not been identified as a “strong suite” with the notable exception of India, which is expanding its capabilities.

d) Improving framework conditions for private investment in research
Intellectual property (IP) is increasingly seen as a key issue for stimulating private investment in research. A contradictory trend may be discerned with respect to IP in developing and advanced industrialized countries. Developing countries have become more interested in adopting IP strategies as they realize that they have unique knowledge worth protecting. On the other hand, advocates of collaborative technol-
ogy development in advanced countries argue against IP protection as retarding the pace of technological advance. Nevertheless, there is a general trend toward enhancement of intellectual property as an innovation strategy. On the one hand, government agencies are performing an educational role in enhancing the awareness of industry and academia of the importance of IP, such as Australia’s Intellectual Property Agency, which manages a university relationship marketing programme that consists of an annual university seminar series to promote issues of IP protection, commercialisation and management, and IP Professor, a tertiary specific online resource. On the other, changes in the legal framework are introduced to incentivise universities to protect and commercialise IP, such as Japan’s Basic Law on Intellectual Property (2002), which aims to accelerate patent application and strengthen the organisational capacity for managing IP in universities.

There is a concomitant shift to seeing IP and R&D measures, in general, as a means to the end of economic growth rather than as an isolated policy area. Different emphases may be discerned in various countries but the general direction is more or less similar in all countries examined. Japan may be seen as the strongest case of IP strategy, through legal change and funding of IP protection in universities, while Canada may be seen as the exemplar of a spin-off focus. The US pursues both strategies more indirectly, with a shift in emphasis in universities, over time, from IP protection as an end in itself to facilitating start-ups. The process, instantiated in academia as a re-organization of technology transfer into enterprise development occurs isomorphically, by example, rather than through central direction, as in S. Korea. Interestingly, the Indian focus is on systematizing traditional knowledge that may be useful to contemporary product development and, especially, in developing an IP strategy to protect this knowledge form foreign appropriation.

In the regulation of products and standardisation, a general trend exists towards enhancement of standards as a key part of innovation strategy. This occurs through enhancement of the role and funding of Standards Agencies. Although most agencies are focused on expanding traditional functions tied to metrology, the US agency has been given a more direct role in creating programmes to encourage industry collaboration and university-industry cooperation based on an underlying theme of identifying areas for co-operation and collaboration bottom-up but with the encouragement of Agency experts who identify potential areas to address and then seek out potential proponents and collaborators in developing specific programmatic initiatives e.g. ATP focused programmes on particular technology themes.

**Competition policy** walks a tightrope between encouraging collaboration among firms to promote innovation and discouraging collaboration to set prices. In most countries, competition policies are formulated and implemented by specialised national agencies, except for Brazil, where the regulation of competition is rather confusing, with multiple institutions competing for a mandate in this area.

The understanding of the ‘financial markets’ concept tends to broaden to include early stage seed capital for new enterprises and creation of equity markets for emerging firms with growth potential. This appears as a matter of virtually universal concern. In some instances, a general theme such as financial markets may be too broad to capture this dimension, but it exists nevertheless. Developing countries, like Brazil, have also recognized that it is not only necessary to create new financial mechanism, but it is equally important to educate technology entrepreneurs on how to address these opportunities. Again, as with IP, government play an educational role in running training programmes to enable potential users to take the fullest advantage of new opportunities.

**Corporate research strategy, management and financial reporting** seem to be marked by some contradictory trends. Large firms, in many countries that traditionally
invested heavily in R&D have downsized and reduced their R&D spending. On the other hand, a significant number of both large and mid-sized firms have increased their collaborations with universities, often aided by government programmes, especially in the area of so-called pre-competitive R&D, a term that reflects the trend toward collaboration and provides a means of conceptualising and justifying this trend. There is also a relatively new trend of high-growth firms establishing relatively small R&D units adjacent to universities, often located in science parks, to take advantage of collaboration opportunities, gain a window on commercial opportunities from basic research and, of course to provide opportunities for recruitment. Brazil, for example, has used tax incentives to encourage multinationals to establish R&D units and encourage learning about the innovation potential in local universities.

To conclude, one can remark that the increase in R&D spending, although with no specified quantitative targets in most cases, is a common objective in all the countries examined and is pursued through a variety of policy initiatives. These policy initiatives cover a wide spectrum of needs and priorities, but a number of similarities can be discerned:
- an increasing interaction between the national and regional levels of governance, with higher involvement of regional stakeholders, from local government authorities to local business, education institutions, bankers and venture capitalists. Local universities play a key role in such linkages, as major suppliers of skilled workforce and facilitators for the emergence of clusters of high tech firms from competitive research fields and the infusion of advanced technology into older firms.
- a gradual shift in the public support from large firms to SMEs and the implementation of various forms of co-funding from industry.
- a shift from mission-oriented, often sectoral policies to diffusion-oriented policies;
- a growing support for human capital for research and innovation, rather than physical equipment.

The effectiveness of such policy initiatives depends not only on the clarity in the formulation of set objectives, coordination and integration of efforts at different administration levels, the public support lent to the R&D and innovation debate in the society, but also on their adaptation to and accurate reflection of structural and macro-economic features that cut across all the innovation policy areas.
1. INTRODUCTION

1.1. Overall and specific objectives of the contract
The Specific Contract ‘Identification and analysis of policies to promote investment in research in non-EU countries’ was undertaken during 22/12/2006 – 22/05/2007 and was allocated a budget of € 139,980.

The overall objectives of the contract were to improve the understanding of key research investment policy developments and trends in non-EU countries and to draw conclusions relevant to the Lisbon strategy in support of research policy-making. The specific objective of the contract was to identify the lessons that EU policy-makers can draw from research investment policy developments elsewhere and the impact which the research strategies of major non-EU countries can have on their own competitive position and that of the EU. The study took into account the work undertaken by IPTS and members of the ESTO network in 2005, when policy mixes and individual research investment policies and policy measures were identified and analysed for: Canada, China, Japan, South Korea and the USA. The work on these countries was revisited and completed with information collection and analysis along similar lines and of consistent quality for Australia, Brazil, India and New Zealand.

1.2. The project team
The project management was ensured by the Newcastle University Triple Helix Group, which established a project team consisting of: Project Manager, Deputy Project Manager, 15 Country Correspondents, two Senior Policy Analysts and a Quality Manager (see the structure of the project team in Annex 1). The project team worked in close collaboration with the ERAWATCH Network office in Brussels and the IPTS team in Seville. The approach adopted by the Newcastle University project managers in building up the team was two-folded:

- on the one hand, it focused on the creation of country teams with a high level of expertise, combining academic and policy experience. The country teams consisted in most cases of two experts in R&D and innovation policies, many of them being a member of the International Triple Helix Network. The two-person country team structure was adopted in order to ensure a better distribution of tasks, typically between an academic expert and a policy analyst, located close to or even within the policy-making apparatus, and a timely submission of deliverables.

- on the other hand, it aimed to ensure a competent content quality check of the deliverables, provided by the Senior Policy Analysts – two distinguished experts with broad international R&D policy expertise, and the Quality Manager – a leading expert in R&D and innovation policies, with in-depth evaluation experience.

The project managers also contributed to the team with their global RDI perspective, project management skills and previous ERAWATCH experience.

1.3. Project phases, deliverables and deadlines
In order to achieve the goals described above, the specific contract was achieved in three phases, each with its own specific deliverables and deadlines:

a. The inception phase (22/12/2006 – 22/01/2007) concluded with:
- An Inception report, which included:
  - The methodology for collecting the national information
  - An assessment of the usability of the country template already developed by IPTS in close co-operation with colleagues in DG Research (and in consultation with DG Enterprise with a view to maximising synergies with TrendChart) for the information requests of this specific contract. This country template (see Annex 2) is currently used for the other countries covered by the ERAWATCH Base load inventory and was presented to the country correspondents as guidelines for collecting the information.
- Proposals for additional tools and information collection activities;
- Proposals for the structure of the Country Summary Fiche (see Annex 3).

- A Review of first phase reports for Canada, China, Japan, South Korea and the USA, and existing ERAWATCH base load inventory content for China, Japan, and the USA. The first phase reports were produced by IPTS and members of the ESTO network in 2005, identifying and analysing the policy mix and individual research investment policies and policy measures in place in the respective countries. The project team revisited this information and worked along similar lines and with consistent quality for Australia, Brazil, India and New Zealand. The Inception Report and the Review were approved by IPTS on 7 March 2007.

b. The implementation phase (22/01/2007 – 22/04/2007)
This phase was dedicated to collecting information for constructing the Country Profiles and Country Summary Fiches. The Country Profiles were prepared for the six countries not yet included in the base load inventory (Australia, Brazil, Canada, India, South Korea, New Zealand), and the Country Summary Fiches were prepared for all the nine countries of concern for this specific contract. The Country Profiles and the Country Summary Fiches are based on up-to-date and complete quantitative and qualitative information collected from national statistics offices, government and other authoritative sources.

The implementation phase recognised the work already done and the complexity of information that had to be collected for complementing the existing resources. Therefore, the nine countries of concern in this study have been differentiated on the basis based on the following criteria:
- existing material in ERAWATCH (1st phase reports for China, Canada, Japan, South Korea, USA);
- existing country profiles in the base load for China, Japan and the USA;
- the size of the country and complexity of the R&D system, influencing the likely amount of information that will be collected.
Based on the above criteria, the following country categories were defined:
1. Countries with existing profiles in the base load and 1st phase reports: China, Japan, USA
2. Countries with 1st phase reports: China, Canada, Japan, South Korea, USA
3. Larger countries with no existing material in ERAWATCH: Brazil, India
4. Smaller countries with no existing material in ERAWATCH: Australia, New Zealand
The number of workdays and the allocation of resources between country correspondents took into account this differentiated approach.

c. The conclusive phase (22/04/2007 – 22/05/2007), which led to the production of:
• A Draft Synthesis Report presenting the structure of the templates proposed for the collection of information on R&D policies and an account of main issues and problems identified in the collection of national information, as well as an assessment of the effectiveness of the methodological approach adopted.
• A Final Synthesis Report providing an overview of the main developments in research investment and related policies outside Europe. The report draws on the results of the Country Profiles and Country Summary Fiches providing an overview and analysis of the main issues arising, in the form of a concise, self-standing report. The report sets out the main conclusions, lessons and recommendations for policy making in Europe and discusses methodological implications in view of ensuring comparability and coherence between ERAWATCH and RIP-WATCH and their eventual convergence.
2. PROJECT BACKGROUND - THE R&D POLICY-MAKING PROCESS IN THE EU

This project aimed to improve the understanding of key research investment policy developments and trends in non-EU countries and to draw conclusions relevant to the Lisbon Strategy in support of research policy-making in the EU. In this section, we will provide a brief overview of the Lisbon strategy and the broader research policy-making process in the EU over the recent years, as the background against which the findings of the study will be placed.

The Lisbon Strategy was launched in March 2000, at the meeting of the European Council in Lisbon, where the Heads of State or Government aimed at making the European Union "the most competitive and dynamic knowledge-driven economy by 2010". The political will to achieve this goal was expressed and an overall strategy was formulated, focusing on the need to:

- prepare the transition to a knowledge-based economy and society by formulating better policies for the information society and R&D, as well as by accelerating the process of structural reform for competitiveness and innovation and completing the internal market;
- modernise the European social model, invest in people and combat social exclusion;
- sustain the healthy economic outlook and favourable growth prospects by applying an appropriate macro-economic policy mix.

This strategy, developed at subsequent meetings of the European Council, rests on three pillars:

- An economic pillar preparing the ground for the transition to a competitive, dynamic, knowledge-based economy. In this context, adapting constantly to changes in the information society and performing high quality research and development were seen as essential elements.
- A social pillar designed to modernise the European social model by investing in human resources and combating social exclusion. To this end, it was agreed that the member states should play a more active role in terms of increased investment in education and training, and active employment policies that should facilitate the transition to a knowledge economy.
- An environmental pillar, which was added at the Göteborg European Council meeting in June 2001, draws attention to the fact that economic growth must be decoupled from the use of natural resources.

The Lisbon European Council of March 2000 recognised the central role that science and technology play in the implementation of this strategy and acknowledged the weaknesses of the European S&T system which needed to be overcome in order to realise the set objectives:

- insufficient funding,
- lack of an environment that stimulates research and exploitation of results, with sub-optimal research framework conditions (e.g. fiscal incentives for research, intellectual property protection, availability for venture capital, market policy, competition policy)
- fragmentation of research activities and dispersal of resources, poor integration and coordination in research and innovation policies at national, EU and regional levels.

Thus, the idea of a European Research Area (ERA) grew out of the need to deal with these weaknesses. The ERA was seen as an ambitious long-term agenda for change and it became a key component of the Lisbon Strategy. A list of targets has been drawn up with a view to attaining the goals set in 2000 and further clarifications and dimensions have been added to the concept after its launch in 2000. For instance:
- In 2002 three strategic and interlinked objectives have been added to the ERA: 1) the creation of an ‘internal market’ for research, which should increase co-operation, stimulate competition and a better allocation of resources; 2) a restructuring of the European research fabric, particularly through improved co-ordination of national research activities and policies; 3) the development of a broader framework for an European research policy that would not only address the funding of research activities, but also all relevant aspects of other EU and national policies.

- In 2003, the changing role of universities and their contribution to society were emphasised, and also the need for increased investment in research, which was addressed in the so-called 3% Action Plan. This policy objective aims to increase the average research investment level to 3% of GDP by 2010, of which 2/3 should be funded by the private sector. These initiatives were meant to give Europe a stronger public research base and to make it much more attractive to private investment in research and innovation. Given that the policies in question fall almost exclusively within the sphere of competence of the Member States, an Open Method of Coordination (OMC) entailing the development of national action plans was introduced. However, nearly halfway through the implementation period, some criticism was expressed about insufficient progress made in achieving these ambitious goals. The causes for this poor performance were related to the global economic downturn of the early 2000s and governments’ reluctance to promote difficult and unpopular economic reforms or to increase their national budgets for research and innovation.

- In 2005, the ‘knowledge for growth’ concept was added, based on the idea of the ‘knowledge triangle’ of research, education and innovation.

In 2005, a mid-term review was held, for which a report was prepared under the guidance of Wim Kok, former Prime Minister of the Netherlands (the so-called Kok Report). The Kok Report, presented to the European Commission and the European Council in November 2004, painted a gloomy picture on the progress made in the last four years, stating that the “disappointing delivery” is due to “an overloaded agenda, poor co-ordination and conflicting priorities”. The report puts the main blame on the lack of political will by the Member States.

As a result, the Commission has decided to shift attention on the actions to be taken rather than targets to be attained, in the so-called Renewed Lisbon Agenda, which is designed to promote growth and jobs, putting strong emphasis on increasing knowledge and innovation for growth. In this context, the concept of the European Research Area was strengthened and was joined by the concept of a European Higher Education Area, which should give a better use to universities’ potential to generate knowledge and economic growth.

The Renewed Lisbon Agenda outlines three priority areas:
• Investment in networks and knowledge: starting the priority projects approved in the ‘European Growth Initiative’;
• Strengthening competitiveness in industry and services: stepping up efforts in the areas of industrial policy, services market and environmental technologies;
• Increasing labour market participation of older people: promoting active ageing by encouraging older workers to work for longer.

Former priorities, such as the date of 2010 and the objectives concerning the various rates of employment have been replaced by a set of policies particularly with regard to growth, employment and governance. In terms of implementation, the coordination process has been simplified, by presenting the integrated guidelines for growth and employment jointly with the guidelines for macroeconomic and microeconomic policies, over a three-year period. They serve as a basis both for the Community Lisbon
Programme and for the National Reform Programmes. The implementation of the National Reform Programmes moved the 3% Action Plan up to a higher level, based on increased commitment from the Member States. This simplification in programming also made possible a simplified monitoring of implementation.

At present, it is generally recognised that the progress in implementing the objectives of the original and renewed Lisbon Strategy is relatively modest in the various aspects covered by the agenda. Among them, one is of particular interest for the objectives of this study – the progress towards the R&D investment target of 3% of the GDP (the 3% Action Plan). Therefore, the following sections of this report will focus particularly on the experience of the nine con-EU countries examined in promoting research investment policies that are relevant to the EU’s 3 % Action Plan.

In our study, the key points in relation to research investment policies in the nine non-EU countries that are relevant to the implementation of the 3% Action Plan have been addressed in detail in the Country Profiles, while the specific aspects have been captured in the structure of the Country Summary Fiche. Thus, the four main sets of actions of the 3% Action Plan served as ‘building blocks’ of the Country Summary Fiche structure and have been further substantiated with a series of sub-headings that reflect details of major policy initiatives and structural constraints to increasing research investment in the nine countries of concern for this project.

This approach of embedding the key elements of the 3% Action Plan in the structure of the Country Summary Fiche was thought to ensure a maximum of relevance of the information collected in the nine countries and to allow for EU/non-EU comparisons on various significant dimensions. Moreover, the proposed four main sections of the Country Summary Fiche follow closely the structure of the 1st phase Country Reports prepared by IPTS-ESTO in 2005 and facilitate the use of information contained in these reports for the completion of the Country Summary Fiche. The main findings of our study are presented in detail in the following sections.

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2 The 3% Action Plan comprises four main sets of actions:

1. **Actions aimed at supporting the steps taken by European countries and stakeholders, to ensure that they are mutually consistent and that they form an effective mix of policy measures** (co-ordination with and between Member States and acceding countries, creating a number of “European technology platforms”, which will bring together the main stakeholders – research organisations, industry, regulators, user groups, etc. – around key technologies, in order to devise and implement a common strategy for the development, the deployment and the use of these technologies in Europe).

2. **Actions aimed at improving considerably public support to research and technological innovation** (improving the career of researchers, bringing public research and industry closer together, developing and exploiting fully the potential of European and national public financial instruments).

3. **Actions addressing the necessary increase in the levels of public funding for research** (encouraging and monitoring the redirection of public budgets, making full use of the possibilities for public support to industry offered by State aid rules and public procurement rules).

4. **Actions aimed at improving the environment of research and technological innovation in Europe** (intellectual property protection, regulation of product markets and related standards, competition rules, financial markets, the fiscal environment, and the treatment of research in companies’ management and reporting practices)
3. RESEARCH POLICY COORDINATION

3.1. Key findings
This section presents various mechanisms of research policy coordination at five levels: public administration, sectoral, stakeholders, regional and international, starting from the premise that better governance depends essentially on coordination and interaction across different organisations active at these levels, ensuring both vertical and horizontal coherence.

The cross-country examination of research policy coordination mechanisms revealed a variety of institutional set-ups that are relatively distinct, as a result of historical developments and path dependencies. However, under the pressure of globalisation and international political integration, all the countries examined appeared to be engaged, with varying degrees of success, in the shift from ‘traditional’ economic activities to knowledge-intensive industries and services, in increasing the business R&D intensity and in implementing new strategies for growth. Therefore, the increasing importance given to research and innovation as a prerequisite for advancing national competitiveness and economic growth is a common feature for all the countries examined. Moreover, research and innovation policies are no longer considered to be the exclusive remit of agencies in charge with science and technology development, but are increasingly integrated in other policy fields, such as enterprise, taxation, competition, regional policy, education, intellectual property rights, employment, trade and environment, which suggests significant advancements towards the so-called ‘third generation innovation policy’, accompanied by co-ordinated, strategic actions to induce a coherent policy framework for dynamic innovators and structural change.

At the public administration level (see Table 1 below), there appears to be increasing co-ordination to realize R&D and innovation objectives, performed within an institutional format that usually includes: a ministry/agency with a key role in STI policy formulation and implementation in the national/federal government, which collaborates with other ministries/agencies with responsibilities in STI policy-making, inter-ministerial coordination agencies, and various forms of advisory bodies to the prime minister or the government. Variations in the specific features of this institutional setup arise from the “centralized” vs. “decentralized” nature of the administration, ranging across a continuum from highly centralised (China, Brazil) to highly decentralised (USA, Australia), with various degrees of centralisation in between (Canada, India, Japan, Korea, New Zealand). Such variations often emerge from differences in

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3 Vertical coordination refers to the relationships between different layers of government bodies, for example, between ministries and agencies or between ministries and regional administrations. They usually generate different governance structures. Horizontal coordination refers to the links between STI policy and other policy areas in a multi-sectoral approach, and reflects the degree to which innovation policy is integrated into a comprehensive national strategy.

4 See ‘Innovation Tomorrow’ – a survey commissioned by DG Enterprise, Innovation Directorate for further details (ftp://ftp.cordis.lu/pub/innovation-policy/studies/studies_innovation_tomorrow_summary.pdf). The ‘first generation of innovation policy’ reflects the linear process for the development of innovations, which begins with basic science and moves through successive stages until applied R&D generate new commercial applications that diffuse in the economic system. The current, ‘second generation innovation policy’ emphasises the importance of the systems and infrastructures that support innovation and are influenced by many policy areas, in particular research, education, taxation, IPR and competition policy that are not exclusively focused on innovation matters. Although second generation policies still have to be adopted in many agencies, the third generation of innovation policy is already apparent, placing innovation at the heart of those policy areas shaping innovation performance of the knowledge-based economy (e.g. Research, Education, Competition, Regional policy, etc.). Such articulation and fusion is a feature of the innovation process itself – none of the innovation actors alone have sufficient in-depth experience to put together all the pieces required to make successful innovation. Therefore, successful innovation policies need to bring together leadership, education, better communication mechanisms between stakeholders, examples, guidance and co-ordination.
the broader or narrower remit of the respective institutions, the strength of their executive and advisory powers, as well as from the nature of stakeholder representation in the inter-ministerial coordination agencies (e.g. government representatives only vs. a mixed representation of government and other stakeholders). This top-down approach is often complemented by bottom-up initiatives that draw together various mission-oriented S&T agencies in different sectors of industry and economy to reach a common objective.

Policy entrepreneurs at the regional and national government levels, in universities and industry associations often take the lead in inventing new programmes and measures that are later generalised. An example in this sense is the application of the high-tech incubator format in Brazil to employment generation and poverty reduction through development of cooperatives as initiated by university-NGO cooperation that then became a national programme for social innovation. Cross-agency collaborations initiated by entrepreneurial programme officers to aggregate complementary resources to accomplish macroscopic projects in emerging S&T fields and reduce inter-agency competition have become a mainstay of US R&D policy since the inception of the Human Genome project (DOE/NIH). Such initiatives tend to break the bounds of previously seemingly coherent division of labour, roles and remits among different agencies and levels but auger potentially important new trends that may later be seen as the model for a new policy paradigm.

Table 1 – Research policy coordination bodies

<table>
<thead>
<tr>
<th>Country</th>
<th>Name</th>
<th>Role/remit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Prime Minister’s Science, Engineering and Innovation Council (PMSEIC)</td>
<td>Advice on S&amp;T, engineering and innovation policies to the PM and the Government</td>
</tr>
<tr>
<td></td>
<td>Chief Scientist</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coordination Committee on S&amp;T</td>
<td>Coordination of research policies between all government departments and agencies that fund or perform research</td>
</tr>
<tr>
<td></td>
<td>Australian Research Council</td>
<td>Research funding (competitive funding primarily for university researchers)</td>
</tr>
<tr>
<td></td>
<td>National Health and Medical Research Council</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>Ministry of Science and Technology</td>
<td>- Lead agency for STI policy-making</td>
</tr>
<tr>
<td></td>
<td>- Other ministries: Energy, Education, Telecommunications, Planning, Trade, Economic and Industrial Development, through the Brazilian Agency for Industrial Development</td>
<td>- Formulation and execution of research budgets</td>
</tr>
<tr>
<td></td>
<td>National Industrial Policy Council</td>
<td>Presidential advisory body on industrial policy, composed of government and society representatives</td>
</tr>
<tr>
<td>Canada</td>
<td>Federal government</td>
<td>Research funder, facilitator, performer and regulator (over 20 organisations performing and/or funding R&amp;D)</td>
</tr>
<tr>
<td></td>
<td>Office of the National Science Advisor</td>
<td>Policy advice to the PM and federal government on international S&amp;T developments; innovation and commercialization; S&amp;T challenges in the developing world; S&amp;T, society and the economy</td>
</tr>
<tr>
<td></td>
<td>- Council of Canadian Academies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Advisory Council on Science and Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ministry of Industry</td>
<td>Lead agency for STI policy-making in the Canadian federal government. It has jurisdiction over several policies directly and indirectly linked to STI policy, including: industry; trade and commerce; science; consumer affairs; corporations and corporate securities; competition and restraint of trade; intellectual property; telecom; investment; small businesses; and regional development.</td>
</tr>
<tr>
<td></td>
<td>Provincial ministries for S&amp;T</td>
<td>e.g. Ministry of Research and Innovation in the Government of Ontario</td>
</tr>
<tr>
<td>Country</td>
<td>Key Institutions and Agencies</td>
<td>Lead Agency for STI Policy-Making</td>
</tr>
<tr>
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</tr>
<tr>
<td>China</td>
<td>- Ministry of Science and Technology&lt;br&gt;- Other ministries: Education, Finance, Agriculture&lt;br&gt;- National Natural Science Foundation of China, Chinese Academy of Sciences, Chinese Academy of Engineering, National Development and Reform Commission, Commission of Science, Technology and Industry for National Defence</td>
<td>Lead agency for STI policy-making</td>
</tr>
<tr>
<td></td>
<td>National Steering Group for S&amp;T and Education</td>
<td>Coordination of all education, research and innovation activities through the agencies mentioned above</td>
</tr>
<tr>
<td>India</td>
<td>- Dept. of Science and Technology&lt;br&gt;- Other S&amp;T departments in the central government: Scientific &amp; Industrial Research, Atomic Energy, Space Biotechnology and Ocean Development&lt;br&gt;- other central government ministries, with S&amp;T organisations: Defence, Agriculture, Health &amp; Family Welfare</td>
<td>Lead agency of the central government for STI policy-making</td>
</tr>
<tr>
<td></td>
<td>Planning Commission</td>
<td>Coordination of S&amp;T policy-making through its various committees for S&amp;T and HEIs</td>
</tr>
<tr>
<td></td>
<td>Office of the Principal Scientific Advisor to the Government of India</td>
<td>Policy advice to the central government</td>
</tr>
<tr>
<td></td>
<td>Innovation 25 Strategy Council</td>
<td>Coordination of S&amp;T policy at government level, chaired by the PM</td>
</tr>
<tr>
<td></td>
<td>Policy advice to the government on S&amp;T, social and human resource innovation</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>- Ministry of Research, Science and Technology (MoRST)&lt;br&gt;- Foundation for Research, Science and Technology (FRST)&lt;br&gt;- Health Research Council&lt;br&gt;- Royal Society&lt;br&gt;- Tertiary Education Commission</td>
<td>- Lead agency for STI policy-making&lt;br&gt;- Government’s single funding agency for S&amp;T and advisory body&lt;br&gt;- government agency for public health&lt;br&gt;- independent, national academy of sciences, represents the science community, provides advice to the government&lt;br&gt;- government agency for tertiary education funding and policy</td>
</tr>
<tr>
<td>South Korea</td>
<td>Ministry of Science and Technology (MOST)</td>
<td>Lead agency for STI policy-making, through the Office of Science &amp; Technology Innovation, or Headquarters of S&amp;T Innovation</td>
</tr>
<tr>
<td>USA</td>
<td>Executive Office of the President, through the Office of Management and Budget and the Office of Science and Technology Policy (OSTP), led by a Science Advisor to the President</td>
<td>Set out STI policy development and budgets. OSTP also acts as an inter-agency coordinating body.</td>
</tr>
<tr>
<td></td>
<td>Federal departments/agencies with funding and evaluation role</td>
<td></td>
</tr>
<tr>
<td></td>
<td>National Academies, the American Association for the Advancement of Science and the Council on Competitiveness</td>
<td>Policy advice to the federal government</td>
</tr>
</tbody>
</table>
At the sectoral level, priorities are a common feature of virtually all R&D systems, emerging top-down in centralized countries and bottom-up in decentralized ones. They are expressed through various forms (see Table 2 below), ranging from thematic/sectoral priorities (e.g. Australia, Brazil, South Korea) to strategic technology roadmaps (Japan, New Zealand) or clusters development (Canada, India). Although, they have significant commonalities in terms of prioritised areas (usually ICT, environment, health, biotechnology, nanotechnology, etc.), there tends to be a "large"/"small" country difference. Especially in small countries, foci are closely tied to existing resources whereas in large countries they are more related to the common global research frontier. Nevertheless, even in large countries sub-priorities relating to special local themes and resources can be identified, beling the general perception that a few themes rule. For instance, it is interesting to remark here the Brazilian government’s effort to link innovation policy with industrial policy and to use innovation developments for increasing social inclusion and development opportunities, particularly in the poorest regions. Furthermore, it is also worth noting the selective investments in areas with high potential for growth, such as Canada’s Technology Clusters policy, Japan’s Strategic Technology Roadmap (see Box 1) or the Korean government’s investment in biotechnology and nanotechnology, that has led to a rapid advance of the country in the international arena (South Korea has outperformed Britain and France in nanotechnology development, and now ranks forth behind the US, Japan, and Germany – see Box 2)

Table 2 – Sectoral priorities

<table>
<thead>
<tr>
<th>Country</th>
<th>Priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>4 national thematic priorities: environment, health, frontier technologies for industries, security</td>
</tr>
<tr>
<td>Brazil</td>
<td>14 Sectoral Funds, strategic programmes (stem-cell research, bio-products, molecular structural biology research, nanotechnology and energy), links between innovation policy and industrial policy, social inclusion and development, especially in the poorest regions</td>
</tr>
<tr>
<td>Canada</td>
<td>10 Technology Clusters</td>
</tr>
<tr>
<td>China</td>
<td>10 priority fields, four sectoral areas (key technologies, environment, human resources, national security)</td>
</tr>
<tr>
<td>India</td>
<td>Knowledge-intensive sectors and clusters (ICT, pharmaceuticals, automotive, biotech, nanotech, agriculture and SMEs clusters), strategic sectors (atomic energy, space, defence and electronics)</td>
</tr>
<tr>
<td>Japan</td>
<td>4 primary and 4 secondary priorities emphasised in the Basic Plans for S&amp;T; Strategic Technology Roadmap (20 technologies)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Roadmaps for Science (4 so far: energy, nanoscience and nanotechnology, biotechnology, environment)</td>
</tr>
<tr>
<td>South Korea</td>
<td>Nanotechnology Development Plan; Biotech 2000</td>
</tr>
<tr>
<td>US</td>
<td>National Nanotechnology Initiative, Networking and Information technology, Climate Change Programme, defence R&amp;D, biomedical research.</td>
</tr>
</tbody>
</table>

At the stakeholder level, there appears to be an increasing trend towards enhancing stakeholder participation in a policy advisory capacity. Some notable differences have been observed in the stakeholder representation, ranging from a rich mix of actors from industry, research and higher education, government and civil society, to predominantly government agencies, or industry and civil society (see Table 3).

A continuum may be constructed from intensive to less intensive stakeholder involvement, but with a clear focus on this issue in all countries. For instance, in some countries, the policy focus is to foster industry leadership and helping industries develop strategies for growth, prioritise and make commitments to change (e.g. Australia’s Action Agendas or the growing trend in China to enhance industrial leadership by establishing technology development centres in firms). In others, such as India, the stakeholder involvement is broadened to include private industry and civil society groups represented by NGOs, and has as main objective the strengthening of public-private partnerships and of the human resource base in specific areas, particularly in
high-tech sectors. In yet another group of countries, stakeholders’ participation is much broader, encompassing not only industrial actors, but also research and higher education institutions, as well as civil society groups, such as Canada’s Technology Road mapping exercises (see Box 3), Brazil’s Social Technology Network, which is meant to develop sustainable development technologies and is complemented by other social inclusion programmes, New Zealand’s Roadmaps for Science or the National Forum ‘Capitalising on research Summit’, or Japan’s ad hoc committees of industry and university representatives.

Table 3 – Types of stakeholder involvement

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of stakeholder involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Action Agendas (to foster industry leadership and development of strategies for growth)</td>
</tr>
<tr>
<td>Brazil</td>
<td>Thematic networks in strategic areas; Social Technology Network complemented with other social inclusion programmes</td>
</tr>
<tr>
<td>Canada</td>
<td>Technology Roadmaps (broad representation of industry, suppliers, academic and research groups, government)</td>
</tr>
<tr>
<td>China</td>
<td>Policies to enhance industrial leadership</td>
</tr>
<tr>
<td>India</td>
<td>Policies directed at private industry firms and civil society groups represented by NGOs, to strengthen public-private partnerships and the human resources base in specific areas</td>
</tr>
<tr>
<td>Japan</td>
<td>Ad hoc committees of various industry and university representatives</td>
</tr>
<tr>
<td>New Zealand</td>
<td>‘Roadmaps for Science’, National Forum ‘Capitalising on Research Summit’</td>
</tr>
<tr>
<td>South Korea</td>
<td>Industry and academia advisory teams to the office of National S&amp;T Strategy and Planning, National S&amp;T Council and MOST, advisory role of STEPI</td>
</tr>
<tr>
<td>US</td>
<td>The President’s Council of Advisors on Science and technology (PCAST), National Academies, direct interaction with congress</td>
</tr>
</tbody>
</table>

The regional focus is increasingly present in research and innovation policy priorities. Some countries have recently refreshed their regional policies to make them better suited to the economic needs. For instance, in 2006 New Zealand’s cabinet adopted the policy paper ‘Boosting the Impact of Regional Economic Development: Detailed Changes’ (see Box 4), which encourages regions to develop robust economic development strategies, and enhanced the regional autonomy, including through the reform in the tertiary education sector. Also notable is Japan’s initiative to introduce the legal obligation (Article 4 of the Science and Technology Basic Law) for local governments to formulate and implement policies that promote S&T according to the national initiatives, as well as to own priorities. Furthermore, the 2004 Law on National University Incorporation encouraged regional universities to develop stronger links with firms and to engage in regional development strategies and clusters, as key sources of skilled workforce and strategic knowledge. These developments are also accompanied by further devolution of funding towards regional governments.

In fact, the growing involvement of universities in regional economic development appears as a common feature for all the countries examined, with various types of institutional mechanisms and strategies to achieve this objective, from a ‘government-pulled’ development model in China to decentralised, bottom-up policies and initiatives in the US, such as the Georgia Research Alliance (see Box 5).

The combination of top-down and bottom-up approaches is present in various degrees in all the countries examined, ranging from regional development programmes initiated and funded by the central governments (e.g. China, Brazil, Japan) to local initiatives proposed and implemented by the regional governments (Australia, Canada, USA). An increasing interaction between the central and regional levels of coordination has been observed, with central governments tending to give stronger powers to the regions, and federal governments tending to intervene to correct regional imbalances.
Another notable development is the increasing involvement of S&T in reducing regional disparities, which can be observed in countries like China or Brazil, where a relevant component of human resources training was added to regional development programmes.

A growing emphasis on international cooperation in research has been identified in all the countries examined, and it is usually promoted through various bilateral programmes and scientists exchange programmes funded at national or regional level (e.g. Australia’s International Science Linkages Programme, Canada’s Going Global and International S&T Partnerships programmes, China’s International S&T Cooperation Programme for Priority Projects, Japan’s International Cooperative Research Projects, Korea’s International Joint Research Programme, etc.). Also worth noting are the Agreements on S&T collaboration between the EU and some of these countries, such as the US (document signed in 1985 and renewed in 2004), New Zealand (document signed in 1991), India (which is a partner in several EU-funded programmes).

A notable recent trend towards the development of more strategic international consortia was observed, which can be exemplified by Japan’s Strategic Fund for Establishing International Headquarters in Universities (JSPS) or Canada-California Strategic Innovation Partnership (CCSIP), which currently focuses on high-speed connectivity, IT-supported audiovisual collaboration, cross-border investment barriers, and research on stem cells, nanotechnology, transportation, energy, and infectious diseases.

3.2. Overview of research coordination mechanisms

3.2.1. At public administration level

From an overall perspective, the research and innovation systems in the nine countries of concern for this study provide a variety of configurations ranging from highly centralised (China, Brazil) to highly decentralised (USA, Australia), with various degrees of centralisation in between (Canada, India, Japan, Korea, New Zealand).

China has a highly centralised research system, organised and controlled by the central government. Decisions related to S&T go through agencies and organisations in a hierarchical order. The National Steering Group for S&T and Education in the State Council is the highest ranked organisation in China, coordinating all education, research, and innovation related activities. It has nine member ministries or agencies: 1) Ministry of Science and Technology (MOST), 2) Ministry of Education (MOE), 3) Ministry of Finance (MOF), 4) National Natural Science Foundation of China(NSFC), 5) Chinese Academy of Sciences (CAS), 6) Chinese Academy of Engineering (CAE), 7) National Development and Reform Commission (NDRC), 8) Commission of Science Technology and Industry for National Defence (CSTIND), and 9) Ministry of Agriculture (MOA).

MOST, formerly known as the State Science and Technology Commission, is the leading ministry and works with other ministries or agencies to coordinate S&T activities. In particular, MOE plays a role in policies for S&T talent and managing R&D activities in universities; MOF helps to develop fiscal policies to promote R&D activities especially in enterprises; NSFC develops S&T programmes and provides funding for basic and some applied research; CAS is comprised of high-level research institutes and together with CAE has academic divisions of science and engineering; NDRC develops strategies and policies with a focus on the economic and social aspects of S&T; CSTIND and MOA manage R&D activities related to defence and agriculture respectively.
Early 2006, the Chinese central government issued the “2006-2020 National Long-and Medium-Term S&T Development Guiding Vision” (The Guiding Vision), which provides the guidelines for S&T development and enhancement of endogenous innovation. The document highlights two major priorities for S&T policy in China: 1) promoting S&T development in selected key fields; and 2) enhancing innovation capacity. The Guiding Vision calls for more than 2.5% of GDP to be invested in R&D and for the contribution of S&T progress to economic growth to be at least 60%, and the dependence on foreign technologies to be reduced below 30%. The document also sets the goal for China to rank in the top 5 in the world in terms of invention patents and international paper citations. The Guiding Vision focuses on 16 specific projects, 11 developing fields and 68 priorities topics, which aim at strengthening the institutional reform and consolidating a technology innovation system centred on industry-academia collaboration and links with enterprises.

**Brazil** has a highly centralised research system, with the Ministry of Science and Technology as the lead agency for the formulation, implementation and coordination of research policy, through its innovation agency - FINEP, its basic research arm – the National Council for Scientific and Technologic Development (CNPq) and its network of public research organisations.

In terms of definition and execution of the research budget, other ministries are also involved: Energy (ME), Education (MEC), Telecommunications (MINICOM), Planning (MPOG), Trade, Economic and Industrial Development (MDIC), through the Brazilian Agency for Industrial Development (ABDI). Research budgets (S&T) are structured on an annual basis, but are part of a multi-year government wide budgetary planning tool (PPA), designed and coordinated by the Ministry of Planning, Budget and Administration (MPOG). The budgetary sections of each ministry prepare the budget proposal to MPOG, in which they have to identify planned expenditures on S&T activities in line with the PPA objectives and guidelines for the area.

Inter-ministerial coordination remains a problem. Some improvements in the horizontal coordination at the ministerial level have been achieved over the past few years through such actions as:

- the participation of the Ministry of Science and Technology in the elaboration of the 2004 Industrial Policy for Industry, Technology and Foreign Trade (PITCE), which is the Federal Government’s Action Plan to increase the production and export capacities of Brazilian firms, as well as their innovativeness.
- the creation in 2004 of the inter-ministerial Brazilian Industrial Development Agency (ABDI) in charge with the implementation of industrial policy, foreign trade and STI interfaces, which brought a measure of horizontal coordination to some strategic STI areas.
- the creation of the National Industrial Policy Council (CNDI) in December 2004 as a Presidential advisory body on industrial policy guidelines composed of government and society representatives.
- attempts to revive the Council for Science and Technology, which is acting as a presidential advisory policy-making body.

At present, the Ministry of Science and Technology is drafting the **National STI policy for 2007-2010**, which envisages the establishment of a new regulatory framework for the National Fund for Scientific and Technological Development (FNCDT), the main funding source of innovation in the country, to improve the formulation and implementation of cross-cutting programmatic actions. However, this apparently highly centralised system is responsive to bottom-up initiatives from the universities and civil society, for example, the federal programme to extend the cooperative incubator programme, originated at the Federal University of Rio de Janeiro, nationwide. Moreover, FASPESPE, the State S&T Agency of the State of Sao Paulo, provides a benchmark for the federal government, having historically operated at a higher level.
of activity, most notably in recent years through its Genoma Project, a networked initiative establishing the equivalent of a European Research Area (ERA). Indeed, Genoma provides an instance of aggregating research resources towards a collective economic and social objective that could provide a model for the ERA.

In Canada, the federal government is centralised, with decisions resting with the Prime Minister and the Cabinet of Ministers. S&T and innovation policy falls under a number of federal departments and agencies, and a coordinated effort is carried out through the horizontal approach to S&T and innovation policy and planning. The Canadian S&T system is organized around the three principal institutional sectors of: a) governments (both federal and provincial), b) industry, and c) higher education.

The federal government plays four roles: funder, facilitator, performer and regulator. There are more than 20 federal organizations performing and/or funding R&D and 120 federal research laboratories. The National Research Council of Canada alone has 20 research institutes and 10 technology centres. Other federal Science-Based Departments and Agencies, such as Environment Canada, Natural Resources Canada, Agriculture and Agri-Food Canada, Fisheries and Oceans Canada and Health Canada also support research centres across Canada. These institutions and laboratories fulfil the government's role of research performer to support policy, regulation, safety and economic development.

The federal government receives S&T advice from several sources of expertise. One of them is the Office of the National Science Advisor (NSA), which was created in 2004 to provide sound, independent, non-partisan advice on Canada's S&T directions and priorities to the Prime Minister. The Advisor alerts the Prime Minister to and offers advice on issues such as international S&T developments; innovation and commercialization; S&T challenges arising in the developing world; and balancing excellence in S&T with benefits to society and the economy. The recently-established Council of Canadian Academies has also been called upon to provide advice regarding Canada's S&T strengths and weaknesses.

The Prime Minister and Cabinet of Ministers receive advice from two independent bodies that report directly to them:

• The Prime Minister's Advisory Council on Science and Technology provides advice on national S&T issues and performance; and
• The Council of Science and Technology Advisors provides advice on S&T issues internal to the federal government.

In 1989 S&T policy-making was brought under the auspices of the Ministry of Industry. The 1996 review of S&T policymaking and of all federal departments and agencies with S&T policies and programmes resulted in Science and Technology for the New Century - a strategy of federal government departments' and agencies' investment in innovation which put in place a new structure for governance and outlined goals for federal S&T and federal S&T departments and agencies, introducing a 'horizontal' management of S&T and innovation across the government.

The Industry Portfolio is made up of fifteen departments and agencies, and also includes the Canadian Foundation for Innovation (CFI), Canada Research Chairs, Genome Canada, and the Networks of Centres of Excellence. The portfolio brings together the organizations to help meet the government's goal of building a knowledge economy and advance the jobs and growth agenda. Industry Canada is a lead department in the portfolio for science, technology and innovation policy in the Canadian federal government. It has jurisdiction over a range of policies directly and indirectly linked to science, technology and innovation policy, including: industry; trade and commerce; science; consumer affairs; corporations and corporate securities; competition and restraint of trade; intellectual property; telecommunications; invest-
ment; small businesses; and regional development. Several provincial governments also have ministries responsible for science and technology. For example, the Government of Ontario recently established a Ministry of Research and Innovation.

In 2002, the Canadian government set goals and targets for federal government policy in four areas: Knowledge performance, Skills to drive innovation across all sectors of the economy, Innovation environment, and Strengthening communities at the local level. The new Federal Conservative government elected in 2006 released an economic plan which proposes to improve Canada’s competitiveness through initiatives in five policy areas: fiscal, tax, entrepreneurial, knowledge, and infrastructure. The government committed itself to produce a S&T strategy, entitled: "Mobilizing Science and Technology to Canada’s Advantage"\(^5\), which was released in May 2007.

This strategy is the government’s plan to achieve the goals it has set itself in the 2006 economic plan. The new S&T strategy sets out a comprehensive, multi-year S&T agenda. It is focused on encouraging a more competitive and sustainable Canadian economy with the help of S&T. In the new strategy, the government will continue to play significant role, but with new resources to be made available for the private sector and the universities to commercialise research. The new S&T policy document is directed at fostering S&T advantages in three domains: entrepreneurial advantage; knowledge advantage and people advantage. These advantages will be supported by the federal policy commitments guided by four core principles: promoting world-class excellence; focusing on priorities, encouraging partnerships and enhancing accountability.

The Provinces and their municipalities: Canada's governments actively seek national and international partnerships and investment in STI and R&D. The provinces provide most of the basic physical infrastructure and operating costs for education and for research in Canada’s universities and teaching hospitals. Some provinces also perform and fund research in ways similar to the federal government, often in partnership with it. Recognising the economic potential of R&D clusters, many provincial and regional governments have joined forces with the federal government to start venture funds, incubators and research facilities at the local level.

The Government of Canada has also created innovative schemes for delivering and expanding research support and strength, such as:

- The Canada Foundation for Innovation
- The Canadian Institutes of Health Research
- Genome Canada and
- Canada Research Chairs

In addition, several provinces have also created innovative programmes to support S&T development. Another growing source of research support is the voluntary sector, where organizations raise money for specific fields of research in, for example, the life-sciences.

The Federal Partners in Technology Transfer (FPTT) is a network of people who work in Canada’s federal science-based departments and agencies to establish common approaches, practices and policies to effectively transfer research and technologies from government laboratories to the private sector.

\(^5\) The report is available at: [http://www.ic.gc.ca](http://www.ic.gc.ca)
In **India**, there are three nodal agencies responsible for the overall administration, co-ordination of research policies: the Department of Science and Technology (DST), the Planning Commission with its various committees for S&T and HEIs, and the Office of the Principal Scientific Advisor to the Government of India.

The S&T departments functioning under the auspices of the Central Government are: the Department of Science and Technology (DST), Department of Scientific & Industrial Research (DSIR), Department of Atomic Energy (DAE), Department of Space (DoS), Department of Biotechnology (DBT) and Department of Ocean Development (DOD). DST is primarily entrusted with the responsibility of formulation of S&T policies and their implementation, identification and promotion of thrust areas of research in different sectors of S&T; technology information, forecasting and assessment; international collaboration, promotion of science & society programmes and coordination of S&T activities in the country. The major organisation under DSIR is the Council of Scientific and Industrial Research (CSIR), with its 40 institutes dedicated to research and development in well defined areas and around 100 field stations. Among the other programmes of DSIR are: support to R&D by industry, programmes aimed at technological self-reliance, schemes to enhance efficacy of transfer of technology and a National Information System for Science and Technology (NISSAT).

Sufficient infrastructure exists in the Indian S&T organisations to efficiently interact with the end-users. In fact, a large number of projects are carried out on collaboration/sponsorship basis. In addition to R&D activities, these organisations also support extramural research, and provide extension services such as consultancy and training for the benefit of industry and other end-users.

A number of other S&T organisations are associated with other Central Government Ministries, such as the Defence Research & Development Organisation (DRDO) under the Ministry of Defence, the Indian Council of Agricultural Research (ICAR) under the Ministry of Agriculture, and the Indian Council of Medical Research (ICMR) under the Ministry of Health & Family Welfare, all of them having large R&D infrastructure.

Most of the S&T system and HEIs in India are headed by scientists working in the public service and given the same status as high-ranking civil servants or secretaries to the government. If the formulation and coordination of research policy rests with the central government, its implementation is rather pluralistic and decentralized, consisting of various mission-oriented S&T agencies in different sectors of industry and economy.

In **Japan**, the lead agency for the formulation and implementation of S&T policy is the Council for S&T Policy (CSTP). The CSTP define the *Science and Technology Basic Plans*, which set sectoral priorities in terms of key research fields and the level of funding for S&T activities. The Science and Technology Basic Plan is budgeted at 160.8 Billion Euro (25 trillion Yen) or 1% of GDP, assuming nominal growth rate of 3.1% over the 2006 to 2010 period, and the overall government budget programme is set on an annual basis by the Ministry of Finance (MOF). Once the budget has been approved by the Diet, the Japanese Parliament, the budget is distributed from the cabinet to the heads of the ministries and agencies, according to the value decided. The prioritisation of research fields shapes the budgetary activities of agencies and Ministries involved in implementing S&T policy and programmes.

The Ministry of Economy, Trade and Industry (METI) plays a key role with regard of policies for industry, industrial competitiveness, and the regional economy. The Japan Patent Office (JPO) which sets the rules and regulations regarding intellectual property is an agency of METI. Key agencies such as the Institute of Physical and Chemical Research (RIKEN), the National Institute of Advanced Science and
Technology (AIST), the New Energy and Industrial Technology Development Corporation (NEDO) are all independent administrative agencies that maintain relations with METI.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) plays a key role in determining the structure of the education and research and development systems of Japan, and the National Institute of Science and Technology Policy (NISTEP), which is the key body for maintaining and analysing data on science and technology is an agency of MEXT. The Ministry of Internal Affairs and Communications (SOUMU) plays a key role in shaping the government administrative structure through policies related to policy evaluation, communications and the publication of governmental data and statistics, as well as budgetary matters.

Other Ministries such as the Ministry of Health, Labour and Welfare (MHLW), Ministry of Agriculture, Fisheries and Food (MAFF) or the Ministry of Land, Infrastructure and Transport (MLIT), which houses the Japan Meteorological Agency (JMA), also play specific roles in setting regulatory frameworks and policies for areas under their jurisdiction. The Defence Agency is a major sponsor of governmental research and has 5% (1,891 billion yen) of the S&T budget. Funding is distributed via the Ministries to the Independent Administrative Institutions (IAIs) such as key funding bodies like the Japan Science and Technology Agency (JST) and Japan Society for the Promotion of Science (JSPS), as well as the National Universities, which receive most of their budget from the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Following widespread reform of government structures in January 2001, the Council for Science and Technology Policy (CSTP) was set up as a cross-ministerial umbrella body at cabinet level. The CSTP is chaired by the Prime Minister and acts as a “watchtower” over the various actors and resources for coordinating S&T policy. S&T policy formulation was previously characterized by high fragmentation and overlap between different government ministries.

More recently, the new Prime Minister, Shinzo Abe introduced in October 2006 the policy initiative Innovation 25, which is meant to be a long-term strategy to promote innovation by setting sectoral innovation goals in such fields as medicine, engineering and information technology. Some first steps towards its implementation have been the creation of the post of Minister of State in charge of Innovation, the first of its kind in Japan, and the establishment of the Innovation 25 Strategy Council by the Cabinet Office to hear views and opinions from intellectual people in the academic and business communities. The Council is composed of seven members selected from such communities, with a Special Adviser to the Cabinet serving as Chairperson.

The establishment of the Innovation 25 Strategy Council tasked with developing a strategic innovation policy roadmap to 2025 suggests that the Abe government is placing significant importance not only on S&T in a narrow sense, but also more broadly on innovation as one of the main policy issues for the long term development of Japan. The main strategic areas for the Council encompass: S&T innovation, social innovation and human resource innovation. The relations between the Innovation 25 Council and the CSTP are currently developing, as both bodies comprise members from government, academia and industry. However, it is too early to assess the effects of these recent policies and administrative changes on the S&T system.
South Korea has placed a strong focus on S&T in recent years, starting with the promotion of the Minister for Science and Technology to the position of Deputy Prime Minister and the establishment of the Office of Science & Technology Innovation (OSTI), or Headquarters of S&T Innovation (HSTI) in the new Ministry of Science and Technology (MOST) to plan, coordinate, and evaluate the national R&D programmes. MOST is mandated to provide central directions, planning, coordinating, and evaluation of all S&T activities in the country; and to formulate S&T policies, programmes and projects including technology cooperation, space technology, and atomic energy in support of national development priorities.

The Government empowered the new MOST with total control of the national R&D budget, from planning to coordination and evaluation. The process of planning and distribution of the national R&D budget changed after the launch of the new MOST. Previously, all the ministries submitted proposals for their R&D budget for the next year to Ministry of Planning & Budget (MPB), which decided on budget allocations. After the launch of the new MOST, OSTI took over the role of MPB, which became just a partner to help MOST. The new MOST was also granted more political power, by the promotion of the Minister by the President from the position of a secretary of the National S&T Council to that of Vice Chairman, which was the nation’s highest decision-making body.

In New Zealand, the main player in S&T policy system is the Ministry of Research, Science and Technology (MoRST), which develops research and innovation policies and manages the publicly funded part of the S&T system on behalf of the Government. MoRST’s main responsibilities are to manage the Government’s S&T investment, provide policy advice on S&T issues, encourage innovation and commercialisation of S&T knowledge and ideas, and collaborate with other government organisations where S&T intersects with their work. MoRST contracts other agencies, such as the Foundation for Research, Science and Technology (FRST) to manage the funding of research and innovation projects carried out by research organisations. The Foundation for Research Science & Technology (FRST) is the Government’s primary agency for allocating public funding for S&T – it allocates around half of the government’s investment in S&T in accordance with government priorities set down by the Minister of S&T. FRST is the biggest single funder of research in New Zealand and has funding relationships with virtually every type of research organisation. FRST also provides the Minister of S&T with independent policy advice on matters relating to S&T, including advice on research needs and priorities. The Health Research Council of New Zealand is the Crown agency responsible for the management of the Government’s investment in public good health research. Ownership of the HRC resides with the Minister of Health, with funding being primarily provided from Vote Research, Science and Technology. The Royal Society of New Zealand (RSNZ) is an independent, national academy of sciences, which represents some 60 scientific and technological societies and individual members. It administers several funds for S&T, publishes journals, provides science advice to government, and fosters international scientific contact and co-operation. It has a special place in the science system because it most directly represents those individual scientists and their professional societies who make up the science community.

The Tertiary Education Commission (TEC) is a crown entity responsible for managing relationships with the tertiary sector and for policy development. TEC is responsible for funding the government’s contribution to tertiary education and training offered by universities and other post-compulsory education and training providers. TEC administers the Performance Based Research Fund, which allocates funding to institutions based on the quality of their research, and funding for the Centres of Research Excellence. In the research community, there is a) the university sector with 7 multi-faculty universities and 2 institutes of technology, and b) nine Crown Research
Institutes (CRIs) with the primary purpose of undertaking research for the benefit of New Zealand.

The S&T priorities of the present Labour-led Government have been articulated in the recent document “Science for New Zealand – An overview of the RS&T system” (2006), which presents specific goals for how science should contribute to the economic transformation, social development and sustainable development of the society. The objectives are divided into four categories covering issues related to knowledge production, economic contribution, protecting the environment and the social well-being of the society.

In Australia, research policy is largely pluralistic and decentralised to agencies with functional responsibilities. The structure of the research system shows four levels below that of the Commonwealth Government: advice, coordination, funding and performance. Research policy advice is provided by the Prime Minister’s Science, Engineering and Innovation Council (PMSEIC) which advises on important issues in science, technology, engineering and innovation, and the Chief Scientist who advises the Government on major scientific issues. Research policy coordination is provided by the Coordination Committee on Science and Technology, which includes representatives of all Government Departments and agencies that fund or perform research to facilitate exchange of information, coordination and strategic planning.

Research Funding is provided by two major direct research funding bodies: the Australian Research Council which provides competitive funding primarily for university researchers in all fields except medicine, and the National Health and Medical Research Council which provides competitive funding primarily for university researchers in medical fields. Block funding (65%) is provided directly to research organisations. Other funding is provided through competitive and peer-reviewed processes (20%). The Research Performers include the Commonwealth Scientific and Industrial Research Organisation, the Australian Nuclear Science and Technology Organisation, the Australian Institute of Marine Science, the Defence Science and Technology Organisation (DSTO) and 38 AVCC Members’ Universities. The Australian S&T system has a strong systemic approach triggered by the establishment of four broad-ranging national research priorities: environment, health, new knowledge, security - and the requirement that all relevant research-funding and -performing agencies develop plans to pursue these priorities.

In the US, the research system is highly decentralized and involves many organizational actors. The Executive Office of the President sets out policy development and budgets through the Office of Management and Budget and the Office of Science and Technology Policy (OSTP), led by a Science Advisor to the President. OSTP also acts as an inter-agency coordinating body.

Funding is done through the federal departments and agencies in the executive branch as a result of Congressional authorisations. The US Congress uses a committee structure to approve budgets and oversee executive agency activities, and utilizes the General Accountability Office (GAO) to conduct specialized evaluations. The Executive Branch of the government includes 12 federal departments and 18 federal agencies that fund research. The top departments and agencies based on their R&D budgets are the Department of Defence, Department of Health and Human Services, NASA, Department of Energy, and the National Science Foundation. Several agencies operate research laboratories, e.g. the Department of Energy operations 10 national laboratories. The federal judiciary may review policies in the national research enterprise. State and local governments also provide funding for research that impacts their local economies. Coordination among actors occurs through “checks and balances” which reflect the relationship among these actors as they engage in give and take for financial, policy, and legal decisions.
The federal government receives policy advice on research from many organisations including non-profit research boards such as those of the National Academies, the American Association for the Advancement of Science and the Council on Competitiveness.

The main recent policy initiative that has been promoted at the federal level is the **American Competitiveness Initiative (ACI)**. The ACI was initiated out of the Executive Office of the President to promote S&T based innovation by increasing research investments in science and engineering in three federal agencies, extending the R&D tax credit offering, reforming intellectual property laws, and enhancing the educational system for science, technology, engineering, and mathematics.

### 3.2.2. At sectoral level

In **Australia**, thematic research priorities have been established at national level in the policy programme *Backing Australia’s Ability*: Environment, Health, Frontier technologies for building and transforming Australian industries, and Safeguarding Australia. Implementation is being achieved by requiring every government funding body and research performing agency to develop a plan to demonstrate how they will make a significant contribution to the priority goals, and to report annually on those achievements. Within these national priorities, several knowledge-intensive industry/technology sectors have been selected for substantial R&D support: biotechnology, ICT, nanotechnology, pharmaceuticals and wine. There are also a number of more specific R&D support programmes e.g. in the areas of food innovation, automotive R&D, shipbuilding innovation, information technology (Building Information Technology Strengths (BITS) – Incubators, BITS – Advanced Networks), renewable energy commercialisation, greenhouse gas abatement, and Low-Emissions Technology. In the national research priority ‘ Frontier Technologies for Building and Transforming Australian Industries’, priority goals include breakthrough science, enhanced capacity in the frontier technologies of nanotechnology, biotechnology, ICT, photonics, genomics/phenomics, and complex systems, advanced materials including ceramics, organics, biomaterials, smart material and fabrics, composites, polymers and light metals, and creative applications for digital technologies including e-finance, interactive systems, multi-platform media, creative industries, digital media creative design, content generation and imaging.

In **Brazil**, the sectoral focus of research policy-making is reflected by the adoption of the *Sector Funds for Science and Technology* from 1998 to 2002, which introduced a new management and governance model based on the participation of various social segments within each sector (see Box 1 below). Currently there are 14 operational Sector Funds in several areas6, which are funded from small percentages of existing mandatory taxes and levies on productive revenues in the respective sectors, and the revenues are managed by FINEP - Brazil’s innovation agency under the Ministry of Science and Technology. It is interesting to remark here the Brazilian government’s effort to link innovation policy with industrial policy, through the 2004 *Industrial Policy for Industry, Technology and Foreign Trade (PITCE)*, which provided a more strategic focus on four priority areas: capital goods, semiconductors, software and pharmaceuticals. In addition, efforts are made for advancing strategic programmes in stem-cell research, bio-products, molecular structural biology research, nanotechnology and energy (hydrogen, biomass and biofuels), and to use innovation developments for increasing social inclusion and development opportunities, particularly in the poorest regions.

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In conjunction with financing from the IDB’s Multilateral Investment Fund (MIF), FINEP created the Inovar Project in 2000, a financial mechanism to support small high-tech start ups through venture capital funds. The project has since established 24 funds, half of which have been invested in by the MIF, and has also created the Inovar Seed Money program (Inovar Semente) to stimulate the generation of seed and early stage funds for small entrepreneurs. Additionally, Inovar has created the first venture capital website in Brazil, a tool to help entrepreneurs connect with each other, thus contributing to the creation of a more receptive environment for entrepreneurs and venture capital in the country. FINEP has also been placing greater focus on promoting investments in ST&I for social and urban development, focusing on areas like health, sanitation, education, housing technologies, popular cooperatives and family agriculture. Overall, furthering the integration of ST&I into the public policy agenda boils down to strengthening the scientific base in Brazil, which will in turn serve to enhance Brazil’s position as a global competitor.

Source: Inter-American Development Bank
In Canada, the sectoral approach is exemplified by the recent initiative to develop 10 internationally recognized technology clusters by 2010. Canada’s National Research Council (NRC) has received several rounds of funding to establish and reinforce cluster initiatives across the country. Currently, NRC’s cluster initiatives are spread throughout the country and include: ocean technologies, e-business and information technologies, life sciences, nanotechnology, nutraceuticals and sustainable infrastructure, biodiagnostics, fuel cells, photonics; and aerospace, biotechnology, and aluminium transformation. While these new facilities conduct some of the world’s most innovative research, their impact is much greater when coupled with NRC’s other strengths in research assistance, information sharing, industry partnership and technology licensing. Through NRC, Canadian companies can access the expertise, knowledge and help they need to develop and market new technologies.

China has recently adopted The Medium- and Long-term National Plan for Science and Technology Development (2006-2020), which outlines ten prioritised fields in research policies, each with its subset of prioritised topics. The prioritised fields are: energy (5 topics), water and mineral resources (7 topics), environment (4 topics), agriculture (9 topics), manufacturing technologies (8 topics), transportation (6 topics), information technology (7 topics), population and health (5 topics), urbanization (5 topics), and public security (6 topics). In addition to these prioritised fields, eight frontier technologies have been selected as priorities for funding: biotechnology (5 topics), information technology (3 topics), new materials and nanotechnology (3 topics), advanced manufacturing technologies (3 topics), advanced energy technologies (4 topics), ocean technology (4 topics), laser technology, aeronautics and astronautics.

From a more general perspective, China’s sectoral priorities for R&D policies are:
1. Advancing key technologies in manufacturing industry, information technology and agriculture industry. China expects to be one of the leading countries in these key technologies in the near future in order to ensure the country’s competitiveness.
2. Addressing environmental issues - China’s energy consumption is growing rapidly as the economy grows, raising significant environmental concerns. China aims to develop energy efficient and clean energy technologies to reduce energy consumption and optimise energy structure. A cyclic economy model will be piloted in selected cities and industries to explore the potential of establishing an environmental friendly society.
3. Human resource development - High quality human resources are regarded as the basis of S&T development in China. The share of S&T personnel as a percentage of the population is expected to increase significantly. China also aims to develop top-level universities, research institutes and leading scientists.
4. Enforcing national security - China also seeks to develop technologies important to national security, for improving capabilities to deal with major diseases and promoting breakthroughs in pharmaceutical and medical equipment technologies.

In Japan, after the introduction of the Science and Technology Basic Law in 1995 there has been a greater emphasis on sector-specific prioritisation. The three Science and Technology Basic Plans (1996-2000, 2001-2005, 2006-2010) implemented since the passage of the Basic Law have prioritised four primary and four secondary sectors, each with its own subset of priorities. Primary Priorities include: 1) Materials and Nanotechnology, 2) Life Sciences, 3) Information and Communications, 4) the Environment. Secondary Priorities include: 1) Energy, 2) Manufacturing Technologies, 3) Social Infrastructure, and 4) Frontier Science. Ministries and funding agencies implement programmes following these themes. In addition, the Ministry of Economy, Trade and Industry (METI) formulated the Strategic Technology Roadmap (STR) in order to realize the ‘New Industrial Structure’ through aggressive efforts in R&D by private and public sectors (see Box 2). The STR was designed as a navigating tool for strategic planning and implementation of R&D investment in cooperation with industry, academia, and public institution. It includes twenty technologies, dis-
tributed between the four priority and secondary fields set out in the Basic Plan. These strategic technologies include semiconductors, medical devices, robotics, and nanotechnologies, amidst other technologies.

Box 2 – Japan’s Strategic Technology Roadmap

1. Purpose
Through the formulation process of, and based on the STR, METI seeks public understanding by providing an explanation of the perspective, details, and achievements of METI’s R&D investments. METI understands technological and market trends, prioritizes critical technologies, and develops policy infrastructure for planning R&D projects. In order to respond to specialized technologies as well as diversified market and social needs, METI not only promotes cross-field and cross-industrial alliances, technology fusion, and coordinated implementation of relevant policies, but also assembles the comprehensive strength of industry, academia, and public institution.

2. Structure
The STR consists of: i) Scenario for Introduction, ii) Technology Overview, and iii) Roadmap. The Scenario for Introduction includes relevant policies that should be dealt with in order to provide the public with findings of R&D as products and services. Prioritized critical technologies are described in the Technology Overview in addition to technological challenges, elemental technologies, and desired functions in order to satisfy market and social needs. Improvement and progress of elemental technologies generated from R&D, and enhancement of desired functions are displayed on a time axis as milestones in the Roadmap.


4. Formulation process
- Task forces set up for each field in NEDO (New Energy and Industrial Technology Development Organization) and in RITE (Research Institute of Innovative Technology for the Earth) for "carbon dioxide capture and storage," drew up drafts of the Technology Overview and the Roadmap. Task forces consist of representatives of universities; private companies such as manufacturers of goods, components, materials, and equipment; METI, NEDO, and AIST (National Institute of Advanced Industrial Science and Technology), to reflect the expertise of industry, academia, and public institution.
- Since July 2004, meetings of the Research and Development Subcommittee of the Industrial Science and Technology Policy Committee under the Industrial Structure Council (chairperson: Hiroshi Komiyama, former Vice President of the University of Tokyo) have been convened four times to discuss the drafts. In addition, specialized meetings consisting of members of the Subcommittee were held.

5. Utilization and management of the STR
1) Utilization of the STR
The STR is provided to be utilized as a reference for the study of R&D strategy and contents among industry, academia and government. The STR will be used when METI develops new R&D policies and assesses ongoing ones, taking into consideration role-sharing between industry and government, business environment, and the utilization of intellectual properties. Utilization of the STR is proposed as a method for allocating public R&D resources.

2) Management of the STR
The contents of the STR are regularly revised for updates, which is called "rolling," based on technology and market trends. The STR is posted on the websites of METI and NEDO to enable broad public access. Through the above-mentioned two measures, repetitive accumulation of information about and knowledge of R&D, as well as formulation of a network of personal contacts, are accomplished.

6. Features
1) Formulating the STR is the first attempt ever not only by METI but also by Japanese government as a whole.
2) Major features of the contents are as follows:
   i) They consist of three parts that indicate R&D achievements and relevant policies.
   ii) They enable the compact showing of necessary elemental technologies, relevant policies, and other relevant information.
   iii) They lay out the concept of critical technologies in each field, and prioritize specific ones.
   iv) They comprehensively cover necessary technological fields to fill market and society needs.
3) A total of approximately 300 members were involved to study and discuss the STR under task forces, such as front-line junior researchers and those who actually use products and receive services, i.e., users, manufacturers, and medical/care workers, in order to reflect comments and advice of users’ side. In addition, fundamental technologies, technology fusion, and interdisciplinary issues were discussed.

Source: Ministry of Economy, Trade and Industry (2005)
http://www.meti.go.jp/english/information/data/TechMape.html
India has set R&D priorities in several knowledge-intensive industry sectors and clusters: ICT software, pharmaceuticals, automotive, biotechnology, nanotechnology, agriculture and SME clusters. In the strategic sectors, one can include atomic energy, space, defence and electronics. India’s main objective is to take advantage of internationalisation of R&D and globalisation of innovation through developing national and local science, technology and innovation capacities (including S&T infrastructure and highly skilled human resources). The corresponding policy objective is to enhance the rural, local and regional (state level) and national knowledge based technological capacities and threshold levels. Here, the thrust is being given to education and training in various skills for a diverse sectoral needs and demands. The other main objective at the sectoral level is to foster public – private partnerships mainly in pharma, biotechnology, automotive and ICT software sectors of the economy. For instance, the Indian ICT sector (IT services, BPO, IT enabled services and engineering services and R&D Products) performance witnessed a ten-fold increase in the last ten years. The sector has set a milestone of 60 billion US$ by 2010.

New Zealand has developed a wide range of sector or issue-specific strategies and reports with relevance for the national science policy during the last couple of years. This include but are by no means limited to the following: the Biodiversity Strategy 2000 (Department of Conservation), Biosecurity Strategy 2003 (Biosecurity NZ & Ministry of Agriculture and Forestry), Biotechnology Strategy Biotechnology Strategy 2002 (MoRTS), Biotechnology Industry Taskforce report (2002), Climate Change policy (Climate Change Office, MFE), Government Memorandum of Understanding with agricultural sector on greenhouse gas mitigation research in agriculture (MFE, 2004), Sustainable Development Programme of Action: Sustainable Energy 2003 (MED), National Energy Efficiency and Conservation Strategy 2001 (EECA), Health Strategy 2000 (Ministry of Health), ICT Industry Taskforce report 2003 (MED), Digital Strategy 2005 (MED, e-government strategy 2003).

Under the label 'Roadmaps for Science', the Government has launched a new instrument designed to guide New Zealand’s science and research activity. The intentions with the roadmaps are to provide a New Zealand perspective on strategic context and high-level directions on a particular area. So far the following roadmaps have been published: Energy Research Roadmap, Nanoscience and Nanotechnologies, Biotechnology Research, Environment Research. They are not technological roadmaps in the traditional sense with "milestones, targets or detailed research plans" - rather they represent the Government’s position on areas of science and how it believes research capabilities should develop to best meet New Zealand’s future needs.

In South Korea, pursuing its ambitious vision of becoming one of the leading nations in the world in S&T within the next ten years, the government launched in 2001 the Nanotechnology Development Plan under the framework of the National R&D Programme. In order to establish and expand the R&D infrastructure in this field, the government has also launched several action plans, including the establishment of a Nano-Fabrication Centre, a National Nanofab Centre for human resource development, etc. The Korean government aims to develop 10 nanotechnologies by 2010, and has identified a set of "core" technologies, including nanostructured materials and nanoscale mechatronics. Data released by the Korean government indicate that South Korea has outperformed Britain and France in nanotechnology development, and now ranks forth behind the US, Japan, and Germany. South Korean companies as well as the Korean government, continue to show strong investment in nanotechnology in various industries such as semiconductors, medicine, chemicals and microscopic mechanics. The Ministry of Science and Technology aims to place Korea as one of the top three nations in nanotechnology development by 2015. The Korean government has rapidly increased its investment in nanotechnology from 83 billion won (US$80 million) in 2001, to 277 billion won (US$277 million) in 2005. In addition,
the number of nanotechnology courses offered in universities has almost doubled, from 17 in 2002, to 31 in 2004.

The government also formulated “Biotech 2000” which is the basic plan for the development of biotechnology. The plan is being executed in three stages over a period of fourteen years. It is currently in its third stage (2002-2007). Through the plan, Korea aims to attain technological competitiveness in the area of biotechnology, with a view to joining the ranks of the G-7 by the year 2010 (see Box 3 below).

### Box 3 - South Korean biotechnology: a rising industrial and scientific powerhouse

In 1994, seven government ministries signed onto the 'Biotech 2000' plan, in which the government hoped to make South Korea one of the world's top seven biotechnology-producing countries by 2010. A survey of respondents, company web sites and other sources, such as the Bioindustry Association of Korea suggests that between 450 and 600 Korean companies are using some aspect of biotechnology in their business. This covers brand and generic pharmaceutical firms with a business plan to diversify into biotechnology R&D as well as start-up firms involved in cutting-edge biotechnologies (e.g., regenerative cell therapy). Therefore, the number of enterprises created solely for the purpose of healthcare biotechnology may be somewhat lower.

A glimpse at the Korean stock market illustrates the recent explosive growth in Korean biotechnology: in 2000, only one South Korean biotechnology firm was publicly listed; by 2002, there were 23. These firms are focusing their efforts primarily on the development of new brand drugs, medical devices, bioinformatics and functional genomics research. According to government figures, over one-third of biotechnology products being developed in South Korea are in the biomedical field and the product pipeline is growing. Over 40 South Korean pharmaceutical firms have 130 new drugs in either phase 1 or 2 clinical trials. South Korean life science ventures, such as Macrogen (Seoul) and Bioneer (Daejeon, South Korea), are capitalizing on the post-genome era, and are beginning to gain an international reputation in DNA sequencing and synthesis.

These supply-side investments are beginning to pay off in terms of scientific productivity. The number of health biotechnology-related publications by South Korean researchers increased tenfold from 1992 to 2002. In addition, on the basis of a July 2004 analysis of the United States Patent and Trademark Office's database from 1991 to 2002 patents including South Korean inventors' addresses also increased, particularly rapidly in the mid-1990s. According to one respondent, the Korean Intellectual Property Office granted over 800 genetics and biotechnology patents to domestic inventors in 2002 alone.

South Korea is thus emerging as a player in the global biotechnology scene. It is catching up with other Asian countries, such as Japan, and keeping pace with regional competitors like Taiwan, Singapore and China. Winning the bid in 2000 to be the permanent host of the International Vaccine Institute confirmed South Korea's strong global reputation in the field (...). It is clear South Korea is positioning itself to become a major contributor to both life science R&D and its commercialization in the near future. The country’s success in developing high-technology brands, which started with the automobile sector and in information technology, increases the likelihood of its success in healthcare biotechnology (...).

Source: selected from Wong, Quach, Thorsteinsdottir, Singer and Daar (2004), Nature Biotechnology 22.

The US system does not have an explicit policy to promote certain industry sectors. Most public financing of R&D at the federal government level is mission-driven, focused on the priorities given to particular agencies. Defence-related R&D constitutes more than half of public R&D, over $83 billion (€66 billion) proposed for fiscal year 2008. Most defence-R&D is allocated to large-scale development projects rather than to “blue skies” long-term research. Despite this focus on mission, defence-funded research has yielded many technologies with important dual civilian uses.

Biomedical research grew significantly during the 1990s as a result of a doubling of research funding. The largest manager of civilian R&D is National Institutes of Health (NIH). NIH has a budget in more than $28 billion (€22 billion), managed as separate
research portfolios by the 20 research institutes within NIH. About four-fifths of NIH’s R&D budget funds extra mural research, mostly following peer-review of applications made in response to grant solicitations. There are three main interagency initiatives which promote research targeted to particularly technologies: National Nanotechnology Initiative (proposed for $1.4 billion/€1.1 billion) in the President’s fiscal year 2008 budget), Networking and Information Technology R&D (proposed for $3.1 billion/€2.5 billion), and the Climate Change Programme (proposed for $1.5 billion/€1.2 billion).

3.2.3. At stakeholders level

In Australia, the Action Agendas are a central element of the Government’s industry strategy. Their primary purpose is to foster industry leadership, and in doing this they have succeeded in helping industries develop strategies for growth, agree on priorities and make commitments to change. Their focus is on the actions industry itself can take to achieve its objectives. High-level industry commitment is a pre-requisite for an Action Agenda proceeding in a particular industry. Whole of government access is provided to address issues including research and innovation and education and training. They have been developed for some 38 sectors, which account for about a third of Australia’s GDP and employment, about half of export earnings and around 75 per cent of the business investment in R&D.

Brazil stakeholders’ participation is associated with various thematic networks in strategic areas that are funded through the National Research Programmes (e.g. nano-sciences and nanotechnology, bio-fuels) and several other energy and mineral resources programmes (e.g. renewable energy, mineral resources; genomic studies, semiconductors, software, certification and standardization among other so-called technological services to firms and research institutions). More traditional and older programmes (e.g. Nuclear; Space; Antarctic, and Meteorology, Climatology and Hydrology) have been joined recently by the Social Technology Network (2003) with almost 500 associated institutions, including several from other Latin American countries, which aims to develop and promote sustainable development technologies. The Social Technology Network is complemented by several other social inclusion programmes, including Local Productive Arrangements, Vocational Technological Centres, Digital Inclusion and Diffusion and Popularisation of S&T programmes.

In Canada, most major innovation policy initiatives involve stakeholders. Typically, these are industrial actors and supporting institutions such as governmental agencies, research institutions, and institutions of higher education. In some cases, broader groups of citizens are involved. The three policy agendas that typically mobilize stakeholders are competitiveness, health, and environmental sustainability. One example of stakeholder involvement in innovation policy is Canada’s Technology Road mapping exercises. Technology Roadmaps are the result of a consultative process designed to help stakeholders (industry, suppliers, academic and research groups, and governments) identify and prioritise the technologies in supported of strategic decisions regarding R&D, marketing and investment (see Box 4). The technologies are ones that are expected to be critically important to industry within 5-10 years. To date, 22 industry-led Technology Roadmaps have been developed.
**Box 4 – Canada's Technology Roadmaps**

The Technology Roadmap (TRM) concept is a consultative process that is designed to help industry, its supply-chain, academic and research groups, and governments come together to jointly identify and prioritize the technologies needed to support strategic R&D, marketing and investment decisions. These technologies will be of critical importance to an industry in the next five to ten years.

In developing a TRM, companies within a sector come together in a joint commitment to identify the critical technologies as well as the skills required to properly utilize the technologies of the future. The TRM, there, is a means to achieve a joint decision on future research and development, future skills development, and to establish a commitment to work together to address these challenges.

The TRM process in Canada is led by industry and facilitated by government. Technology Roadmaps (TRMs) are a process tool to help Canadian industries, or sectors within an industry, identify and address the technology challenges that are critical to their future.

A synthesis of six TRMs undertaken by Industry Canada concluded that overall, TRMs were viewed as worthwhile exercises. Evaluation findings suggested that industry members recognized the potential value of Technology Roadmaps, and believe that Industry Canada provided a very important contribution to the initiatives. These factors contributed to participants’ staying committed to the Phase 1 TRM process until completion.

The progress of a TRM appears to be influenced by a number of factors. It appears that having a facilitator is essential to a TRM and that the TRM collaborative approach adds significant value. Also, assessing an industry's readiness for a TRM is important, particularly the importance of industry-wide issues, an industry's ability to converge on a set of critical technologies, and the speed of an industry's technology development.

**Lessons Learned**

Emphasizing the following success factors will optimize future TRMs' added value to participants and to the concerned industry:

1. TRM's benefit from having a facilitator to help provide direction, momentum, enabling mechanisms, and overall secretariat services.
2. TRM initiatives should include a diversity of participants that are knowledgeable about the industry concerned, and the private sector should be well represented.
3. TRM initiatives should be designed and implemented so that they include industry champions that are, and are perceived as industry leaders.
4. TRMs should maintain their collaborative approach of bringing together and/or consulting with a wide variety of concerned industry stakeholders.
5. TRMs are more likely to encourage information exchange and partnership opportunities if company executives participate actively in the initiative. Executives will also attract other executives, and will increase the credibility and practical usefulness of the TRM.
6. TRM initiatives will progress more deliberately if Phase 1 generates a clear list of key technologies and a series of related future technology development projects.
7. The timing and design of a TRM initiative should take into consideration the industry's other macro-level business priorities and participants' potential to converge on the industry's critical technologies.

Source: selected from Industry Canada
In **China**, since 2000, the former National Economy and Trade Commission has issued a series of policies to enhance the industrial leadership and firms’ competitiveness in order to establish technological development centre within firms and form a technological innovation system centred on firms.

In **Japan**, stakeholders’ involvement in the research and innovation policy-making process is reflected by special *ad-hoc committees* comprising different stakeholders such as industry and university representatives, which are frequently developed to address technological issues and challenges (e.g. the Information and Communications Council of the Ministry of Internal Affairs and Communications, which has various study groups on particular aspects of Information and communications policy, or similar Committees and study groups in other ministries). Other specific stand alone corporations (*Shadan Houjin*) and committees (*linkai*) also exist. Support for such initiatives by government is not clear however. Many business and scientific representative bodies have embraced the innovation policy agenda. The Japan Business Foundation (Nippon Keidanren), in its new vision addressed in January 2007, emphasizes innovation as the centre of Japanese economic development; with other business organizations such as the Japan Chamber of Commerce and Industry playing a more operational role in developing technology stakeholder platforms. Likewise, the Science Council of Japan (Nihon Gakujutsu Kaigi), a national body representing academic researchers, has established an ad hoc committee for promoting innovation in response to the new Innovation 25 agenda.

**India** has developed research policies directed at different stakeholders such as the private industrial enterprises and civil society groups represented by NGOs. The main objective in relation to the private industrial stakeholders is to foster public – private partnerships (PPP) and enhance the human resources base in higher engineering, medical and science and technology fields, particularly in high technology areas. Specific policies for PPP have been created in areas such as ICT software technology parks (39 existing currently such as Bangalore, Hyderabad, Pune, Noida etc), biotechnology parks, technology innovation incubation units with PPP in Indian Institutes of Technology. Secondly, several civil society groups (NGOs) relating to S&T (generally referred to as people science movements) have come to centre stage of political arena during the last two decades. These groups and various representatives in the fields of environment and forests, large dams, special economic zones for speeding up industrialization process, education and GM technologies are given space in the control and regulatory mechanisms of implementing various S&T policy decisions influencing the society and quality of life of people at large.

**New Zealand’s** Government is committed to engaging stakeholder and the wider population in the formulation and implementation of specific S&T strategies. As mentioned in the previous section, the ‘*Roadmaps for Science*’ intend to provide a strategic perspective on the context and directions in a particular area. The roadmaps published so far (Energy Research Roadmap, Nanoscience and Nanotechnologies, Biotechnology Research, Environment Research) are seen as a major instrument to increase the relative awareness of research as main enabler of the economic transformation of the society. The roadmaps are expected to improve stakeholders’ ability to coordinate their effort within a specific area. Another example on stakeholder involvement is the recent national forum “Capitalising on Research summit”. The summit was organised by the Ministry of Research, Science and Technology, in collaboration with Business New Zealand and engaged a wide range of stakeholders in discussions of research commercialisation.

**South Korea’s** Office of National S&T Strategy and Planning has several teams to support the elaboration of S&T policy. STEPI also play a role to assist the government in developing policies to promote and facilitate innovation by conducting research and analyses on the issues. To listen to the opinions of industry and academy,
some of their members participate regularly in the works of the National Science and Technology Council and Ministry of Science and Technology.

In the US, private sector firms (which undertake about 70% of all US R&D), state and private universities (which conduct research and engage in technology transfer); and professional and scientific societies, industry groups, and private non-profit policy analysis and advocacy organizations play important roles in the R&D system. Examples of involvement of these stakeholders in national policy making include:

- The President’s Council of Advisors on Science and Technology (PCAST) which is comprised of private sector executives and university presidents who make recommendations about science and technology matters.
- The National Academies, which conducts evaluations of scientific areas at the request of Congress through panels of university and business experts.
- Direct interaction with Congress, through members offices and testimony before key committees.

3.2.4. At regional level

In Australia, as a federation, the States have significant responsibilities in supporting R&D policies relevant to their goals of economic development and delivery of services to their constituents. There are no significant policies that have a non-State regional development focus, except for access to infrastructure including telecommunications.

In Brazil, at the regional level, federal government policies are oriented towards using S&T to intensify the regional interaction and reduce regional disparities, but the effort is hindered by limited resources. The major initiative to reduce regional disparities is the umbrella rule of the Sectoral Funds (see Box that determines that 30% of funds to be invested in the poorer Northeast, North and Centre-West regions. In addition some of the fiscal incentives or R&D in firms under the Positive Law (2004) provide larger tax exemptions to firms operating in the North and Northeast legal development programme areas. Some Sector Funds, like Energy-CT-Energy have also set up a specialized human resources training programme for the area in the poorer regions mentioned above. Also the Activity National Proteomic Network have also been organized as a group of 7 state research networks, each one specialized in an area of competence and focused on local product. In addition, the effort to reduce regional inequalities also includes measures at the human resources level, such as the Regional Scientific and Technological Development Scholarship Programme (DCR) promoted by the main scientific research and human resources financing agency CNPq.

In Canada’s federal system of government, the ten provincial governments have considerable powers and are responsible for various domains, e.g. education and healthcare. All provinces have ministries that are responsible for education and industry, and many have specialized ministries of higher education, research, innovation, and S&T, although the S&T portfolio is sometimes found in ministries of industry. Several provinces have specialized scholarly granting agencies. Most have business incentive programmes in place. In addition to its line departments that have national scope, the Federal government has four regional economic agencies, which provide support to business development through loans or grants, and they often manage programs that are dedicated to the technological development needs of the communities and regions they serve. They work closely with economic development ministries in the respective provinces.

At the regional level, China’s Ministry of Science and Technology (MOST) has as main objective the reduction of regional disparities and allowing regions to benefit
from increased research and innovation. To this end, the Ministry issued the ‘Suggestions on how to Strengthen S&T of Western Development and the Tenth Five-year Plan on Western Development’, and implemented a plan for reducing “digital disparities. Moreover, MOST launched West Development Specific Programmes, and granted 70 million yuan annually to support S&T development in western China. In order to push the S&T development in North East China, MOST launched “S&T Action to Renew North East Region’s Old Industrial Base”, and set up the specific fund to support S&T development in that region. The priorities are to strengthen equipment manufacturing industry, modern agriculture, traditional medicine modernization and software industry internationalisation etc. In addition, MOST also took measures including the establishment of a specific fund to support the S&T development of Tibet and Xijiang Uygur Autonomous Region of China.

In Japan, various policies have been put in place since the late 1980s by the central government to support regional innovation systems. Article 4 of the Science and Technology Basic Law introduced a special responsibility for local governments in terms of “formulating and implementing policies with regard to the promotion of S&T corresponding to national policies and policies of their own initiatives”. National programmes have been funded through the Basic Plans in combination with local initiatives. Furthermore, national cluster initiatives since 2001, implemented by two Ministries (METI and MEXT) have enhanced the expectation from local governments for universities to play a greater role in promoting knowledge-based local clusters. In 2004, the National University Incorporation Law (2004) has seen many universities, particularly those in the regions, seeking to develop stronger links with regional firms. In July 2006, METI published the New Economic Growth Strategy in which promoting regional innovation and international industrial collaboration are seen as key for economic growth. The Basic Principles of FY2007 Budget Formulation notes that further devolution of funding for regional governments is set to continue.

Main regional policy themes can be recognised as:
1. Developing Regional Research Capabilities, Technology Transfer and University-Industry Links, including: the Knowledge Cluster Initiative (MEXT), the Industrial Cluster Initiative (METI), Regional R&D Resources Utilisation Promotion Programme (2007-; formerly known as Regional Concentrated Collaborative Research Development) (JST), Regional Resources Utilisation R&D Programme (METI), New Regional Consortium Research Development Programme (METI);
2. Developing Innovative Research Capabilities with Firms, through: New Regional Consortium Research Activity Support Fund (METI), SME New Regional Consortium Research Activity Support Fund (METI SME Agency), New Firms Creation Technology Development Programme (METI);
3. Vocational Training, through Promotion of Practical Vocational Training in Outlying Regions;
4. Environmental Research, through a Regional Environment Comprehensive Research Promotion Fund (MOE)
5. Deregulation at the local level, through Special Deregulation Zones (METI)

The number of competitive funds for regional innovation is increasing, while there is a perception that regional disparities are a problem which may require some policy instrument.
India, as a federal form of government consists of 28 States and seven Union Territories. In the Indian context, the ‘regional’ dimension can be considered at the States level. The States, their governments and locally elected legislative bodies in India are relatively autonomous in formulating and implementing state level research policies. Such policies are articulated generally through State level Science and Technology Councils and various state level ministries. States such as Karnataka (Bangalore STP), Andhra Pradesh (Hyderabad STP), Haryana (Gurgaon STP), Maharashtra (Pune STP), Uttarakhand, Orissa, Uttar Pradesh (Noida STP) have promoted ICT based policies with Central government, during the last decade, to contribute to India’s growth as software power in the world.

In New Zealand, in August 2006, the Cabinet agreed to refresh the framework for regional policy as part of the government’s economic transformation agenda. One of the government's goals with the renewed policy is to improve the quality of the regional business environment to support the development, attraction and retention of globally competitive firms. The cornerstones in the new regional policy as outlined in the Cabinet paper “Boosting the Impact of Regional Economic Development: Detailed Changes” are to a) reduce the number or regional groupings from 26 to around 14 focus and b) encourage regions to develop robust regional economic development strategies and undertake activities arising out of their strategies (see Box 5).

The increased autonomy of regions in developing and implementing their own sustainable economic development plans is reinforced by the ongoing tertiary education reform (see e.g. “Investing in a Plan – A New System for Investing in Tertiary Education”). According to this new plan, tertiary education organisations (TEO) will in the future be encouraged to increased specialisation and to focus on developing their strengths to meet the needs of both the region in which the TEO is anchored and the nation as a whole.
In August 2006, the Cabinet agreed to refresh the framework for regional policy. The government's goal for refreshed regional policy is to improve the quality of the regional business environment to support the development, attraction and retention of globally competitive firms. This ensures that regional policy is clearly aligned with the government's economic transformation agenda. This paper sets out how the existing regional policy and the Regional Partnership Programme (RPP) will be reshaped around the achievement of the goal.

To assist with the transition from the current 26 regional groupings to about 14, it is proposed that existing RPP regions be offered up to $0.05m to meet one-off costs directly caused by the aggregation of RPP regions and the establishment of the associated governance structures.

The RPP provided for funding for regional economic development strategy development and capability building. It is proposed that this funding be reshaped as the Enterprising Regions fund. This funding will similarly focus on encouraging regions to develop robust regional economic development strategies and to undertake activities arising out of their strategies. It is proposed that $0.75m be available to regions over a three year period, with flexibility in accessing this funding. This funding will encourage regions to take a longer term perspective, and to take a productivity based approach to improving the quality of the regional business environment to support the development, attraction and retention of globally competitive firms.

It is proposed that Major Regional Initiative (MRI) funding be reshaped as the Enterprising Partnerships Fund. This fund will be available for regionally based projects that are commercially driven, generate substantial economic benefits for the region, and align with national goals and priorities.

The Enterprising Partnerships Fund will be a contestable fund, with funding decisions made by Cabinet. Projects to be funded will be selected based on their merits relative to other projects, as well as their ability to contribute to both regional and national economic outcomes. It is proposed that up to two funding rounds be held per year. The total amount of funding available per year will vary subject to the other commitments outlined in this paper, and will be approximately $9m in 2007/2008, $10.5m in 2008/2009 and 2009/2010, and $11.5m in 2010/2011 and outyears. (…)

This paper also proposes a number of work items designed to support the refreshed approach to regional economic development. These will be undertaken collaboratively, including Local Government New Zealand (LGNZ) and the Economic Development Association of New Zealand (EDANZ), and will be reported to the Minister of Industry and Regional Development by 14 December 2007. These are:

- Communicating national goals and priorities. This will help build the economic development capability of regions by ensuring that they have access to the best information for developing strategies and identifying and exploiting economic opportunities. It also helps ensure that regional activity is aligned with the achievement of national economic goals.

- Stocktaking of current central government activity at the regional level that affects the regional business environment. This will provide useful information to regions, and from a central government perspective, will provide information on whether there are any gaps, overlaps or inconsistencies that need to be addressed or managed.

- Regional Coordination Models. There are currently a range of different models in place for coordinating central government input into regional economic development processes. There will be significant value in analysing the different models to determine what works and what doesn’t work in different circumstances, as well as capturing some of the learning and experiences from implementing and working with different models.

Source: Ministry of Economic Development
In South Korea, the government has been expanding the ratio of R&D for regional innovation. For example the R&D expenditure changed from 27.0% in 2003 to 39.8% in 2007, but there were some limits to strengthen the role of the regions. For example, the government research centres (GRIs) are concentrated in some regions. Also industrial companies show a high degree of concentration in some regions, but many regions have insufficient amount of infrastructure for innovation.

In the US federal system, the national government does not take a large role in specific policies to promote regional R&D. One noticeable exception is that the federal government does take some responsibility for regional S&T development through a handful of programmes to help states address science and technology policy needs. One example of this is the Experimental Programme to Stimulate Competitive Research (EPSCoR) which is a multi-agency programme created to build up regional capabilities for the conduct of research in US states and territories that in the past have received smaller amounts of federal R&D expenditures. At the federal level, Congress has an influence on the distribution of research funding via “earmarks” or investments specified for a particular use at a particular location which are incorporated into the language of broader pieces of legislation.

The most dynamic aspect of regional-level activity comes from the bottoms-up policies and initiatives of states and localities. States encourage research through state universities, and an increasing number of states have developed explicit policies and programs to strengthen and target state R&D capabilities. Examples include

- California’s Research and Innovation Initiative, which allocates $95 million (€76 million) for green energy research⁷

- Georgia Research Alliance (GRA), which was created in 1990 as a collaborative research initiative involving six research universities in the state to enhance their capabilities through investments primarily in eminent scholars in targeted research areas.⁸ (see Box 6)

States tend to be more active in commercialising research than in the funding of it. Nearly every state houses programmes supporting incubators, seed capital funds, technology licensing offices, technology transfer specialists and the like. The State Science and Technology Institute is a clearinghouse and exchange forum for state activities in research and innovation.

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In 1990, a group of Georgia's leaders envisioned business, research universities and state government coming together to build a technology-driven economy fueled by innovative university research.

The plan was to attract the world’s pre-eminent scientists to Georgia’s universities to lead extraordinary programs of research and development in areas with the most potential for generating new high-value companies, helping established companies to grow and creating new high-wage jobs. The cadre of Georgia Research Alliance Eminent Scholars would:

- Compete successfully for a larger share of federal and foundation research funds.
- Attract other talented faculty and graduate students to Georgia.
- Foster new companies and create new relationships with industry to commercialize technologies developed through their research, so that more jobs and economic opportunities could be created for Georgia’s citizens.

With the financial backing of the state legislature, the state’s research universities, private foundations and other supporters, the Georgia Research Alliance has focused the last 15 years on marshalling the required talent and resources and driving an effective strategy for achieving these results.

Today, the Georgia Research Alliance is an internationally acclaimed model for bringing business, research universities and state government together to create and sustain a vibrant, technology-driven economy for the state. The Alliance’s affiliated universities are (in order of date founded): The University of Georgia, Medical College of Georgia, Emory University, Clark Atlanta University, the Georgia Institute of Technology and Georgia State University.

The Alliance achieves its goals through strategic investments at the state’s leading research universities in four programs: eminent scholars, research laboratories and equipment, national centres for research and innovation, and technology transfer.

To date, the Alliance has invested some $400 million, which has helped to attract more than 50 Eminent Scholars, leverage an additional $2 billion in federal and private funding, create more than 5,000 new technology jobs, generate some 120 new technology companies, and allow established Georgia companies to expand into new markets.

The extraordinary success of the Georgia Research Alliance in capitalizing on innovative university research to achieve significant economic gains for the state is based on the commitment to its vision ‘Georgia will be ranked among the top tier of states in the nation with a vibrant, sustainable, technology-rich economy’ and core values:

- **Flexibility** in a rapidly changing environment, agility and flexibility breed success.
- **Sharp Focus and Broad Application** - focus on the development and application of those technologies that offer the best opportunity for significant impact on Georgia’s economic vitality.
- **World Class Initiatives** - aspire to the excellence in each initiative.
- **Balanced Interests** - maintaining a balance of interests among partners who must come together to achieve the vision.
- **Collaboration** We promote collaboration among the business, university and government sectors, among industries, among universities and across departments and disciplinary lines. We believe that it is the breadth and depth of our research and development teams that lend singular strength to Georgia Research Alliance initiatives.

Source: selected from Georgia Research Alliance (http://www.gra.org/homepage.asp)
3.2.5. At international level

In **Australia** there has been a strong emphasis on strengthening international collaboration in the past 5-10 years. Part of the 2004 *Backing Australia’s Ability* Programme provided for $94.5 million over nine years to support international collaboration through the *International Science Linkages Programme*, which supports Australian scientists, from both the public and private sectors, to collaborate with international partners on leading edge S&T in order to contribute to Australia’s economic, social and environmental well-being. In addition, the Australian Research Council *Linkage–International programme* provides funding to build collaborations between research groupings or centres of excellence in Australia and overseas, and the National Health and Medical Research Council has established a limited fund to offer support towards Australian participation in projects selected for funding under the European Commission’s *Framework Programme*.

In **Brazil**, international cooperation is mentioned as one of the components of the STI policy strategic axis National Strategic Objectives. However, there are no existing government-wide pro-active policies or programmes, but rather reactive programmes and piecemeal strategic activities in various areas (e.g. nuclear; space). Individual ministries / public enterprises with strong STI components like health (Ministry of Health and its research foundation FIOCRUZ) and agriculture (Brazilian Agricultural Research Enterprise EMBRAPA, under the Ministry of Agriculture, Husbandry and Supply) have developed their own programmes. For example, EMBRAPA has established joint laboratories with foreign institutions for technological prospection (Labex USA and Labex Europe) and FIOCRUZ has promoted bilateral cooperative programme with foreign research executive agencies such as France’s CNRS. Other policies and programmes include: Mercosul tariff and normalization agreements for informatics and telecommunications products, Brazil-Argentine Biotechnology Centre (1986), International Centre for Genetic Engineering and Biotechnology, Brazil affiliated centre.

**Canada** maintains an international network of seven Science and Technology Counsellors and about twenty-five Trade Commissioner Service Officers with S&T responsibilities. The Science and Technology Counsellors monitor S&T policies and programmes in their designated countries or regions and promote S&T collaboration between Canadian public, university, and private actors and their counterparts in the host country or region. Support of international S&T activities is an area in which Canada has sought to improve its performance. The situation has improved in recent years, through the expanded support of international scientific collaboration given by the scholarly granting councils, programmes to encourage international S&T activities of Canadian SMEs, and participation of Canadian teams in certain international research projects, including projects under EU framework programmes.

Current Canadian international S&T programmes are:

- **Going Global**, a programme that supports Canadian research participation in international events.
- The *International S&T Partnerships Programme (ISTPP)*, a five-year, $20-million program to increase bilateral research projects with good commercialisation potential between Canada and Israel, India, China, and Brazil.
- The *Enhanced Relationship Initiative (ERI)* joins Federal S&T departments and university tech transfer offices with Technology Partnering Officers in U.S. Markets.
- The *Canada-California Strategic Innovation Partnership (CCSIP)* illustrates a new breed of international cooperative consortia. It is a platform for the development of collaborative projects between U.S. and Canadian players, with present focus on high-speed connectivity, IT-supported audiovisual collaboration, cross-border in-
vestment barriers, and research on stem cells, nanotechnology, transportation, energy, and infectious diseases.

To be noted is Canada's International Development Research Centre, a federal crown corporation that funds international development research with a budget of approximately $145 million. IDRC enjoys substantial autonomy and in many respects resembles a public-sector philanthropic foundation. Private not for profit sources, most of it performed in the higher education sector. Domestic philanthropic foundation spending on research is relatively modest. The association of Philanthropic Foundations of Canada has over 80 members who manage nearly $5 billion in assets. Most are family foundations that support research in a variety of ways. However, none specializes in research support.

In Canada, R&D funding from foreign sources more than doubled, from $1,049 million in 1992 to an estimated $2,630 million (€1.6 billion) in 2003. Most of this funding comes from private industry outside Canada and is performed by industry in Canada. International public agencies or international intergovernmental agencies are not major sources of R&D funding for Canada. Canadian participation in EU projects is funded from Canadian sources.

China has created the program of “International S&T Cooperation Programme for priority projects” for the first time in its 10th five-year S&T plan. It strives to bring China’s S&T innovation activities in line with international norms, enhance China’s S&T innovation capacity and improve its comprehensive strengths. The programme has been implemented through different measures, including the International S&T cooperation award (which was established in 1992), exchange programs funded by the government and NGOs and technology demonstrations in developing countries.

In Japan there is a strong emphasis on international links both in terms of policy discussion and in policy activity. The CSTP and Innovation 25 Strategy Council frequently emphasize internationalisation and international links in their discussions and the number of programmes with an international dimension have gradually increased since the 1980s. With this the number of international researcher exchanges have expanded and joint projects through the Human Frontier Science Programme, Core-to-Core Programme, International Cooperative Research Project promoted by various agencies have provided more opportunities for international research. There have also been developments to support more strategic international initiatives and the Strategic Fund for Establishing International Headquarters in Universities (JSPS) provides funding for 20 competitively selected universities to develop their own international strategy. Attention is also being directed towards developing “world-class research centres” in Japan (CSTP 2006).

At the international level India has forged international cooperation in nuclear energy, physics, space and communication technologies with USA and more recently, with the European Union. DST, the Indian National Science Academy, the Council of Scientific and Industrial Research (CSIR) and other science agencies have formal divisions for international cooperation in S&T. With USA India is finalizing a nuclear deal for international cooperation to develop peaceful nuclear energy for civilian purposes; and collaborating in the area of agriculture to enhance India’s S&T capacity for agriculture productivity. India is member of European Union’s International Thermonuclear Experimental Reactor (ITER) nuclear fusion energy project. India now is also a partner in the European Union-based Facility for Antiproton and Ion Research (FAIR) project contributing 35 million US$. India recently joined the satellite based navigation system, Galileo Project (European version of USA’s Global Positioning System) and participates in the Framework Programme FP7 for 2007-13.
New Zealand’s strategy for international collaboration is described in the “International Linkages Strategy 2005-2007”. The most important research partners are the EU (New Zealand signed in 1991 an agreement for Co-operation in Science and Technology with the EU) and Australia - New Zealand’s closest ‘neighbour’. The proximity provides substantial potential for close research and science policy linkages and over 30% of New Zealand’s research community already have links with Australian counterparts. New Zealand’s Ministry of Research, Science and Technology actively supports collaborative links with a number of countries by way of bilateral science arrangements, other government initiatives, and funding mechanisms such as the International Science and Technology (ISAT) Linkages Fund administered by the Royal Society of New Zealand.

In South Korea, the International Joint Research Programme, first launched in 1985, has served as a major financial source for international joint research based on bilateral, inter-governmental and inter-institutional agreements. So far, the programme has funded 1,896 joint projects. The international joint projects have been small in scale, and have been used more as a means to facilitate international scientific interactions i.e. scientific exchanges than as projects for serious research and development. The international joint research projects have also been very concentrated on a limited number of countries, such as Japan, U.S.A, Germany, France, Russia, China and the U.K. The program is now being restructured so it can facilitate bona fide international joint R&D.

Most US federal R&D programmes are limited to US-based or owned organisations or companies. However, there are some US programmes with major international elements, such as research on global climate change, the human genome project, public health research in developing countries, and numerous bilateral and multilateral research programmes. The Agreement on Scientific and Technological Co-operation between the EU and the US, signed in 1998 and renewed in 2004, establishes a broad framework for US-EU collaboration in various scientific areas. Under this framework, separate US-EU agreements have been instituted in the areas of fusion energy R&D and environmental research.

The US encourages foreign R&D investment in all but a segment of classified technologies. Nearly $30 billion (€24 billion) of US R&D was conducted by affiliates of foreign multi-national corporations in 2003. At the same time, US corporations have long invested in R&D in other countries, although recent concerns have called into question outsourcing of R&D to China and India (in addition to traditional locations in Europe and Japan). These activities have had an impact on US R&D policies. In the 1980s and 1990s influences from Japan and Europe were evident in US policies around commercialisation of research. Current attention has been directed toward R&D practices in India and China.

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9 National Science Foundation (2007), Linking Multinational Corporations Data from International Investment and Industrial R&D Surveys, NSF 07-310.
4. PUBLIC SUPPORT TO RESEARCH AND INNOVATION

4.1. Key findings

The measures for public support to innovation examined in this section are organised in three main areas that will be discussed below:

a) Human resources
b) Public research base and links to industry
c) Improving the mix of public financing instruments and their effectiveness, including: the mix of financing instruments, direct measures for research and innovation, fiscal measures for research, support to guarantee mechanisms for research and innovation in SMEs, support to risk capital for research-intensive SMEs.

a) Human resources

The development of human resources for S&T is a key policy issue in all the countries examined, which adopted a broad range of policy measures to strengthen human resources for S&T, starting from the improvement of the higher education system to the provision of skilled workforce for industry, attracting young scientists and improve women’s participation in S&T related careers (see Table 4 below).

A strong emphasis is placed on the improvement of the higher education system, with increasing contributions for universities both from the public budget and from the industry (e.g. South Korea’s 2006-2010 Basic Plan for Promoting S&T Human Resources, which gives universities a central role and encourages the partnerships with business). Early identification of talent and full support for training needs, at least through the PhD, is becoming commonplace. A notable development is some countries’ efforts to provide support for the training of scientists at very early career stages, such as China’s programmes for excellent scientific youth, India’s 15 year Career Support Programme that provides scholarships to bright 15 year-old students after high school until PhD and post-doctoral training, or Australia’s programmes to promote an innovation culture in schools.

The supply of trained human resources for S&T takes a specific dimension in the context of Japan’s ageing population or the USA’s concern for declining flows of international scientists after the 9/11 events, and is often combined with initiatives to attract foreign researchers or increase women’s participation in S&T related careers.
<table>
<thead>
<tr>
<th>Country</th>
<th>Policy measure/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>The higher education reform package <em>Our Universities: Backing Australia's Future</em>, including: Science Connections Programme (SCOPE) and Endeavour Programme, Federation Fellowships (Australian Research Council), Science, Engineering and Technology Skills Audit ((Department of Education, Science and Training))</td>
</tr>
<tr>
<td>Brazil</td>
<td>Scholarship programme for Technological Innovation (PIBITI), Software Human Resources Capacity Building Program (FCHS), Various thematic programmes and horizontal programmes, Programme on Technological Development and Innovation Extension Productivity Scholarship</td>
</tr>
<tr>
<td>Canada</td>
<td>Canada Research Chairs programme</td>
</tr>
<tr>
<td>China</td>
<td>Programmes to improve the quality of higher education (Projects 211 and 985), Cheung Kongjiao-Art Programme (Ministry of Education), National Excellent Youth Scientific Fund (National Science Foundation of China)</td>
</tr>
<tr>
<td>India</td>
<td>Creation of the National Knowledge Commission by the Prime Minister (2006), Universities with Potential for Excellence (UPOE) Programme (UGC), Memorandum of understanding for the development of IT workforce (2005) (UGC-NASSCOM), Support for post graduate teaching and research in advanced areas of biotechnology (Department of Biotechnology and Department for S&amp;T), Relocation Fellowships for Women (Planning Commission), 15 year Career Support Programme (Planning Commission)</td>
</tr>
<tr>
<td>Japan</td>
<td>The New Economic Growth Strategy (Ministry of Economy, Trade and Industry), Measures for expanding female participation in R&amp;D (CSTP), Higher education reforms (MEXT): Research Fellowships for Young Scientists (PhD students), International Training Programme; Postdoctoral Fellowships for Foreign Scientists; Award to Eminent Scientists to undertake research in Japan (JSPS), Technology transfer programmes, Comprehensive Strategy for Personnel with Intellectual Property skills</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Skills for the future, Support for high performers, New Zealand S&amp;T postdoctoral fellowship scheme, Te tipu pātaiao fellowships for maori people, Technology for industry fellowships</td>
</tr>
<tr>
<td>S. Korea</td>
<td>2006-2010 Basic Plan for Promoting S&amp;T Human Resources (Korean government)</td>
</tr>
<tr>
<td>USA</td>
<td>The Innovation and Competitiveness Act (HR 4845) and Protecting America’s Competitive Edge through Education and Research (PACE)</td>
</tr>
</tbody>
</table>

**b) Public research base and links to industry**

The initiatives meant to strengthen the links between the public research base and industry typically involve various forms of support for university-industry-government links or small businesses (see Table 5 below). Some relevant examples include: Australia’s *National Innovation Awareness Strategy* and *Pre-Seed Fund*, Brazil’s programmes to foster university-industry cooperation and SMEs competitiveness (COOPERA, Brazilian Technology Network, Yellow-and-Green Fund, PAPPE), India’s programmes for S&T Parks and Software technology Parks, or the SME and cluster development programmes, Japan’s *Technology Transfer Law at Universities* and *Law on Special Measures for Industrial revitalisation* (widely seen as the Japanese version of the US Bay-Dole Act), New Zealand’s *Partnerships for Excellence, Growth and Innovation Pilot initiatives*, *Technology for Industry Fellowships* or the *Pre-Seed Accelerator Fund*, South Korea’s Daedok Innopolis and the US *Advanced Technology Programme*.

The increasing inability to distinguish R&D from industrial policy is reflected in disputes over “subsidies” to industry and how they are to be defined. As the innovation process takes a graduated approach, without clear distinction between stages, due to the resolution of gaps, the terms of this debate are formulated through recognition of the validity of policy input to emerging industries as opposed to support for mature industries. The remaining point of contention will be the appropriate role of govern-
ment in promoting the utilization of advanced technology to revive declining industries. An activist trend in this direction may be discerned, especially when one country’s emerging industry may be another country’s mature industry.

Another trend consists of initiatives designed to fill gaps in the innovation process, whether forward linear from the science base or reverse linear from firm needs, whether expressed by the players themselves, imputed to them by policy-makers, or increasingly through interaction. The common emerging objective, whether implicit or explicit, is to create a “seamless web” from enhancement of the science base to economic growth. Thus, the emergence of relatively new categories/gaps such as translational research, entrepreneurial encouragement and IPR reform are increasingly prominent in the R&D and industrial policy landscape and become issues for policy entrepreneurs, in and out of government, to address.

Table 5 - Policy measures for building stronger links between the public research base and industry

<table>
<thead>
<tr>
<th>Country</th>
<th>Policy measure/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Commercial Ready, National Innovation Awareness Strategy (2006), Pre-Seed Fund, Improvements to the Intellectual Property regime</td>
</tr>
<tr>
<td>Brazil</td>
<td>Programmes to foster university-industry cooperation (FINEP)</td>
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<tr>
<td></td>
<td>- Enterprise Research Support Programme (PAPPE) and the PAPPE-Subsidy;</td>
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<tr>
<td></td>
<td>- Technological Extension programmes (the National Technological Support Programme for Exports (PROGEX); the Mobile Units Programme (PRUMO) for metrology and related services; the Pilot Technological Extension Programme)</td>
</tr>
<tr>
<td></td>
<td>- National Incubation and Technological Parks Programme (PNI)</td>
</tr>
<tr>
<td>Canada</td>
<td>Several public R&amp;D programmes for business innovation opportunities</td>
</tr>
<tr>
<td></td>
<td>Interpretations on Several Issues of Concrete Application of Laws on Handling Criminal Cases of Infringing Intellectual Property (December 2004)</td>
</tr>
<tr>
<td>India</td>
<td>Approach to XIth Plan (2007-2012)</td>
</tr>
<tr>
<td></td>
<td>S&amp;T Parks and Software Technology Parks of India (STPI) Programmes</td>
</tr>
<tr>
<td></td>
<td>Science and Technology Entrepreneurs Park (STEP)</td>
</tr>
<tr>
<td></td>
<td>Entrepreneurship Development Cell (EDC) scheme</td>
</tr>
<tr>
<td></td>
<td>New IPR policy (January 2005)</td>
</tr>
<tr>
<td></td>
<td>SME and cluster development programmes</td>
</tr>
<tr>
<td></td>
<td>Policies to strengthen the Indian national agriculture innovation system</td>
</tr>
<tr>
<td>Japan</td>
<td>Collaborative Research Centres at National Universities (1988)</td>
</tr>
<tr>
<td></td>
<td>Technology Transfer Law at Universities (1998)</td>
</tr>
<tr>
<td></td>
<td>Establishment of Incubation facilities at universities (1998)</td>
</tr>
<tr>
<td></td>
<td>Law on Special Measures for Industrial Revitalisation (1999)</td>
</tr>
<tr>
<td></td>
<td>Law to Strengthen Industrial Technical Ability (2000)</td>
</tr>
<tr>
<td></td>
<td>Incorporation of the National Universities (2004)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Partnerships for Excellence (TEC)</td>
</tr>
<tr>
<td></td>
<td>Growth and Innovation Pilot Initiatives (Growth Pilots)</td>
</tr>
<tr>
<td></td>
<td>Technology for industry fellowships (TIF) Programme</td>
</tr>
<tr>
<td></td>
<td>The Pre-Seed Accelerator Fund (PSAF)</td>
</tr>
<tr>
<td></td>
<td>Incubator support programme funding awards</td>
</tr>
<tr>
<td>S. Korea</td>
<td>New MOST strategy to activate university-industry links</td>
</tr>
<tr>
<td>USA</td>
<td>The Advanced Technology Program (ATP)</td>
</tr>
</tbody>
</table>
c) Improving the mix of public financing instruments and their effectiveness

The measures to improve the mix of public financing instruments and their effectiveness were examined from several angles:

- **Mix of financing instruments**
- **Direct measures for research and innovation** (grants, conditional grants or loans, elimination of rules and practices in national programmes that impede international cooperation and technology transfer, foreign funding of organisations, etc.)
- **Fiscal measures for research** (use of fiscal incentives to encourage creation and early growth of research-intensive firms, fund-raising by new or existing foundations supporting R&D activities, use of fiscal incentives to raise attractiveness of research careers, improvement of fiscal measures for research)
- **Support to guarantee mechanisms for research and innovation in SMEs** (equity investment of venture capital funds or loans, use of guarantee mechanisms to improve access to debt and equity financing for research and innovation activities in SMEs, national and regional guarantee programmes to improve access to debt and in particular equity financing for research and innovation in SMEs)
- **Support to risk capital for research-intensive SMEs** (networking activities for risk capital fund managers and business angels, encouraging the emergence of coordinated risk capital activities, seed and early stages, including incubators and funds established jointly by networks of universities), increasing awareness of research-intensive SMEs about appropriate use of risk capital notably through actions at regional level).

The policy measures reported by the nine countries under each of these headings have been listed in Tables 6-10 below.

Two main approaches have been identified in the efforts to improve the mix of public financing instruments:

1. making funds available directly to firms to assist in the commercialisation of new technology, either through grants, loans or some combination of the two, with differing emphases on funding approaches in different countries and
2. making funds available for collaborations with universities and/or other intermediaries and quasi-intermediaries, including not-for-profit Institutes and government labs to assist the innovation process.

These two basic approaches are not mutually exclusive. They may be combined in various mixes, with sectoral emphases and other priorities mandated or left open-ended to take advantage of new possibilities that may not be foreseen in advance. What is remarkable is that across our nine countries, irrespective of their stage of development, there is an efflorescence of publicly inspired venture capital instruments targeting different phases and stages of firm formation and growth. Indeed, this implicit similarity in focus on aggressively filling gap in the translation of R&D into economic goods may be the driving force that reaches back and stimulates the increase in R&D spend as the pump priming mechanism for these emerging venture capital industries.

The prominence of the venture industry in the formation of growth firms in the US and Europe, from Google to Skype, also provide exemplars that stimulate emulation. Moreover, public venture capital instruments have gone through an evolution, carefully balancing mixes of public and private funds, with the weighting coming out differently in various financial environments, depending upon the readiness of private capital to act. The Israeli Yozma model, in which these lessons were embodied, has, for example, been diffused to Brazil and Italy. The next step is the diffusion of networked les that both group expertise and funds, while also providing mentoring mechanisms, both from more to less sophisticated investment arenas and within them as well.
Table 6 - Policy measures regarding the mix of financing instruments

<table>
<thead>
<tr>
<th>Country</th>
<th>Policy measure/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Australian Research Council’s ‘Linkage Projects’ (part of the National Competitive Grants Programme). NHMRC support for research at the early stage projects with commercial potential.</td>
</tr>
<tr>
<td>Brazil</td>
<td>Grant programmes to PROs adapted to individual needs and specific functions (FINEP) Innovation Financing Loan Programme for enterprises Pro-Inovação (FINEP) Zero-interest loan financing programme for micro and small technological enterprises Juro Zero (2004, FINEP) Pre-investment financing programme APGFOR (FINEP) Programmes of the National Social and Economic Development Bank (BNDES):</td>
</tr>
<tr>
<td>China</td>
<td>863 and 973 Programmes The R&amp;D Infrastructure and Facility Development Programme Programmes of the National Natural Science Foundation of China (NSFC)</td>
</tr>
<tr>
<td>USA</td>
<td>Small Business Innovation Research Programme (SBIR).</td>
</tr>
</tbody>
</table>

Table 7 - Policy measures for research and innovation

<table>
<thead>
<tr>
<th>Country</th>
<th>Policy measure/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Competitive funding, block funding, tax concessions and subsidies</td>
</tr>
<tr>
<td>China</td>
<td>Foreign firms allowed to establish R&amp;D centres with foreign capital</td>
</tr>
<tr>
<td>India</td>
<td>Block grants provided by the Science and Engineering Research Council (SERC) of DST The New Millennium Indian Technology Leadership Initiative (NMITLI) Nano Science and Technology Initiative Private R&amp;D centres and institutions in ICT software, biotechnology and electronics and telecommunications Support to R&amp;D in higher education (UGC) Advanced Composites Programme</td>
</tr>
</tbody>
</table>

Table 8 - Policy measures regarding fiscal measures for research

<table>
<thead>
<tr>
<th>Country</th>
<th>Policy measure/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Financial returns, support mechanisms, finance and other resources</td>
</tr>
<tr>
<td>Canada</td>
<td>Tax credits rather than direct contributions. The Scientific Research and Experimental Development (SR&amp;ED) Programme Fiscal incentives used in some provinces to attract highly qualified scientists Venture capital applied only to a few high-growth potential companies Government also provides VC funds in early-stage development of knowledge industries</td>
</tr>
<tr>
<td>China</td>
<td>Knowledge Innovation Programme</td>
</tr>
<tr>
<td>India</td>
<td>The R&amp;D Cess and Technology Development Board (TDB) Tax incentives for in-house R&amp;D Tax incentives for Special Economic Zones (SEZ) Fund for Improvement of S&amp;T Infrastructure in Higher Educational Institutions (FIST) Home-grown Technologies Programme</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Introduction of a R&amp;D tax credit currently under analysis by the government</td>
</tr>
</tbody>
</table>
Table 9 - Policy measures regarding support to guarantee mechanisms for research and innovation in SMEs

<table>
<thead>
<tr>
<th>Country</th>
<th>Policy measure/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>INOVAR Programme (FINEP, 1999)</td>
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<tr>
<td></td>
<td>INOVAR SEMENTE (FINEP, 2006)</td>
</tr>
<tr>
<td></td>
<td>CRIATEC Programme (BNDES, 2007).</td>
</tr>
<tr>
<td>China</td>
<td>“Note on Strengthening the Building up of Technological Innovation Service System in SMEs” (2000)</td>
</tr>
<tr>
<td></td>
<td>“SMEs Promotion Act” (2002)</td>
</tr>
<tr>
<td></td>
<td>Environment Building for S&amp;T Industries</td>
</tr>
<tr>
<td>India</td>
<td>National Innovation Foundation (NIF), SME Growth Fund</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Venture capital programme, Seed co-investment programme</td>
</tr>
</tbody>
</table>

Table 10 - Policy measures regarding support to risk capital for research-intensive SMEs

<table>
<thead>
<tr>
<th>Country</th>
<th>Policy measure/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Early Stage Venture Capital Limited Partnership</td>
</tr>
<tr>
<td></td>
<td>Venture Capital Limited Partnerships Program (VCLP)</td>
</tr>
<tr>
<td></td>
<td>Biotechnology Innovation Fund (BIF)</td>
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<td></td>
<td>Incubators</td>
</tr>
<tr>
<td></td>
<td>Industry Cooperative Innovation Programme (ICIP)</td>
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<td></td>
<td>Innovation Investment Fund (IIF)</td>
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<td></td>
<td>Intermediary Access Programme</td>
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<tr>
<td></td>
<td>Pooled Development Funds (PDF) Programme</td>
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<td></td>
<td>Pre-Seed Fund</td>
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<td></td>
<td>Renewable Energy Development Initiative (REDI)</td>
</tr>
<tr>
<td></td>
<td>Renewable Energy Equity Fund (REEF)</td>
</tr>
<tr>
<td>China</td>
<td>The Innofund (1999)</td>
</tr>
<tr>
<td></td>
<td>The Small and Medium Enterprises Board</td>
</tr>
<tr>
<td>India</td>
<td>Venture capital for SMEs</td>
</tr>
<tr>
<td></td>
<td>National Venture Fund for Software and Information Technology (NFSIT):</td>
</tr>
<tr>
<td></td>
<td>Credit Linked Capital Subsidy Scheme for Technology Upgrade</td>
</tr>
</tbody>
</table>
4.2. Overview of measures for public support to research and innovation

4.2.1. Human Resources

**Australia** has placed a strong focus on skill issues at the higher and advanced education levels, although the declining support for universities as a proportion of GDP has partly counteracted this effort. A large number of programmes has been adopted in recent years, many of them in the context of the Innovation Statement *Backing Australia’s Ability*, in order to support the higher education sector and the promotion of an innovation culture in schools, the international mobility of scientists, the improvement of work conditions for domestic researchers and of the flow of skilled workforce to industry, the attractiveness of S&T careers to young people, etc. For instance, the Department of Education, Science and Training promoted the higher education reform package *Our Universities: Backing Australia’s Future*, which provides funding for 24,883 new Commonwealth-supported places by 2008 and 2000 additional university places each year in ICT, science and mathematics. It aims to develop a culture of innovation in schools and improve the teaching of science, mathematics and technology. Under the reform package *Backing Australia’s Ability*, several programmes have been implemented, such as:

- **Science Connections Programme (SCOPE)**, which encourages engagement in S&T and engineering
- **Endeavour Programme**, which provides international scholarships for foreign scholars to study or do research in Australia, and Australian scholars to do research overseas;
- **the Federation Fellowships**, promoted by the Australian Research Council to encourage outstanding Australian researchers to return to, or remain in, key positions in Australia;
- **the Science, Engineering and Technology Skills Audit**, promoted by the Department of Education, Science and Training to examine the supply of skills from the education and training system to industry.

**Brazil** promoted several programmes for human resources through the National Council for S&T Development (CNPq):

- **the Scholarship Programme for Technological Innovation (PIBITI)**, which encourages access of university and technical school students to STI careers;
- **the Software Human Resources Capacity Building Programme (FCHS)**, which aims to train 50,000 professionals in public and private institutions in 2006-2012;
- various thematic programmes and horizontal programmes for human resources training in microelectronics, microfabrication, nanotechnology, etc.
- **the Programme on Technological Development and Innovation Extension Productivity Scholarship**, which encourage high quality talents to develop innovation activities.

**Canada** has a very highly qualified labour force, compared to other OECD countries, 45 percent of it having a college or university education. It is part of the Federal government’s long-term goal to develop R&D capabilities in institutions of higher education in preference over internal laboratories. Undergraduate and graduate enrolments in Canadian universities have increased dramatically in the past decade, passing the million mark in 2004-2005. Canada’s HERD/GDP ratio of 0.7% is the second highest among OECD countries, preceded only by Sweden. Canadian universities and colleges are performing an increasingly large share of Canadian R&D. Canadian universities performed about $8.1 billion of R&D in 2003-2004, which accounts for around 35 percent of the national total R&D spending. Given the anticipated sharp increase in rates of retirement of university teaching staff in the coming decade, recruitment and retention are certain to become issues of concern. In order to repatriate or attract top scientific talent to Canadian universities, the Government of Canada created the *Canada Research Chairs Programme* in 2000. This programme will have
established 2000 research professorships in Canadian universities by 2008, at a cost of about $300 million annually. Candidates, who are selected by peer review, receive competitive salaries, reduced teaching loads, a research stipend, and access to infrastructure funding through the Canadian Foundation for Innovation.

The Chinese government’s investment in human resources is reflected by two programmes (Project 211 and 985) that aim to support a few selected internationally recognized universities. Project 211 could be considered as the first national key project that “has been funded intensively in higher education”. Also worth mentioning here is the “Cheung Kongsciao-Art Programme” launched by the Ministry of Education together with Hong Kong officials, in order to involve excellent domestic and foreign academics in the build-up of key schools in China and support them at subsequent stages of their career, including at the international level. In order to encourage young talents, the National Science Foundation of China set up the “National Excellent Youth Scientific Fund” to support the mobility of domestic and foreign scholars in basic nature sciences research and applied research.

In India, human resources policies, particularly in S&T and higher education, are given a top priority in the overarching S&T policies of the government, as India expects to benefit from the big ‘demographic dividend’ in the coming two or three decades, with over 50-60% of the population in the 25–45 years age group. In 2006 the National Knowledge Commission was created by the Prime Minister, with the aim to build excellence in education, increase India’s competitive advantage, promote S&T, create1500 universities by 2015, including 50 national universities. The National Knowledge Commission estimates suggest that in 2006 there were 550 million people in India under the age of 25. Currently the Gross Enrolment Ratio (GER) in higher education is relatively low at 12 (that is 10.481 million students in HEIs in about 360 universities and 17500 colleges affiliated to these universities in 2005-06) compared to 83 for USA, 15 for China and 20 for Brazil. India is targeting to achieve a GERD of 15 to 17 in the XIth Plan period, which translates into reaching the level of approximately 15-17 million enrolments in HEIs by 2012.

India’s human resources policy is reflected by a variety of programmes:
- the Universities with Potential for Excellence (UPOE) Programme was created by the University Grants Commission (UGC) and provides funding for 5 years to foster excellence in 15 universities
- the Memorandum of understanding for the development of IT workforce was concluded in 2005 between UGC and NASSCOM) to support collaborative activities for IT workforce development through curricula, faculty, infrastructure and pedagogy improvements in line with IT Industry requirements. It also provides
- Support for post graduate teaching and research in advanced areas of biotechnology is provided by the Department of Biotechnology and Department for S&T, to promote advanced biotech research in 35-40 university departments and national research laboratories;
- Relocation Fellowships for Women, promoted by the Planning Commission, encourage women in S&T by facilitating their mobility;
- 15 year Career Support Programme, promoted also by the Planning Commission, provides scholarships to bright 15 year-old students after high school until PhD and post-doctoral training;

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In Japan, a key issue for understanding human resource-related policies for S&T is the anticipated decline and aging of the population. Official statistics suggest that by 2020 there will have been a 31% decrease in the young working population. The issue is seen as a key factor influencing the Japanese innovation system and is accorded significant discussion and attention in policy activity. The New Economic Growth Strategy (METI, 2006) states that improvement in human resources is one of the key strategic areas for Japan, emphasising the need for better connection between the different levels of education; greater flexibility in course provision and learning opportunities to enhance creativity, and attracting excellent human resources. In addition to this, the CSTP has also recently discussed measures for expanding female participation in R&D, which is currently under-represented as a proportion of the Japanese S&T workforce. MEXT introduced a number of higher education reforms to strengthen graduate education and support career development of researchers (internships), such as: Research Fellowships for Young Scientists (PhD students); International Training Programme; Postdoctoral Fellowships for Foreign Scientists.

Complementing these are JSPS’s Award to Eminent Scientists (Nobel Laureate scientists) to undertake research in Japan and support to international exchanges of young researchers. Several technology transfer programmes have been introduced to promote academic-industry interactions and developing human resources with special skills: - S&T Co-ordinator Programme (1996), Regional Collaborative Research New Technology Agent Programme (1997), Patent Advisor Programme (1997), introduction of NEDO Fellowships for specialists employed in Technology Licensing Organisations. More recently, the Comprehensive Strategy for Personnel with Intellectual Property Skills (Cabinet Office 2006) has set out a further strategy to increase personnel with IP skills, through expanding graduate school education in intellectual property issues.

New Zealand’s Ministry of Research, Science and Technology has implemented a broad number of programmes to enhance the human resources for S&T, such as:
- Skills for the future - supports science, technology and mathematics at all levels of the education system.
- Support for high performers - reviews the existing support for high performing scientists and design programmes to increase science leadership skills and provide for their increased mobility
- New Zealand S&T postdoctoral fellowship scheme - fosters the development of emerging scientists and future science leaders and provides funding for postdoctoral fellowships and employment support to approx. 22 new fellows each year.
- Te tipu pūtaiao fellowships for maori people – meant to unlock the innovation potential of māori knowledge, people and resources for national benefit;
- Technology for industry fellowships - enables students and experienced researchers to complete R&D projects in companies

The government of South Korea attaches great importance to the issue of human resources for S&T, as reflected by the recent launch in 2006 of the 2006-2010 Basic Plan for Promoting S&T Human Resources. The core programmes for HRST development include 1) promoting the world-class research-oriented universities, 2) promoting research capabilities of S&T post-graduate students, 3) promoting efficient allocation/utilization of HRST through industry-academia-research exchange programmes, 4) improvement of HRST’s welfare and research environments, and 5) promoting life education system for HRST etc. Worth mentioning are also some inter-ministry programmes (MoCIE – MoE) to develop the engineering colleges focusing on industry-academia collaboration for the purpose of raising-up industry demand-oriented S&T personnel. There are 8 universities and 5 community colleges selected to receive fiscal support during 2004-2009, on a total amount of 200 billion wons. Moreover, the certification for engineering education was introduced in 2001
to certify 23 universities and 181 engineering programmes until 2006. Since 2004, sectoral councils for human resources developments have been established.

In the **US**, an important element of R&D policy is the openness of the country to international scientific talent. One in four employees with college degrees in S&T fields are reported to be foreign-born.\(^{12}\) Post 9/11 security-related immigration policies and their impact on the ability to obtain visas have raised concerns about the ability of the US to maintain the traditional in-flows of foreign talent. At the same time, it has been observed many of the most educated American scientists are at or near retirement at the same time that the presence of foreign scholars is declining. The National Education Defence Act of 1958, passed in response to concerns of U.S. lags in math and science in the wake of the launching of Sputnik stimulated these scientists to enter technical fields early in their careers. The number of U.S. students receiving bachelor degrees in engineering, mathematics, computer science, and the natural sciences rose until 1986. However, S&T bachelor’s degrees among American students have since generally declined, while non-technical bachelor’s degrees continued to rise. The *American Competitiveness Initiative* has prompted several pieces of legislation supporting the promotion of talent in science, technology, engineering and mathematics (STEM) disciplines by providing for scholarships and increased teaching training, such as the *Innovation and Competitiveness Act (HR 4845)* and *Protecting America’s Competitive Edge through Education and Research (PACE)*.

### 4.2.2. Public research base and links to industry

**Australia** has adopted several programmes aimed to strengthen the linkages between the public research base and industry, including:

- **‘Commercial Ready’** – a competitive merit-based grant programme that supports innovation and its commercialisation, by offering industry a single entry point to competitive grants for early-stage commercialisation activities, R&D with high commercial potential and proof-of-concept activities. The programme aims to stimulate greater innovation and productivity growth in the private sector by providing around $200 million per year in competitive grants to SMEs between 2004-05 and 2010-11.

- The recent *National Innovation Awareness Strategy* (2006), which is a $35 million 5-year programme aimed to raise awareness in the community and SMEs of the importance and benefits of innovation, entrepreneurship and commercialisation.

- **The Pre-Seed Fund** - addresses the gap between scientific discoveries and commercialisation in universities and public research agencies. The fund supports links between R&D, finance and business communities, and is part of the Innovation Statement *Backing Australia’s Ability*.

These programmes have been accompanied by improvements to the Intellectual Property regime, through a series of amendments to patent legislation meant to bring the novelty and inventiveness requirements for patents closer to international practice, a simplified and less costly way of obtaining trade-mark registration overseas, and a world-class *Designs Act*.

**Brazil** has several programmes to foster university-industry cooperation promoted by the innovation agency of the Ministry of Science and Technology (FINEP). They provide financial loans to enterprises and grants to public research organisations and include:

- **COOPERA** (cooperative RDI projects);
- **PPI-LPAs** (support to public research organisations to solve technological problems and provide technical assistance to Local Productive Arrangements (LPAs));

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- Brazilian Technology Network (RBT), which is a strategic programme for integrating universities, public research organisations, private and public enterprises and financing agencies, supports cooperative projects of PROs and suppliers for competitive import substitution in selected sectors (oil, gas and energy);
- Yellow-and-Green Fund (FVA), which is the main policy funding instrument to foster cooperative research among universities, public research organisations and firms and to increase corporate R&D expenditures.

In addition, several programmes for SMEs support have been promoted recently, such as:
- The Enterprise Research Support Programme (PAPPE) and the PAPPE-Subsidy – this is a programme for cooperative R&D targeted to SMEs, which contributes to the reduction of regional disparities, together with the PAPPE Subsidy - a decentralized implementation programme to fund RDI activities in SMEs, alone or in consortia;
- Technological Extension programmes: the National Technological Support Programme for Exports (PROGEX); the Mobile Units Programme (PRUMO) for metrology and related services, and the Pilot Technological Extension Programme, initially for the capital goods sector.
- National Incubation and Technological Parks Programme (PNI)

Canada has several public R&D programmes for business innovation opportunities, which are promoted and managed at every level of the innovation system, from the individual IRAP Industrial Technology Adviser, who helps a specific small firm find a specific technological solution to a specific problem, to the institutional level in which interface and partnership mechanisms are put in place, to the highest policy levels where partnerships and innovation and encouraged and endorsed by senior political and business leaders. The tendency at present is to expect higher education institutions to improve their effectiveness in economic and social value creation. This can mean innovation for economic growth, and also innovation to improve social welfare.

China’s National Committee of Planning issued in 2002 the *Instructive Notions on Establishing National Engineering Research Centre*, which provide guidelines for setting-up technology centres in firms and encourage the collaboration between LMEs (large and medium-sized firms), universities and research institutions. Also in 2002, the National Economy and Trade Committee, Ministry of Finance, Ministry of S&T and the State Administration of Taxation issued jointly the *National Industrial Technology Policies*, which provide guidelines for structural improvements and industrial upgrading, and encourage the collaboration of industry, universities and research institutes. The document establishes the priorities for public research: IT, biology engineering, advanced manufacturing technology, new materials, new energy, sea technology etc. In 2004, the Expert Group for IPR Protection was set up by the State Council of China, under the coordination of the Vice Premier, and with responsibilities in directing and coordinating IPR protection issues at the national level. The legal protection of IP was further enhanced in 2004 by the promulgation by the Supreme People’s Court of the *Interpretations on Several Issues of Concrete Application of Laws on Handling Criminal Cases of Infringing Intellectual Property*. More recently, in 2006, the *Medium and Long Term Guiding Vision* set out the government policy to establish the technological innovation system centred on the collaboration of firms and academia, and with a market orientation.
India's policy to strengthen links between national labs, universities and industry is synthesised in the Approach to XIth Plan (2007-2012) proposed by the S&T Steering Committee. These tripartite linkages are seen as a top priority by CSIR, DST and UGC and are considered as the new innovation strategy of S&T policies. Over the last decade, the DST and the Ministry of Information and Communication Technology promoted several S&T Parks and Software Technology Parks of India (STPI) Programmes. Indian Institutes of Technology, national laboratories and Universities have begun to promote incubators in various institutions. There are currently 80 operational incubators. All Indian Institutes of Technology, Information Technology and Management have institutionalised organizational structures to foster research – industry linkages. In addition, the Science and Technology Entrepreneurs Parks (STEPs) were created to foster innovation and entrepreneurship. About 15 STEP-s have already been set up and the plan is to increase rapidly their number and operations in the coming years.

Another scheme set up by the UGC to create an entrepreneurial culture in S&T institutions, to foster techno-entrepreneurship for wealth generation and employment of S&T persons is the Entrepreneurship Development Cell (EDC). The EDCs are established in academic institutions (science colleges, engineering institutes, universities, management schools) with adequate expertise and infrastructure. Around 50 EDCs have been supported at various S&T Institutes and universities.

Several SME and cluster development programmes have been recently introduced by the Ministry of Industry, DST and other agencies to network knowledge institutions with the needs and demands of SMEs. Furthermore, policies to strengthen the Indian national agriculture innovation system were introduced by the Indian Council of Agriculture Research, concerned ministries and the planning Commission as a top priority, in order to double the agriculture's share to the GDP from the current 2% or less to 4% in the coming decade.

In January 2005 a new IPR policy was introduced to conform to WTO norms of 20 years protection of patents, instead of 5-7 years as stipulated by the old policy of 1970. This policy is considered as a major shift in IPR policy, as India has not formulated policies such as the 1980 US Bayh-Dole Act, but there is a new policy discourse on this subject currently going on.

Japan has promoted the so-called Collaborative Research Centres at National Universities since 1988 in order to develop stronger links between universities and local firms. Later on, in 1998, the Technology Transfer Law at Universities (1998) allowed universities to establish relations with technology transfer organisations and the setup of incubation facilities at universities. In 1999 the Law on Special Measures for Industrial Revitalisation was promoted, and was widely interpreted as the Japanese version of the US’s Bayh-Dole Act. It was followed in 2000 by the Law to Strengthen Industrial Technical Ability and in 2003 by the Intellectual Property Headquarters (IPHQ) Policy at Universities, meant to strengthen IP culture within universities. In 2004, the Incorporation of the National Universities Law saw IP ownership pass to the national universities. Many universities have gone on to develop their own IP policies, strategies and organisational reforms for liaising with industry. According to surveys undertaken with industry, academic researchers are more enthusiastic to work with industry than previously, yet debate continues on the viability of the system considering the cost basis, and the overall effectiveness vis-à-vis the more informal technology transfer system.
New Zealand’s policy to strengthen the links between the public research base and industry is implemented through several programmes, such as:

- **Partnerships for Excellence (TEC)**, which aims to increase private sector investment in tertiary education and foster better links between tertiary education institutions, industry and business.

- Growth and Innovation Pilot Initiatives (Growth Pilots) – which support pilot projects between tertiary education organisations (TEOs) and businesses

- Technology for industry fellowships (TiF) Programme - enables students and experienced researchers to complete R&D projects in companies

- The Pre-Seed Accelerator Fund (PSAF) - supports experimental development and related pre-commercial activities that develop research undertaken by public sector research providers to an 'investor-ready' point.

- Incubator support programme funding awards - provide financial support to approved New Zealand incubators. So far $14.8 million has been awarded since the programme was established in 2001.

In South Korea, the government has only recently started to promote some policy measures to strengthen the weak academia (university and government research institutes) - industry interaction. Such interaction was hindered by the low of absent technological and absorptive capability in the business sector and its lack of interest in technology diffusion, inability of universities and government research institutes to solve business’ technical problems. The new MOST has been planning to activate R&D collaboration between academia and industry. There were two cases showing the results of the new MOST strategy: the establishment of Graduate School of Automobile Technology at Korea Advanced Institute of Science & Technology, and the strengthening the role of ‘Daedeok Innopolis’.

In the US, the federal government is considered to place much more emphasis on research than on innovation policies and programmes. The small numbers of prominent innovation programmes that connect research with commercialisation are not in favour in the current administration. The Advanced Technology Programme (ATP) is a case in point. Administered by NIST, ATP offers matching federal funds to companies engaged in applied research in high risk technology areas. The programme also has favoured joint ventures in some of its solicitations. ATP was created in the Omnibus Trade and Competitiveness Act of 1988, to address national concerns that the lack of a government-industry joint R&D programme was placing the US at a competitive disadvantage with Japan and other countries. ATP works through a solicitation call, resulting in bottom-up submissions from industry which are selected through a peer review system. ATP has made approximately 770 awards totalling $2.3 billion (€1.8 billion), which has been cost shared by private industry. Most of the awardees are small high tech firms in fields such as electronics and photonics, information technology, advanced materials, and biotechnology. However, the current administration has recommended the phasing out of ATP, although Congress has continued to put forth some funds to maintain it.
4.2.3. Improving the mix of public financing instruments and their effectiveness

4.2.3.1. The mix of financing instruments

**Australia’s** policy to encourage long-term alliances between university researchers and industry, government and community organisations is exemplified by the Australian Research Council’s ‘Linkage Projects’ (part of ARC’s National Competitive Grants Programme). The programme supported 488 new collaborative research projects and awards worth $116 million over the five years to 2009, which attracted $173 million in matching contributions in cash and in-kind from partner organisations. Linkage Infrastructure approved 78 applications for funding which represented a commitment of $30.4 million. In addition, one can mention the NHMRC support for research at the early, proof-of-concept stage which demonstrates commercial potential. Grants for research commercialisation rose from $0.4 million in 1999 to $9.2 million in 2002. The total budget rose to $411 million for health and medical research in 2004-5.

**Brazil’s** innovation agency FINEP has implemented several grant programmes to public research organisations adapted to individual needs and specific functions, such as PROINFRA for the modernization of infra-structure and maintenance; MODERNIT to restructure and re-orient technological research institutes; PROPESEQ for S&T research projects in strategic sectors by individual PROs or organized in thematic networks; EVENTOS for seminars, congresses, technology fairs and meetings. On the enterprise side, FINEP introduced an Innovation Financing Loan Programme for enterprises Pro-Inovação, a Zero-interest loan financing programme for micro and small technological enterprises Juro Zero (2004), which was designed as a regional programme, initially implemented in 5 regions, and a Pre-investment financing programme APGFOR. In addition, the National Social and Economic Development Bank (BNDES) added to some older sectoral RDI loan financing programmes in pharmaceutical (PROFARMA) and software (PROSOFT), some new loan financing programmes (2006), for more radical innovation (Inovação - PDI) and for incremental process innovation and technology transfer (Inovação - Produção).

**China** has two relevant programmes for enhancing the mix of public financing instruments:

- **863 Programme**, which aims to boost innovation capacity in high-tech sectors, particularly in strategic high-tech areas, to increase international competitiveness, achieve national economic and security objectives; provide high-tech support to strategic objectives in the 3rd step of the country’s modernization process.
- **973 Programme**, which is based on the existing basic research programmes conducted by the National Natural Science Foundation and early-stage basic research key projects. It has the strategic objective to mobilize China’s scientific talents for innovative research in agriculture, energy, information, resources and environment, population and health, materials, and related areas, in accordance with the objectives of China’s economic, social, and S&T development goals up to 2010 and the mid 21st century.

In addition, the **R&D Infrastructure and Facility Development Programme** is a major component of the national S&T planning system in the 10th Five-year Plan period. It aims to strengthen the national S&T research base and rationalize efforts to build up S&T capacity. It supports basic S&T activities involving basic data and national standards, resource specimens, etc. and provides shared resources and conditions for scientific research and technical development. Furthermore, the Programmes of the National Natural Science Foundation of China (NSFC) support basic research and applied research, by identifying and fostering scientific talents, promoting S&T through sponsoring projects. Projects are divided in General Programme, Key Programme, Major Programme and Special Fund projects.
In India, during 2002-05 around 77% of GERD was provided by the government and the remaining 23% by the private sector. Around 50% of the GERD is consumed by the strategic sectors (atomic energy, space and defence R&D), and the rest of 50% is accounted by the civilian R&D sectors.  

In the US, the Small Business Innovation Research Programme (SBIR) is one of the major federal programmes for supporting R&D in small businesses, created in 1982 to raise US small businesses capabilities to meet federal R&D requirements. Eleven federal agencies with extramural R&D budgets of $100 million (€80 million) or more reserve 2.5 percent of their R&D funding for SBIR applicants. Phase 1 awards offer up to $100,000/€80,000 to conduct feasibility analyses, while Phase 2 awards offer up to $750,000/€598,000 to fund further proof of concept work. Phase 3 commercialisation of the product or technology into the marketplace is hoped for, although no federal funds support this activity. SBIR resulted in more than $2 billion (€1.6 billion) in awards, comprising 4,305 Phase I awards ($497.1 million/€395.9 million in total funding) and 2,044 Phase II awards ($1,517.5 million/€1,208.6 in total funding) in fiscal year 2004.  

Studies have suggested that there is a relationship between SBIR funding and receipt of private sector venture capital.

4.2.3.2. Direct measures for research and innovation

In Australia, the current arrangements used to provide public support for science and innovation, include competitive funding, block funding and tax concessions and subsidies. The competitive funding consists of:

* peer reviewed competitive grants — allocation is on the basis of quality in response to researcher initiated proposals (ARC and NHMRC research grants)
* competitive tenders against predefined objectives — precise project objectives and outcomes are specified by the funding agency (Rural R&D (RRDC) funded research)
* other competitive grants and loans — Cooperative Research Centre (CRC) grants, Commercial Ready (industry R&D support programs) and industry-specific grants like Pharmaceutical Partnerships Program and the vehicle producers.

The block funding includes:

* mission driven block grants — funding provided to public agencies with defined missions in which the recipient agency is responsible for internal allocations of this funding (CSIRO, ANSTO, DStO)
* formula based block grants — grants for which the funding between competing recipients is determined entirely or to a large part by a formula (eg university operating grant funding expended on R&D).

Tax concessions and subsidies include:

* the R&D Tax Concession and Tax Offsets for any firm undertaking eligible R&D activities; it allows companies to deduct up to 125% of qualifying expenditure incurred on R&D activities when lodging their corporate tax return. A 175% Incremental (Premium) Tax Concession and R&D Tax Offset are also available. At 30 June 2005, a total of 2 355 companies intended to claim the R&D Tax Off set for the 2003-04 income year and 891 companies intended to claim the 175% Premium R&D Tax Concession for 2003-04.
* subsidies and grants - including industry specific support to the automotive and the TCF sectors.

The percentage distribution by mode of delivery for 2003-04 is estimated as\(^\text{16}\):
- formula-related block grants — 32%
- mission driven block grants — 27%
- peer reviewed competitive grants — 15%
- other competitive grants and loans — 10%
- tax concessions and other subsidies — 9%
- competitive tenders against pre-defined objectives — 7%

**Brazil** has the *Economic Subsidy Programme* that provides grants to finance RDI activities in firms in PITCE priority areas, strategic horizontal areas and future building activities. One component of this programme is Economic Subsidy – Researcher in Enterprise 2006 programme, which aims to place qualified research in corporate R&D labs. In addition, the National Social and Economic Development Bank (BNDES) has re-launched in 2007 its innovation grants program FUNTEC.

In **China**, the former Ministry of Foreign Economy and Trade issued in 2000 a document allowing foreign firms to establish R&D centres with foreign capital.

**India** reports several types of direct funding:
- **Block grants** provided by the Science and Engineering Research Council (SERC) of DST - SERC is the main body to fund basic research through block grants to mission-oriented science agencies in the civilian and strategic sectors, complementary to the budgetary sources.
- **The New Millennium Indian Technology Leadership Initiative (NMITLI)**, which fosters partnerships between public research systems and industry and enables them to attain global leadership position in a few selected niche areas. CSIR supported 50 projects involving 71 industry partners and 250 R&D institutions, with a budget of over rupees 4000 million.
- **The Nano Science and Technology Initiative**, which provides support to about 100 research projects on the synthesis and assembly of nanoproducts. Similar initiatives have been launched by CSIR, DBT and other agencies.
- direct funding provided by private R&D centres and institutions in ICT software, biotechnology and electronics and telecommunications - over 100 of the Fortune 500 companies in ICT software, biotechnology and electronics and telecommunications have set-up R&D centres and institutions in Bangalore, Hyderabad, Calcutta, Gurgaon, Pune and Noida, with approx. R&D investment close to 1.5 billion US$ during 2003-06.
- Support to R&D in higher education (UGC) for Inter-University Advance Centres, centres of excellence, universities with potential of excellence (over the last 3-4 years)
- **The Advanced Composites Programme**, which aims at developing certain critical inputs in terms of raw materials, design capabilities, manufacturing methodologies, skilled manpower and testing devices. Attempts to bring together the research institutions & industries and strives for turning India into a leading nation in composite technology and applications.

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4.2.3.3. Fiscal measures for research

**Australia** has put in place several types of incentives in the university system, such as:

*Financial returns*
- Royalties and other commercialisation net revenue, generally shared equally between the university, the research centre or faculty and the inventors
- Access to equity in spin-off companies, most commonly around 25 per cent

*Support mechanisms*
- Provision of business development staff and resources, both to help identify commercialisation opportunities and provide support and financial relief to inventors in the early stages of the new opportunity’s development.

*Finance and other resources*
- Provision of pre-seed and seed funding for technology development (proof of concept and working prototypes).
- Funding support for intellectual property protection (including patents).
- Market and competitor intelligence to allow business model development.

In **Brazil**, two recent developments regarding the fiscal measures for R&D are: the *Positive Law* (2006), which has put in place a recent flurry of fiscal incentives; and an older fiscal incentive mechanism for IT - *Lei de Informática*, which was revamped in 2004.

**Canada** has one of the most favourable tax regimes in the world in support of R&D. Incentives for business R&D preferentially take the form of *tax credits rather than direct contributions*. The *Scientific Research and Experimental Development (SR&ED) Programme* is the largest federal programme in support of industrial R&D, accounting for some 25% of government support to R&D annually. The programme is one of *deductions* (e.g.: for qualifying ‘current’ R&D expenditures, 100% deduction; for qualifying capital expenditures on R&D machinery and equipment, 100% deduction) and *investment tax credits* (e.g.: on qualifying SR&ED expenses incurred in Canada; varies by size of company: e.g. large company – 20% of R&D expenditures; small business deduction – 35%; current expenses and expenditures on machinery and equipment qualify). Most provincial governments also offer tax incentives.

*Fiscal incentives* are used in some provinces to attract highly qualified human resources. For example, in Quebec, researchers recruited to the business sector are granted a provincial income tax holiday for a number of years.

*Venture capital (VC)* is crucial to innovation and in Canada applies only to a limited number of high-growth potential companies and less than 1% of those who apply to venture capitalists get funding. The tax system and tax credits are government incentives for VC funds, but the government also provides VC funds in early-stage development of knowledge industries. The number of VC firms almost doubled from 95 in 1996 to 182 firms in 2002 and the number of VC funds more than doubled from 130 in 1996 to 282 in 2002. In 2002, almost half of the funds focused on IT firms, followed by life sciences. A recent OECD report tells of Canada coming second behind the US when ranking VC investments as a share of GDP for the years 1995-2000. In 2002, it was government-owned funds that were the only type to maintain investment levels, rising to $329 million compared with $323 million in 2001. The Business Development Bank of Canada (BDBC), with a budget of $190 million in 2002, accounted for 4% of VC investments in Canada in 2002 (in 2002, the BDBC was the 2nd top VC investor based on number of companies financed). Technology Partner-

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ships Canada, a special operating agency of Industry Canada, provides for repayable R&D contributions but the payments are linked to the generation of revenues from the success of the R&D. It supports large-scale technology R&D projects and smaller projects for SMEs (through the Industrial Research Assistance Programme, IRAP). In addition, under the funding of CANARIE, repayments are only due if the project is successfully commercialised.

In **China**, the Knowledge Innovation Programme was launched by the Chinese Academy of Sciences (CAS) in 1998 with the purpose to “enhance the country’s S&T competitiveness and to meet the challenges of economic globalization and a knowledge-based economy in the 21st century”.

In **India**, several types of fiscal measures are in place:
- **The R&D Cess and Technology Development Board (TDB)** - under the 1986 Act (amended in 1995) a 5% cess is levied on all payments made for technology imports. The cess available and given to TDB of DST amounts to about INR 100-130 million per year for the development of indigenous technologies, commercialisation and support with various fiscal measures to public and private enterprises. The board provides financial assistance in the form of equity, soft loans or grants.
- **Tax incentives for in-house R&D** - under the 1960 Income Tax Act of 1960 both revenue and capital expenditure on R&D incurred by R&D units of business enterprises are given 100% exemption for the investments made from the taxable income in that particular year.
- **Tax incentives for Special Economic Zones (SEZ)** - consist of making land available to SEZs on some concessional basis, and tax incentives to promote industrialization and knowledge-based industries.
- **The Fund for Improvement of S&T Infrastructure in Higher Educational Institutions (FIST)** - provides funding for selected HEIs for strengthening their infrastructure for post-graduate education and research in emerging areas.
- **Home-grown Technologies Programme** - is implemented by the Technology Information and Forecasting and Assessment Council (TIFAC) under DST. It supports projects to commercialise Indian processes and technologies with easy loans and equity participation. During 1992-2005, 60 projects were completed with commercial success and 17 are in the pipeline.

In **New Zealand**, the introduction of a R&D tax credit is currently under analysis by the government.
4.2.3.4. Support to guarantee mechanisms for research and innovation in SMEs

**Australia** reported no specific policies to guarantee mechanisms for research and innovation in SMEs.

**Brazil** has implemented several programmes with a SME-focus:
- INOVAR SEMENTE (FINEP, 2006) provides seed capital, acting as a ‘fund of funds’ programme
- CRIATEC Programme (BNDES, 2007) is a co-financing programme to promote seed venture capital fund of (8-9 regional) funds for equity investments in small innovative firms

**China** has made significant efforts to sustain SMEs in order to promote new key products and promote trade through S&T. An innovation fund for small technology-based firms and a fund for application of agricultural S&T finding were created, at the same time with productivity promotion centres, university S&T parks, and agricultural S&T Parks. In 2000 the “Note on Strengthening the Building up of Technological Innovation Service System in SMEs” was issued by the former National Economy and Trade Committee, in order to set up the technological innovation service centres for SMEs, and gradually form the open network technological innovation service system for the whole society.

The “SMEs Promotion Act” of 2002 issued by the central government defined the national active support to SMEs, regulated the services they can provide and protect their rights and interests and created a good environment for the establishment and development of SMEs. The ‘Environment Building for S&T Industries’ is a major component of the National S&T Plan in the 10th Five-year Plan period that aims to strengthen the environment building policy, promote regional economic development, enhance technical services and exchanges, stimulate development of S&T SMEs, develop S&T intermediaries, and create a sound environment for the commercialization of S&T findings and the their industrialisation. There is also a shifting focus in some S&T programmes (e.g. Spark Programme, Torch Programme, and National Science and Technology Achievements Outreach Programme) from project implementation to environment building and development of S&T SMEs.

In **India**, the National Innovation Foundation (NIF) was established by the DST on March 1, 2000, to provide institutional support in scouting, spawning, sustaining and scaling up grassroots green innovations and helping their transition to self-supporting activities. For the last seventeen years the Honeybee Network and Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) has been scouting innovations by farmers, artisans, women, etc. at the grassroots level. **Gujarat Grassroots Innovations Augmentation Network (GIAN)** scales up innovations, from the Honeybee database of innovations, to sustain creativity and ethics of experimentation. The Honeybee database of 10,000 innovations, collected and documented by SRISTI, would be part of the National Register of Innovations to be managed and supported by NIF.

Another initiative is the **SME Growth Fund**, which is targeted to SMEs in growth sectors, such as life sciences, retailing, light engineering, food processing, information technology, infrastructure related services, healthcare, logistics and distribution, etc. It provides financial assistance primarily by way of equity or equity-linked capital in-
vestment, and mentoring support and other value addition to enable the funded companies to achieve rapid growth and achieve / maintain their competitive edge in domestic and international markets.

New Zealand reported the existence of a venture capital programme and a seed co-investment programme.

4.2.3.5. Support to risk capital for research-intensive SMEs

In Australia, there has been a concerted push to strengthen venture capital availability and to support new business formation. Several measures illustrate this policy:
- the Early Stage Venture Capital Limited Partnership aims to establish a regime designed to increase the supply of funding to the early-stage venture capital sector in Australia through the introduction of an investment vehicle with flow-through taxation treatment and no tax liability on the investment gains for investors. This measure will benefit early-stage entities by making it easier for them to obtain capital. Making more money available for early-stage entities with strong growth potential will benefit the Australian economy.
- Venture Capital Limited Partnerships Programme (VCLP) has the objective to facilitate investment by foreign residents into the Australian venture capital market and to further develop the venture capital industry. Amendments announced in the 2006-07 Budget were designed to improve the efficiency of the VCLP scheme that facilitates investment by foreign residents into the Australian venture capital market and thereby increases the supply of capital to new and expanding firms that would have difficulty in attracting capital through the normal commercial means.
- the Biotechnology Innovation Fund (BIF) is a merit-based competitive grants programme which aims to increase the rate of commercialisation of promising biotechnology developed in Australia. It provides financial assistance to companies to demonstrate proof-of-concept between the initial research stage of a biotechnology project and the early stage of its commercialisation. The sixth and final round of the Biotechnology Innovation Fund closed on 15 July 2004. The Australian Government is now providing more than $1 billion to 30 June 2011 via the new Commercial Ready programme.
- Incubators is one of the four initiatives of the Building Entrepreneurship in Small Business Programme. It provides incubation services to small businesses through the establishment and running of small business incubators or the enhancement of existing successful small business incubators.
- Industry Cooperative Innovation Programme (ICIP) is a merit based grants programme aimed at encouraging business-to-business cooperation on innovation projects that enhance productivity, growth and international competitiveness in Australian industries. The programme has the particular focus of meeting strategic industry needs such as those identified through Action Agendas and supports projects which deliver industry-wide benefits.
- Innovation Investment Fund (IIF) is a venture capital programme that assists with the development of new managers in early stage venture capital investing. It invests in private sector venture capital funds to assist small companies in the early stages of development to commercialise the outcomes of Australia's strong research and development capability.
- Intermediary Access Programme is a business assistance programme to assist small and medium-sized businesses to access the skills/technology/knowledge needed to innovate and sustain business growth. The pilot will increase the availability of intermediary services, reduce the cost of accessing intermediary services and will encourage and assist company to company and company to researcher cooperation and collaboration to ultimately improve the competitive position of Australian businesses.
- **Pooled Development Funds (PDF) Programme** is designed to increase the supply of equity capital for growing Australian small and medium-sized enterprises (SMEs). PDFs are private sector investment companies established under the PDF Act which raise capital from investors and use it to invest in Australian companies.

- **Pre-Seed Fund** is a competitive pre-seed fund for universities and public sector research agencies that addresses the gap between promising scientific discoveries and commercialisation. It assists the commercialisation of public sector R&D activities by further developing the management and entrepreneurial skills of public sector researchers and build links with the finance and business community.

- **Renewable Energy Development Initiative (REDI)** is a competitive merit-based grant programme supporting Renewable Energy innovation and its commercialisation. It provides grant funding up to $100 million in competitive grants to allocate to Australian businesses over seven years. It offers grants of between $50,000 and $5 million for research and development (R&D), proof-of-concept, and early-stage commercialisation projects with high commercial and greenhouse gas abatement potential.

- **Renewable Energy Equity Fund (REEF)** is a specialist renewable energy equity fund based on the Innovation Investment Fund (IIF) model. It provides venture capital (equity) to assist small companies to commercialise R&D in renewable energy technologies.

On 30 June 2005 there were nine Venture Capital Limited Partnerships registered with approximately $1 billion in committed capital. About $46 million has been invested by Venture Capital Limited Partnerships in 10 eligible investee companies. In 2005 there were 95 companies registered as Pooled Development Funds, with around $50 million invested in 53 Australian businesses. On December 2004, the total amount invested by the Innovation Investment Fund was $221 million, with returns to investors of $261.4 million. The Pre-Seed Fund had made 25 investments in 22 companies and three projects in the areas of IT, life sciences, medical devices, agriculture, chemical engineering, environment and manufacturing.

**China** established in 1999 the Innofund, which provides funding to innovative Small Technology-based Firms. It aims to attract investment from the whole society and promote a new investment mechanism conforming to the laws of market economy for technological innovations. Without aiming at profit-making for itself, the Innofund aims to contribute to the national economic structure adjustment and economic growth, taking revenue increase and job creations as the reward. The Small and Medium Enterprises Board was created by the government in the period of the Tenth Five Plan and set up in Shenzhen Stock Exchange, providing direct financial support for SMEs.

**India** has adopted several measures to promote venture capital for SMEs. It ranked 5th by the Ernst and Young VC Insights Report 2006 amongst the top destinations for VC. India has attracted VC investments worth $ 1.1 bn in 2005 and is reported to have experienced another good year in 2006. The VC unit of the ICICI Bank is the 2nd largest in the country and raised about 810 million in 2005-06 US$ for investments in the Auto Components, Textiles and Logistics sectors. The National Venture Fund for Software and Information Technology (NFSIT) was set up by the Small Industries Development Bank of India (SIDBI) in association with Ministry of Information Technology (MIT) as a close-ended 10-year fund with an initial capital of Rs. 1000 million/ US$ 22.22 million. The Credit Linked Capital Subsidy Scheme for Technology Upgrade is a revised scheme to facilitate technology upgrade by providing 15 per cent upfront capital subsidy with effect from the 29th September, 2005 (12 per cent prior to 29.09.2005) to industrial units, for well established and improved technologies in the specified sub-sectors / products approved under the scheme.
5. REDIRECTING PUBLIC SPENDING TOWARDS RESEARCH AND INNOVATION

5.1. Key findings

The increase in the proportion of GDP devoted to R&D is a general objective within a stronger trend of linking R&D more directly to innovation and commercialisation. There is a related trend toward identifying and focusing on niche areas within broad technology themes, relevant to current national issues. A sub-theme of the above is increased partnering between national and regional authorities in federal systems; especially since strengths in niche areas are typically location-specific.

Identifying key themes building upon local strengths and/or creating new ones that a broad range of stakeholders can rally around is an emerging trend. A shift from incremental to discontinuous innovation may also be discerned in these broader projects that typically rely on an emerging S&T area, even when building them upon traditional knowledge as in India, and create “hype” and hope around them. Narrower policies focused on specific firms as “national champions” may be ebbing at least by contrast with the growing trend to focus on new technology-based firms and clusters how to promote their growth.

The state aid appeared to be interpreted in different ways in the countries examined, but is generally understood as industrial policies and government subsidies to firm R&D that may be limited by competition policies. Encouraging university-industry partnerships is generally viewed as a mechanism to resolve that issue while also bringing firms together to co-operate around pre-competitive themes when action is believed appropriate.

There is a general, although not universal trend, to using public procurement to promote innovation in advanced areas of technology that have been identified as foci of interest. Unified information policies and programmes have not been identified as a “strong suite” with the notable exception of India, which is expanding its capabilities.

5.2. Overview of measures for redirecting public spending towards research and innovation

5.2.1. Refocusing public spending towards more productive investments in support of research and innovation

In Australia, the major policy supporting investment to achieve higher sustainable economic growth has been the Backing Australia’s Ability – Building Our Future through Science and Innovation (BAA). This policy marks a commitment to pursue excellence in research, science and technology, through three key themes: the generation of new ideas (research and development), the commercial application of ideas, and developing and retaining skills. The two successive packages constitute a ten-year, $8.3 billion funding commitment stretching from February 2001 to November 2010. Total government investment in science and innovation has reached $52 billion over 10 years.

In Brazil, the main policy supporting investments that lead to higher sustainable growth in the future is the 2004 Industrial, Technological and Foreign Trade Policy (PITCE) – the federal government’s Action Plan to increase the innovativeness and export capacity of Brazilian firms.

In Canada, Industry Canada is a lead department having jurisdiction over a range of policies directly and indirectly linked to science, technology and innovation policy.
The deepest issue is that public and private investments naturally flow to the regions with the strongest capabilities. A variety of mechanisms exist to facilitate this coordination. For example, Federal regional development agencies often invest in projects in conjunction with provincial investments. Education is under provincial jurisdiction, so investment in R&D infrastructure often implies involvement of provincial agencies.

Canada has one of the most favourable tax regimes in the world in support of R&D, and Canada's incentives for business R&D preferentially take the form of tax credits rather than direct contributions. The Scientific Research and Experimental Development (SR&ED) Programme is the largest federal programme which supports industrial R&D through deductions. Most provincial governments also offer tax incentives. Fiscal incentives are used in some provinces to attract highly qualified human resources. For example, in Quebec, researchers recruited to the business sector are granted a provincial income tax holiday for a number of years. Technology Partnerships Canada, a special operating agency of Industry Canada, provides for repaymentable R&D contributions but the payments are linked to the generation of revenues from the success of the R&D. It supports large-scale technology R&D projects and smaller projects for SMEs.

Since 1990, China has kept a high growth R&D investment policy. The investment model transformed from government-led into government-industry joint investment. The government share of investment dropped from 79% in 1985 to 33.4% in 2000 and 26.5% in 2005. It is recognised that increasing public R&D investment is important. China has a 2020 target of 2.5% of GDP investment in R&D, with a milestone of 2% by 2010 and a reduction from 60% dependence on outside technology to 35%. University, research institute and business carry out basic research, applied research and experimental development. Business concentrates in the latter (91.6% in 2005).

In India, the objective of the 11th Five-Year Plan (2007-2012) is to enhance the S&T human capital and infrastructure of the country, so that the nation can become a global player in innovation. The government is committed to increase GERD/GDP ratio from the current 1.1% in (2004-06) to 2% in the next five years. Food security is one of the most basic factors of the long-term sustainable growth for India, therefore agricultural science and technology, biotechnology and related areas are a key focus. S&T policy, particularly relating to agriculture is designed to achieve what has been termed the ‘Second Green Revolution’.

Between 2002 and 2006, Japan’s government sought to constrain public expenditure as a proportion of GDP. While expenditure on “culture, education and science promotion” has declined, expenditure specifically on S&T has increased from 1,146 billion Yen (2000) to 1,317 billion yen (2005). The FY2006 Annual Report on the budget observed that general policy expenditures except for social security and science and technology promotion had declined.

New Zealand’s Cabinet recently confirmed its long-term commitment to improving income per capita through innovation and raising productivity in an environmentally sustainable way by agreeing that economic transformation (Economic Transformation Agenda) would be one of the three priorities for the next decade. The Economic Transformation Agenda seeks to progress New Zealand to a high income, knowledge-based market economy. In 2003 New Zealand only spent 1.16 % of GDP on R&D and 53% of all research in the country is public-funded. Even so, the public investment as proportion of GDP is only 0.52% of GDP compared to an OECD average of 0.68%. In 2003 industry only invested 0.64% of GDP in R&D. The Government has the ambition to increase the public investment in research to OECD average by 2010.
In South Korea, the allocation of public spending for research and innovation is defined in the “Basic Plans of Science and Technology 2003-2007”, where the Korean government distinguishes five areas of S&T policy priorities with 14 specific subjects: 1) to create the future economic growth engines; 2) to enhance basic research capabilities; 3) to enhance the internationalisation and regionalisation of the Korean R&D system; 4) to advance the Korean innovation system; and 5) to spread S&T culture to society at large.

In the USA, the American Competitiveness Initiative (ACI) proposes a refocusing of federal R&D spending in order to promote innovation. The ACI calls for a doubling of funding over a 10 year period from 2007 to 2017 in three agencies which conduct the lion’s share of physical science and engineering research: National Science Foundation (NSF), the Department of Energy’s Office of Science (DoE SC), and the Department of Commerce’s National Institute of Standards and Technology (NIST) core laboratories. It is believed that this research will result in major advances in alternative energy technologies and other foundational areas. Various state level initiatives, taken in aggregate, in stem cells, clean energy etc. combined with members bills for specific projects to enhance local initiatives may prove to be more significant in raising R&D spend in the near future than the federal level which is under severe budgetary pressures.

5.2.2. State aid

In Australia, the term ‘state aid’ refers to aid by the Commonwealth to the States, and has a particular historical context of Commonwealth aid for religious schools. In the EC sense, the extent of government support for R&D described elsewhere has always been justified (or required to be justified) by arguments of market failure. The basis of this claim has just been exhaustively examined in a major report by the Productivity Commission, Public Support for Science and Innovation, released on 26 March 2007.

EU type “state aid” analogies exist in Canada, but they are broad analogies. In the last 25 years the government has loosened restrictions on international and inter-provincial trade to reduce distorting economic interventions. The Canadian emphasis on fiscal R&D incentives and on support of R&D in the higher education sector may be interpreted as a movement away from direct subsidy of firm-level innovation. Issues of definition of subsidy have arisen in the context of NAFTA, which, in principal, opens the public procurement markets of Canada and the U.S. to each other.

In China, one form of state aid is considered to be the government’s support for basic research in universities and research institutes. The document ‘Opinions on Strengthening Basic Research’ published in March 2001 aimed to raise the income of scientists and engineering researchers working in basic research. As a result, the central government paid more attention to basic research and provided about 90% of the investment for it in recent years, while the province or city government support applied research or technology R&D. At the same time, the government encourages universities and research institutes to collaborate with the business sector and promotes policies to form firms or joint ventures. In recent years, government has attempted to stimulate business investment in R&D with some success. The increase mainly took place in the East part of the country and is concentrated in a few high-tech industries. An important role in this development was played by the Innovation Fund created in 1999, which provides free financial aid to S&T SMEs. The fund works on a decentralised management model, with every province having its own management department for the Innovation Fund and the various levels of regional government working in conjunction. A major objective is to help SME’s sustain their business through the difficult first three years. The direct financial support is com-
implemented by indirect support measures, such as encouraging mentoring from experienced entrepreneurs.

In **India**, individual states have the autonomy to formulate and implement policies in various fields of S&T. Higher education is given high priority by most of the Indian states. Public–private partnerships in expanding higher engineering, medical and management education is one of the main features of the new policies by most of the states. Recently some states have initiated policies to create *Special Economic Zones (SEZ)* with tax and infrastructure incentives intended to foster knowledge-based industries with good export potential. The creation of such zones in various states has as main objective to attract FDI, increase exports and accelerate the country’s economic growth.

**Japan** has promoted numerous reforms to the state aid support system since the late 1990s. In terms of R&D, however, many programmes and support grants for small firms or venture companies are justified by reference to the “market failure” argument. The *First Science and Technology Basic Plan* stated that the government will “extend support, notably in the form of subsidies, for R&D that the private sector is unwilling to burden all the risks involved” (1996: 35; see also METI 2001). It should be recognised that the Government proportion of Business Expenditure on R&D (BERD) in Japan in 2004 was 1.1% (OECD S&T Indicators).

In **New Zealand**, no obvious trends towards developing policies to redirect state aid towards R&D have been reported as part of the more general redirection of state aid towards horizontal objectives.

In the **USA**, in principle, the federal government does not provide general direct aid to companies. Indirect support, primarily through tax breaks, is targeted to specific sectors in return for expectations of performance. As in Europe and Japan, subsidies are provided to R&D in the agricultural sector. The US government does contract with companies to perform R&D, where that R&D is in the national interest or to meet specific needs of federal agencies. In 2004, the private sector undertook $23.5 billion (€18.7 billion) of R&D that was financed by the federal government, equivalent to 10.7 percent of all US private R&D. The federal government, particularly through line agencies, partners with private companies in a variety of “pre-competitive” research initiatives. The current administration is less supportive than previous governments of significant direct federal funding to consortia. At the state level, a variety of indirect subsides are given to attract and retain major companies. Typically, state and local subsides have focused on industrial facilities, workforce training and supporting infrastructure, but there is an increasing orientation towards R&D. In addition to indirect incentives many states sponsor R&D partnership programmes with fiscal incentives.

### 5.2.3. Public procurement

In **Australia**, the *Government Procurement Policy Framework* establishes the principles for the Government’s acquisition of property and services. The framework is based on the principles of value for money; efficient, effective and ethical use of resources; and accountability and transparency in Australian Government procurement activities. There is no emphasis in Australian government policy on using procurement to promote research or innovation, in sharp contrast to New Zealand. The notion of public investment in R&D being considered as the procurement of knowledge on behalf of the community holds no currency. Other public procurement-related initiatives include:

- the web site [www.business.gov.au](http://www.business.gov.au) provides business with ‘one-stop’ online access to federal, state and local government information, services and transactions. The web site enables business operators to locate information
and transactions that relate to the day-to-day running of their business, and allows them to deal with government in an online environment. Content syndication provides relevant information on web sites, such as bank and business associations, regularly visited by small business operators.

- **Australian Government e-procurement** provides a means to increase the uptake by suppliers and to increase efficiencies in government services. A number of activities are underway to better understand the drivers and inhibitors to the take up of e-procurement. Funding of approximately $30 million was provided in the 2006-07 Budget to fund the development of an online whole-of-government electronic authentication, validation and notary service.

- **Austender** is a secure electronic tendering facility for agencies and their suppliers. It provides a central publishing facility for the Australian Government's business opportunities, automatic notification to suppliers of these opportunities, tender documentation download and secure lodgement of tender responses. Agencies will benefit by streamlining their tender processes and potentially reducing costs of print media advertising; suppliers will benefit from reduced costs in responding and increased bid development time.

Public procurement is prohibited by law in **Brazil**, but studies are currently being carried out at the Brazilian Agency for Industrial Development (ABDI) to promote changes in legislation.

In **Canada**, three issues have been central to the debate on public procurement: 1) how to ensure that the process is transparent and fair; 2) how to ensure that the process is in line with trade commitments; 3) how to use the public procurement process for purposes of innovation. Regarding the transparency of the process, the introduction of an online public tendering system has helped to reduce the advantages of geographical or social proximity. Regarding the issue of trade commitments, the North American Free Trade Agreement provides for reciprocal access to the US and Canadian public procurement markets. Some issues of protectionism, defragmentation of the Canadian public procurement market, and dispute resolution have arisen. Use of some areas of public procurement for purposes of environmental innovation seems likely.

In **China**, the Government is the biggest consumer and public procurement increases at a rate of ¥50 billions annually. The **Government Procurement Law** states that government procurement should be helpful to the state economy and social development, including the protection of the environment, support to undeveloped regions, promotion of SMEs etc. The rapid growth of the Chinese economy since 1997 has relied heavily on the contribution of government procurement since it greatly pushes industrial development.

**Japan**'s public procurement has featured in relation to super-computers, telecommunications and non R&D satellites. There is a strong domestic focus to the award of procurement contracts, where the ratio of foreign supplier's awards accounted for about 2.0% on the number of contracts basis and 3.7% on value basis in 2004.

In **India**, there are a number of areas and sectors where the government is the major customer, such as defence and space technologies, health-related vaccines and new transportation technologies.

For **New Zealand**, there are several potential areas where the public sector could act as a launching customer; particularly, biodiversity and bio-security, protection of environment and electronic patient journals for the health sector. The Government expects its departments, and encourages other public sector agencies, to be guided in their procurement by the following principles:

- best value for money over whole of life;
open and effective competition;
full and fair opportunity for domestic suppliers;
improving business capabilities, including e-commerce capability; and
recognition of our bilateral obligations to Australia (Closer Economic Relations) and Singapore (Closer Economic Partnership), and our trade policy interests in open and transparent government procurement markets. The Government has also endorsed the 1999 APEC Non-Binding Principles on Government Procurement i.e. transparency, value for money, open and effective competition, fair dealing, accountability and due process, and non-discrimination.

The basis for public procurement in S. Korea was set in 1996 through the “New Technology Purchasing Assurance” Programme, which was created for promoting SMEs' technological innovation. It provides government procurement opportunities to SMEs for their technologically innovative products. In an effort to further commercialise new technologies, government agencies, public institutions and private businesses commission SMEs to develop a new technology with the assurance that they will purchase the technological products. Under this programme, the Small and Medium Business Administration of Korea (SMBA) finances the technological development of SMEs, while public institutions buy the products for a certain period of time.

In the USA, government agencies can consider goals other than price (such as performance, socio-economic goals, life-cycle costs, and vendor opportunities). However, there is not a centrally coordinated demand-driven innovation procurement policy in the US, but a variety of decentralized initiatives at the agency level. DARPA (Defence Advanced Research Projects Agency) has served as a lead sponsor of several innovative technologies, including the Internet and Global Positioning Systems. At the state level, many states and localities have sponsored broadband and wireless communications networks to foster the take-up of computing and information technologies. Several states offer subsidies or tax breaks to purchases of energy-efficient vehicles.

5.2.4. Development and diffusion of information

In Australia, there are apparently few explicit policies providing information on technologies. The most significant exception is the Rural Industries Research & Development Corporations (RRDCs). They were first established in 1989. As a group, they plan, fund (primarily from compulsory industry levies and public support) and manage much of the agricultural R&D conducted in the country. There are currently 15 RRDCs with all, but two of these established to operate within specific industries. The rationale for this industry-specific arrangement is based on the characteristics of many primary industries with a large number of producers, each accounting for a relatively small share of relatively undifferentiated industry output. This makes it difficult for producers to capture sufficient benefit from R&D they might conduct individually in order for them to proceed. Accordingly, even though the collective benefits may justify the investment, there may be under-provision of rural research. All potential R&D projects are assessed for their applicability, and require direct involvement of potential users in design and management. The program is regarded as having contributed greatly to the continuing international competitiveness of Australian rural industries.

Canada’s technical information services support primarily scientific research and private buyers. The NRC, for example, operates the Canadian Institute for Scientific and Technical Information (CISTI), and provides technology and market information search services for SME clients.
In China, the development and diffusion of information are currently ensured by over 60,000 S&T agents, 850 productivity centres and 460 incubators for S&T enterprises. China aims to build effective technology transfer and diffusion channels for trading technologies through the Technology Stock Exchange, Technology Condition Market and Human Resource Market, as well as by regularly organizing new technology exhibitions.

India sees the development and diffusion of information as one of the main tasks of National Innovation Foundation, which has the mission to diffuse technologies developed by independent innovators and community-based innovations in indigenous knowledge systems. The National Research Development Corporation (NRDC) is part of the Department of Scientific and Industrial Research in the Ministry of S&T, which has the responsibility of transferring technologies developed in the national laboratories and public research systems. The government has developed a vast network of actors and agencies involved in the production, distribution and diffusion of R&D information and products to address problems in the public health. In 2007 the government introduced The Right to Information Act, which is already playing a significant role in the diffusion of information, which otherwise remains classified, in various departments of governments and enterprises. This Act is directly linked to the democratization of information and aids the decision-making process. One can demand to inspect works, documents, records, take notes, extracts or certified copies of documents or records, take certified samples of materials and obtain information in all forms including electronic and audio and video etc.

In Japan, a key actor in the provision of S&T information is the Japan Science and Technology Agency (JST), which maintains a number of databases including the Science Portal, university-industry links portal as well as numerous databases.

In New Zealand there are no obvious policies in place for securing knowledge diffusion between key users on the best available technologies for key categories of products, which could enable public buyers to procure technologies that are best fit to their needs.

In South Korea, several agencies for technology transfer have been established since the enactment of the Promotion Law for Technology Transfer in 2000. The Basic Plan for National Technology Information System (NTIS) was established in 2005 and made progress in implementing Information Technology architecture in 2006. On the shorter term planning, it aims to provide one-stop service until 2009.

The USA does not have centrally coordinated policies to provide information on best available technologies for public buyers. In that respect, non-defence public purchasers can also draw on the numerous initiatives, programmes and systems in the public and private sectors, which provide consumer or user information. In the private sector, independent testing organisations such as Consumer Reports also serve similar functions. However, SBIR plays a filtering role in identifying and moving forward selected technologies for commercialisation. The DoD has a more explicit process embedded in its R&D categories; there is currently consideration in draft legislation to extending MANTECH across government, with funding possibly devolved to the state or even university levels.

6. IMPROVING FRAMEWORK CONDITIONS FOR PRIVATE INVESTMENT IN RESEARCH

6.1. Key findings
In this section, the framework conditions for private investment in research are discussed across six categories:
a) Intellectual property (IP)

A contradictory trend may be discerned with respect to IP in developing and advanced industrialized countries. Developing countries have become more interested in adopting IP strategies as they realize that they have unique knowledge worth protecting. On the other hand, advocates of collaborative technology development in advanced countries argue against IP protection as retarding the pace of technological advance. Nevertheless, there is a general trend toward enhancement of intellectual property as an innovation strategy. On the one hand, government agencies are performing an educational role in enhancing the awareness of industry and academia of the importance of IP, such as Australia’s Intellectual Property Agency, which manages a university relationship marketing programme that consists of an annual university seminar series to promote issues of IP protection, commercialisation and management, and IP Professor, a tertiary specific online resource. On the other, changes in the legal framework are introduced to incentivise universities to protect and commercialise IP, such as Japan’s Basic Law on Intellectual Property (2002), which aims to accelerate patent application and strengthen the organisational capacity for managing IP in universities.

There is a concomitant shift to seeing IP and R&D measures, in general, as a means to the end of economic growth rather than as an isolated policy area. Different emphases may be discerned in various countries but the general direction is more or less similar in all countries examined. Japan may be seen as the strongest case of IP strategy, through legal change and funding of IP protection in universities, while Canada may be seen as the exemplar of a spin-off focus. The US pursues both strategies more indirectly, with a shift in emphasis in universities, over time, from IP protection as an end in itself to facilitating start-ups. The process, instantiated in academia as a re-organization of technology transfer into enterprise development occurs isomorphically, by example, rather than through central direction, as in S. Korea.

b) Regulation of products and standardisation

A general trend exists towards enhancement of standards as a key part of innovation strategy. This occurs through enhancement of the role and funding of Standards Agencies. Although most agencies are focused on expanding traditional functions tied to metrology, the US agency has been given a more direct role in creating programmes to encourage industry collaboration and university-industry cooperation based on an underlying theme of identifying areas for co-operation and collaboration bottom-up but with the encouragement of Agency experts who identify potential areas to address and then seek out potential proponents and collaborators in developing specific programmatic initiatives e.g. ATP focused programmes on particular technology themes.
c) Competition policy
Competition policy walks a tightrope between encouraging collaboration among firms to promote innovation and discouraging collaboration to set prices. In most countries, competition policies are formulated and implemented by specialised national agencies, except for Brazil, where the regulation of competition is rather confusing, with multiple institutions competing for a mandate in this area.

d) Financial markets
Broadening the definition of financial market to include early stage seed capital for new enterprises and creation of equity markets for emerging firms with growth potential is a matter of virtually universal concern. In some instances, a general theme such as financial markets may be too broad to capture this dimension but it exists nevertheless. Developing countries, like Brazil, have also recognized that it is not only necessary to create new financial mechanism but it is equally important to educate technology entrepreneurs on how to address these opportunities. Again, as with IP, government play an educational role in running and training programmes to enable potential users to take the fullest advantage of new opportunities.

d) Corporate research strategy, management and financial reporting
Trends in corporate R&D are contradictory. Large firms, in many countries that traditionally invested heavily in R&D have downsized and reduced their R&D spending. On the other hand, a significant number of both large and mid-sized firms have increased their collaborations with universities, often aided by government programmes, especially in the area of so-called pre-competitive R&D, a relatively new term that reflects the trend toward collaboration and provides a means of conceptualising and justifying this trend. There is also a relatively new trend of high-growth firms establishing relatively small R&D units adjacent to universities, often located in science parks, to take advantage of collaboration opportunities, gain a window on commercial opportunities from basic research and, of course to provide opportunities for recruitment. Brazil, for example, has used tax incentives to encourage multinationals to establish R&D units and encourage learning about the innovation potential in local universities.

6.2. Overview of measures for improving framework conditions for private investment in research

6.2.1. Intellectual property (IP)

In Australia, intellectual property issues are dealt with by IP Australia, which is the government agency responsible for administering patents, trade marks, designs and Plant Breeder’s Rights. Worth noting here is that the agency also manages a university relationship marketing programme to improve awareness, understanding and use of IP in the tertiary education sector. This programme consists of an annual university seminar series to promote issues of IP protection, commercialisation and management and IP Professor, a tertiary specific online resource. The independent Advisory Council on Intellectual Property (ACIP), made up of representatives of academia, business and legal communities, assists IP Australia and advises the Minister on emerging IP issues. In order to promote commercialisation skills, the Commonwealth Government supported the establishment of an independent Australian Institute for Commercialisation. They operate by addressing market gaps and accelerating the commercialisation of know-how and technology that clients have created, in order to fast-track the commercialisation of Australian innovation.

In Brazil, the national agency in charge with the implementation of the intellectual property policy is the Industrial Property National Institute (INPI), under the Ministry

**Canada** attaches great importance to the promotion of IP in academic institutions: most universities have technology management and commercialisation offices. In 2002, the Government of Canada and the Association of Universities and Colleges of Canada (AUCC) concluded a Framework Agreement on federally funded research, in which universities agreed to double the amount of research they perform and to triple their commercialisation outcomes by 2010. It is reported that Canadian universities disclose as many inventions and create 2.5 more spin-off companies per dollar of R&D performed as U.S. universities.

The poor implementation of IP legislation is an important matter for **China**, which entered WIPO in March 1980, and became a member country in 1985. The IPR system in China is only 20 years-old, and the Patent Law adopted in 1984 has been subject to several amendments ever since and is still being amended at present. New laws and regulations in information diffusion right, especially the copyright, are constantly promoted by the government. IPR issues have become increasingly important for Chinese enterprises, and the Ministry of Information Industry recently reminded China IT enterprises of protecting their IPRs. At present, one can remark stronger basic awareness of IP and technology transfer, supported, among other things, by a series of activities organised by the government, such as four “Activities for IPR Publicising Week”, three “Forums of IPR Summit” in order to increase public understanding for IPR, annual events organised by the National Copyright Administration to create awareness on copyright law.

**India** promoted a new IPR regime from January 2005 conforming to WTO norms of protection given to patents for 20 years through amendments to 1970 Act in 1999 and 2000. The Enactment of the Indian Trademarks Act in 1999 was a big step forward from previous acts, such as the 1958 Trade and Merchandise Marks Act and the 1940 Trademark Act, as it included some new features, such as the registration of service marks, collective marks and certification trademarks. Other IP documents in force in India are The Protection of Plant Varieties and Farmer’s Rights Act (2001), passed by the Indian parliament, and the Biodiversity Act 2002. It is reported that protection of undisclosed information is least known to players of IPR and also least talked about, although it is seen to be one of the most important form of protection for industries, R&D institutions and other agencies dealing with IPRs. Moreover, India’s aggressive actions to protect traditional knowledge that has been claimed in US patents by challenging their validity has had some initial success. This has been followed up with measures to codify and reference traditional knowledge as an IP enhancement strategy in support of local industry.

In **Japan** the IP system is given a central role in the progress of the country. To develop a ‘nation based on intellectual property’, as proposed in the *Basic Law on Intellectual Property* (2002, Law 122), various strategy groups have been established to accelerate the patent application process and to develop organisational capacity for managing intellectual property in universities. Various amendments to relevant patent laws have been introduced, such as the measures established by the Japan Patent Office to accelerate the patent application process from 26 months to 11 months by 2013, and eventually reducing this to zero months. Also, the *Intellectual Property Strategic Programme* (2004) includes measures such as the: creation of *Intellectual Property Strategy Headquarters* to mainstream IP-related activities in universities, amendments of the Patent Law and Law Amendment to Expedite Patent Examination. Human resource related issues are covered by the *Comprehensive Strategy for Personnel with Intellectual Property Skills*, adopted in January 2006.
In New Zealand, the salient property right legislation are the 1953 Patents Act and the 1987 Plant Variety Rights Act. Intellectual Property Policy is placed in the context of the Law, Finance and Business Regulation coordinated by the Ministry of Economic Development. The Intellectual Property Office of New Zealand is a government website which provides information on patents, trade marks and designs, and allows search in the registers, payment of renewal fees, filing of trade mark applications and finding forms and guides on IP in New Zealand. On the academic side, University of Auckland offers a postgraduate diploma and masters of bioscience enterprise – a programme which offers advanced training for scientists in business and legal aspects of S&T enterprises, particularly in the life sciences sector, and addresses IPR issues, such as law and IP. It explains the legal system including basic concepts of contract and corporate law in a biotechnology context, and places emphasis upon IP laws, in particular patent law and practice and other means of protecting new ideas, discoveries and inventions.

In South Korea, the government has recently increased budgets for the direct support of IPR protection in order to align more closely to the international norms and standards in IPR protection. In addition, the adequate supply of high-quality IPR personnel has been recognised as a major challenge in developing the advanced IPR system in the country.

In the USA, IP is administered through filings to the US Patent and Trade Office (USPTO). In 2006, the USPTO received 440,000 patent filings and awarded more than 196,000 patents, nearly half of which were granted to foreign-owned firms. In that year, more than 354,000 trademark applications were filed with USTPO. Most US patents are owned by companies, with fewer than 2 percent of utility patents owned by universities. The “Bayh-Dole Act” of 1980 made it possible for universities (along with small business and non-profits) to own the intellectual property rights associated with federally-funded R&D and license them to companies for use. Patent reform has been on the national agenda for several years. In 2004, an influential study titled “A Patent System for the 21st Century” called for improvements to the US intellectual property system. For example, the Patent Reform Act of 2006 introduced by the US Senate in August 2006 shifts the method of awarding patents from “first to invent” to “first to file,” which harmonizes the US system with what is used internationally. It also contains changes in adjudicatory processes for intellectual property challenges. However, it has not been given high chances of passing due to differences from the bill introduced into the US House of Representatives as well as opposition from selected industries.

6.2.2. Regulation of Products and Standardisation

In Australia, the main body in charge with the regulation of products and standardisation is Standards Australia, which was established in 1922 and is recognised as the peak non-government standards development body in the country. Significant public interest and concern have been manifested in two technological areas: genetically modified organisms and stem cell research. In the first area, the Office of the Gene Technology Regulator administers the Gene Technology Act 2000, which provides a national scheme for the regulation of genetically modified organisms in Australia. Stem cell research and, in particular, therapeutic cloning has been the subject of a number of pieces of legislation at Commonwealth and State level.

In Brazil, the most important policy measure to support the development of standards is Programa TIB (Industrial Technology Programme), which contains, among other things, a Mobile Units Programme (PRUMO) for metrology and related services. In terms of technological areas where existing legislation or the lack of legislation impedes the development and deployment of new technologies, one can mention the
agricultural biotechnology, for which legislation is still up in the air due to governance problems with the legally charged commission to advise the government in bio-security matters (CTNBio). Also, software is not recognized as entitled to a patent by the intellectual property agency (INPI).

In **Canada**, standardisation issues are dealt with by the Standards Council of Canada, a federal Crown corporation which aims at achieving six international and domestic goals, included in their 2005-2008 strategy:

- International: 1) Influence the formation, evolution and operation of standardization bodies that are important to Canada; 2) Improve access to existing and new markets for Canadian goods and services; 3) Build competitive advantage through technology and information transfer and global market intelligence;
- Domestic: 4) Meet the needs of an evolving regulatory and policy environment; 5) Represent fully the range of standardization stakeholders; and 6) Communicate effectively the role and benefits of standards and conformity assessment practices.

Regulatory and certification issues frequently arise in the case of new industries, where the lack of standards and certification procedures can undermine consumer trust and hinder commercialisation.

In **China**, the legal framework for standardisation issues is provided by the 1988 Standardization Law, which promotes technology development and the improvement of product quality. Since 2001, when China entered WTO, it has gradually been synchronized in the global institutional system. In 2006, the Civil Administration Ministry and the National Standardization Council jointly issued the National Development Plan of Civil Administration Standards for 2006-2010 and defined 260 national standards and industrial standards in 15 fields. The standardisation process in China is slow due to the lack of high-tech and safety standards. One primary principle is promoting S&T enterprise and innovation in key fields such as: agriculture, food safety, public security, power saving and environment protection, high-tech, service industries, as well as upgrading standards in traditional industries. Another primary principle of standardisation is internationalisation: actively take international standards and internationalise national standards. In addition, strong emphasis is placed on the training of human resources for international standardisation. So far, there are around 100 international standardisation experts, which is significantly less than those in the US (over 3000) or in Germany (over 2000). China expects to have over 1000 international standardisation experts until 2010.

**India's** main body for standardisation - the Bureau of Indian Standards (BIS) - is involved in the development of technical standards, product quality and management system certifications and consumer affairs. India has not yet enacted any specific law or act to protect intellectual property equivalent to Bayh-Dole Act of 1980 of USA, but the issue is under examination. The links with European standardisation bodies are covered through the **EU-India Trade and Investment Development Programme (TIDP)**, which embodies the Strategic Partnership between Europe and India and seeks to strengthen relations between these two global powers through tangible co-operation activities that bring benefits to both sides.

In **Japan**, standards are recognised as increasingly important for the competitive position of Japanese industry. Traditionally however, standards have not been sufficiently recognized by Japanese industry, and in 2001 the Japan Industrial Standards Association launched the **Standardization Strategy**. More recently, the international role of standards has been emphasized with the development of further action plans in 2005 and 2006. From the Second and Third Science and Technology Basic Plans (2000-2005; 2006-2010) there has been increased emphasis on the role of standards in technological development. Both the Japan Standards Association and the Japan Industrial Standards Association also hold international affairs offices and joint
agreements with other Asian countries and are of increased prominence.

**New Zealand's** government is funding research in Measurement Standards in order to accommodate international trade agreements like WTO (World Trade Organisation) TBT (Technical Barriers to Trade), the APEC (Asia-Pacific Economic Cooperation), and the AFTA-CER (ASEAN Free Trade Agreement - Closer Economic Relations) The research is carried out by The Measurement Standards Laboratory of New Zealand (MSL), which operates under the 1992 Measurement Standards Act and the 1976 National Standards Regulations. MSL is currently staffed by approximately 30 scientists and science technicians.

Standardization and testing of technology in **South Korea** are mostly led by Korea Research Institute of Standards and Sciences (KRISS) and the Industrial Advancement Administration (IAA). The Basic Law for National Standard was enacted in 1999 and the 1st Basic Plans for National Standard 2001-2005 was implemented in 2001. The Korean certification system is operated by five ministries and divides into technology certification, such as New Excellent Technology (NET), New Excellent Products (NEP) certifications, and quality certifications. In 2006 there were 13 certification programmes.

The **US** has a highly developed and complex system of product regulation. Line agencies are responsible for interpreting federal law and administering regulations. There is an administrative rulemaking process, whereby public input is solicited. Final regulations are published in the Federal Register and become part of the US Code of Federal Regulations. There are 50 major regulation titles (or categories), including food and drugs, animals and animal products, energy, telecommunication, and commerce. At the broad level, there are guidelines and consultation mechanisms for EU-US cooperation, including the EU-US Regulatory Cooperation and Transparency Guidelines and forums for dialogue at the specific sector, horizontal and high levels. There is a significant debate and concern in Washington about the influence of product regulation on competitiveness and innovation. Business groups generally seek less regulation; consumer, labour, and other stakeholders seek to maintain or increase regulation. Every year, there are numerous amendments and legislative proposals in Congress.

In the US, there is a high level of non-governmental coordination of standards. The American National Standards Institute (ANSI) is a private non-profit organization that oversees the development of voluntary standards by other US organizations and represents the US to the International Organization for Standardization (ISO). Many federal agencies and laboratories are involved, with industry and other stakeholders, in setting standards, including the National Institute of Standards and Technology (NIST) in the US Department of Commerce. NIST undertakes research related to standards within its domain (including building and fire research, chemical science, information technology, materials, and physics). NIST disseminates standards information and reference materials, including to small and midsize enterprises. The importance of standards to competitiveness is recognized. For example, NIST has undertaken a study on this topic, offering a series of recommendations to measurement technologies and standards setting in the US. Under the ACI (see earlier), NIST has been given a renewed mandate to foster standards that will accelerate the commercialisation of new technologies.

**6.2.3. Competition rules**

In Australia, competition rules are addressed by the Australian Competition and Consumer Commission (ACCC), which is an independent Commonwealth statutory authority, formed in 1995 to administer the 1974 Trade Practices Act and other acts. The ACCC promotes competition and fair trade in the market place and regulates national infrastructure services. Its primary responsibility is to ensure that individuals and businesses comply with the Commonwealth competition, fair trade and consumer protection laws. As well as education and information, the ACCC recommends dispute resolution when possible as an alternative to litigation, can authorise some anti-competitive conduct, and will take legal action when necessary. Free trade agreements have been negotiated between Australia and the United States, Thailand, Singapore and New Zealand, which have some implications for technology transfer arrangements.

In Brazil, the regulation of competition is confusing, with multiple institutions jockeying for a mandate in the area.

Canada’s Competition Bureau is an independent federal law enforcement agency that is responsible for administering and enforcing certain legislative acts: the Competition Act, the Consumer Packaging and Labelling Act, the Textile Labelling Act and the Precious Metals Marking Act. The Competition Bureau promotes and maintains fair competition in support of competitive prices, product choice, and service quality. The Competition Bureau investigates anti-competitive practices and promotes compliance with the laws under its jurisdiction. Competition in some industries such as telecom and media is regulated by national ownership rules. The Government of Canada recently announced its intention to loosen foreign ownership restrictions in the telecom sector.

In China, although the government has issued a series of laws such as Anti-Unfair Competition Law, Pricing Law and Foreign Trade Law, anti-trust laws are still very limited. China looks to the European experience as a reference to construct strict anti-trust laws. The forthcoming Anti-Trust law consists of 56 items that forbid monopoly agreements, market dominance abuse, administration monopoly, etc. The State Council will establish an Anti-monopoly Committee. China’s membership of the WTO is an opportunity, but also a challenge. Item 28 of Income Tax Law allows for a 15% tax reduction for all state-owned high-tech enterprises and a change of policy focus from preferential regions to industries. Only the industries encouraged by the state can receive this tax benefit.

In India, the government enacted a Competition Act in 2002 for upholding competition in Indian market and dealing with other matters regarding competition and consumers. A Commission was also set up for this purpose. Other competition-related policies include the Telecom Competition Policy, enacted in 1994 and amended in 1999 and 2002. The last 2002 Act provides provision for open license policy for telecom. Technology Transfer agreements and other matters are dealt by individual ministries overseen by the Reserve Bank of India.

In Japan, most competition policies have been oriented towards eliminating bid rigging for public works projects with little activity directed towards innovation-related competition policies. Where IP issues relate to competition policy, guidelines on patent pool arrangements were established by the Japan Fair Trade Commission (JFTC) to contribute to preventing violations of the Anti-monopoly Act and promoting the specification of standardization activities. The Merger & Acquisition activity is governed by the Guidelines Concerning Companies an Excessive Concentration of Economic Power (2002) and the Notification System Concerning Mergers and Acquisitions by Companies in Japan (1999). The JFTC published the “Guidelines concerning Joint Research and Development under the Anti-Monopoly Act” in 1993.
New Zealand's primary competition regulatory agency is the Commerce Commission, which was established by the 1986 Commerce Act. The Commission is an independent Crown entity and is not subject to direction from the government in carrying out its enforcement and regulatory control activities. There is no significant current effort in adjusting New Zealand's competition policy. The legislation regarding mergers and acquisitions is primarily concerned with the risk of lessening of competition in any market.

Competition policy in South Korea is aimed at establishing a basic order with respect to economic activities. The Monopoly Regulation and Fair Trade Act (MRFTA) was enacted in December 1980 and took effect in April 1981. Article 1 of the MRFTA prevents the abuse of market dominance by excessive concentration of economic power in enterprises and regulates undue concerted acts and unfair trade practices, thereby promoting a fair and free competition. This is ultimately aimed at ensuring creative corporate activities, protecting consumer interests and pursuing a balanced development of the nation's economy.

The Price Stability and Fair Trade Act produced side effects such as restricting the proper functioning of price mechanism, since the focus of the law enforcement was primarily on achieving price stability. The price authorisation by the government distorted the market function and prompted the public to expect inflation in the future, resulting in the avoidance of production, creation of double prices, and cornering and hoarding. Focusing on the regulations of the side effects arising from monopoly and oligopoly deepened the problem of monopolization. The lack of a mechanism curbing the concentration of economic power gave rise to the problem of economic concentration. For the private sector to play the lead, instead of the government, in the operation of the economy, the sections involving fair trade were separated from those on price stability under the Price Stability and Fair Trade Act. A new legislation was introduced, centring on fair trade practices. Since then, the Act has undergone 7 revisions in 1986, 1990, 1992, 1994, 1996, 1998, 1999, 2001 and 2002. In addition, the Fair Subcontract Transactions Act and the Adhesion Contract Regulations Act were enacted in 1984 and 1986 respectively, in order to protect subcontractors and consumers at the competition policy level. In 1999, the Fair Labelling and Advertising Act (FLAA) entered into force, which is aimed at preventing undue labelling and advertising and promoting the provision of correct and useful information, thereby protecting consumers (entered into force on July 1). In addition, the Omnibus Cartel Repeal Act (the Act on Regulating Undue Concerted Activities Exempt from the Application of the Monopoly Regulation and Fair Trade Act) was enacted in 1999 in order to facilitate the market economy and keep up with international trends by repealing or improving cartels permitted under individual statutes (promulgated in February 1999). Furthermore, the Door-to-Door Sales Act and Installment Transaction Act were transferred from the Ministry of Commerce, Industry and Energy under the authority of the KFTC in 1999 so that the latter has the power to protect consumers in special types of transactions. In 2002, the Consumer Protection in Electronic Commerce Act was enacted to form an institutional basis for protecting consumers' rights in electronic commerce. The KFTC also enacted the Fair Franchise Transactions Act in the same year.

The US maintains a long-established set of laws, policies, agencies, and procedures for identifying and restricting anti-competitive behaviour and unfair business practices, including anti-trust enforcement. Agencies involved in anti-trust, fair business practice, and merger reviews include the US Federal Trade Commission, Securities and Exchange Commission, the Justice Department, and (increasingly) state attorney generals. For a long period, there was a concern that anti-trust and similar legislation was having an undesired chilling effect on R&D collaboration. However, a series of federal laws since the 1980s have clarified the position, and now there is a
more positive environment for R&D collaboration. The key acts of legislation that relax competition rules and facilitate R&D collaboration include the National Cooperative Research Act (1984), which encourages US firms to undertake generic, pre-competitive, collaborative research. This act was amended by the National Cooperative Research and Production Act (1993), which allows companies to collaborate production activities as well as research activities. Additionally, the Federal Technology Transfer Act (1986) allows cooperative research and development agreements (CRADAs) between federal laboratories and other organizations, including private industrial companies. This was amended in 1999 to also allow government-owned contract research labs to enter into CRADA agreements. Through to 2003 (latest data), there were more than 900 registered US Cooperative Research Agreements. Over 2,900 CRADAs were signed in 2003.\textsuperscript{19}

6.2.4. Financial markets

In Australia there are no major concerns about the operation of capital markets. Responsibility for these matters rests with the Reserve Bank of Australia and the Treasury.

A significant development in Brazil is the cooperation of the secondary market Novo Mercado of the São Paulo Stock Market BOVESPA with the Inovar programme.

Canada has the second most intensive venture capital (VC) industry (in terms of VC as percent of GDP) after the United States. Around 0.25% of Canadian GDP is represented by risk capital. Labour-sponsored venture capital corporations (LSVCCs) are the most unusual feature of the Canadian VC industry. These funds have taken on an importance in Canada unequalled in other countries. LSVCCs are capitalized by small retail investors responding to the advantageous tax incentives offered by provincial and Federal governments. LSVCCs are intended to help maintain or create employment and to help overcome barriers to capital flow to a variety of kinds of firms including SMEs, firms in non-metropolitan regions, and technologically advanced firms. They are also intended to permit share ownership by working people, and they are in principle organized and controlled by a legitimate sponsoring labour union. The funds are required by statute to invest local capital in local firms, generally on a provincial basis, and gains realized on investments are the means by which other economic and social goals are expected to be attained.

In China, venture capital increased continuously from 2004 to 2006. At the end of 2006, gross venture capital had exceeded ¥58.39 billion. In 2006 it increased 22.17% and 65.2% of it came from overseas. An important tendency is that traditional industries started to catch VCs’ eyes, attracted ¥2.06 billion, ranking second after high-tech industry. The capital is primarily concentrated in Beijing, Shanghai and Shenzhen. Some economists argue that China should perfect its capital market system and build effective debt market system to avoid risk as soon as possible (e.g. Gang Fan; Zuliu Hu. 2007). 32% of venture capital exit through capital markets. The capital market’s role is emerging, and it is recognized that excessive government interference with the market has become a key issue of Chinese venture capital development.

Since the first VC company was established in 1985, China has had distinct achievements in VC market development. Nevertheless, there still are some problems in policies, laws, debt markets, integration of capital markets, tax, regulatory environment and the emergence of rating mechanisms. These problems will gradually be addressed. China Securities Regulatory Commission is responsible for the

\textsuperscript{19} Science and Engineering Indicators 2006, Chapter 4.
management of secondary markets, on the basis of the Securities Law and Partnership Enterprise Law. The secondary markets of China mainly have Shanghai Stock Exchange and Shenzhen Stock Exchange. China emphasizes support to SMEs through secondary markets, setting up “SMEs Board”. However, the board is not a high-tech entrepreneurship board. Now many China S&T SMEs cannot enter capital markets and have to do their marketing overseas or in Hong Kong. Whether the Second Board Market created for financing high-tech enterprises should be built in China has been a controversial issue since 1999.

In India, the Securities and Exchange Board of India (SEBI) was established in 1988. The International Organisation of Securities Commissions (IOSCO) is discussing ways to regulate the support to SMEs. Most other matters of policies and regulation for the financial markets are mediated by the Reserve Bank of India.

In Japan venture capital funds are amongst the lowest in the OECD, with many investors reluctant to engage in the risk associated with early stage companies. Government has sought to reverse this and over the latter half of the 1990s introduced a number of policy measures to increase access to finance, including preferential tax treatment for venture capital investment. At the same time, the Mothers and Hercules Stock markets in Tokyo and Osaka have sought to increase access to venture capital.

In New Zealand there is a growing venture capital industry represented by the New Zealand Venture Capital Association (NZVCA). However the starting point is rather low relative to other OECD countries. Venture market is only 0.11% of the GDP. The New Zealand Venture Investment Fund Limited (VIF) is responsible for implementing the New Zealand Government venture capital programme. VIF is a venture capital "Fund of Funds" which is investing NZ $100 million alongside private sector co-investors. VIF is running two programmes: Venture capital programme and Seed co-investment programme.

In South Korea, the financial support for private sectors’ technological development started from the late 1970s with government special purpose banks and funds. As the demands for indigenous technological development increased since 1980s, the financing supports for R&D investment and commercialisation have been developed. The Korean Development Bank (KDB) started the loan programme for technology development in 1976, and the SMBA provided the loan programme for SMEs’ technology development in 1977. During 1980s, the SME Bank (now Corporate Bank), the Kookmin Bank has started loan programmes for private sectors’ technology developments. Besides banks' loan programmes, diverse special-purposed funds are established to provide adequate loans to promote technology development. The Funds for Industrial Developments since 1980 have, in part, been used as technology loan financing for industrial technology development. In the 1990s, the funds for S&T development and the funds for ICT promotion were established for technology loan programmes. In 1987, the Credit Guarantee Funds were established to provide guarantee for governmental loan programmes, and Technology Guarantee Funds were established in 1989 to provide technology evaluations and technology financing supports. As far as the equity-based investment policy for technology financing is concerned, the four venture capital corporations (Korean Technology Advancement Corporate (KTAC), Korea Technology Development Corporate (KTDC), Korea Development Investment Corporate (KDIC) and Korea Technology Financing Corporate (KTFC) established during the 1970s and 1980s, are the beginnings of governmental technology financing. In 1986, the Law of corporate financing for the commercialisation of new technology was enacted. The Korean government created the Fund of Funds to promote the establishment of investment funds for venture business in 2005. Korea Venture Investment Corp. was designated as the institution for operat-
ing the Fund of funds. Until 2009, investment resources worth 1 trillion won will be created.

In the **USA**, risk funding comes primarily from personal savings, angel investors, and private sector venture capital firms. According to Auereswald and Branscomb, (Journal of Technology Transfer, 2003), 34% of early stage technology development capital comes from state (SBIR etc), 25% is corporate venture, 25% angel investors, 4% venture capital, and 3% universities. This financing source suffered a dramatic downturn in the early 2000s with the decline of the information technology sector. However, venture capital in the US funded $25.5 billion / €20.3 billion worth of deals in 2006, which was 12 percent higher than 2005.\(^{20}\) With the 2000 downturn, venture capital firms have been placing more of their funds into later stage technologies. As a result, seed funding has been more challenging to come by. Start-up and seed funding in 2006 was estimated at $1.2 billion/€1.0 billion, or about 5 percent of all venture capital funding. In this context, the proof-of-concept funding offered under SBIR ($2 billion/€1.6 billion) annually is a significant public alternative. Additionally, many states have formed seed capital funds and all but five states allow their retirement systems to allocate a small portion of their investments to higher risk alternatives.\(^{21}\)

### 6.2.5. Fiscal environment

Most countries reported no fiscal incentives for R&D and only indicated national agencies in charge with taxation policies (e.g. the Australian Board of Taxation, Finance Canada, the Indian Finance Ministry and Board of Direct Taxes, etc.). **China** reported a serious double taxation problem in the VC industry, between enterprise income tax and individual income tax. The problem arises from a double taxation on capital gain - VC investors pay extra-tax for the Profit-After-Tax of the VC companies, and a double taxation on Stock Dividends and stock bonus - both start-ups and VC companies are independent taxpayers of Income Tax for Enterprises.

In **Japan**, the government has sought to introduce a more favourable fiscal environment supportive of R&D through amending tax law in the following areas:

- **Special Tax Credit for R&D Enterprises** - introduced by the Ministry of Finance in 2003, comprises a proportional R&D tax credit of 8% (applicable only for fiscal years 2003 to 2005), plus 2% for corporations with a higher proportion of R&D expenses.
- For R&D activities conducted by SMEs, a **proportional tax credit of 12% plus 3%** was introduced (applicable only for fiscal years 2003 to 2005).
- For R&D activities conducted jointly by academic, business and government circles, or R&D commissioned by the government in order to promote basic studies or innovative studies, a **proportional tax credit of 12% plus 3%** was introduced (again applicable only for FY 2003 to 2005).
- The scope of qualified R&D expenses included such expenses as labour, non-personnel expenses, depreciation for machinery and buildings, and expenses of R&D activities conducted overseas. The amount of the R&D tax credit is not allowed to exceed 20% of the amount of corporation tax. The amount of the R&D tax credit exceeding this ceiling may be carried-over for one year under certain conditions.
- A review of options for tax reform is currently underway.

In the **USA**, the federal research and experimentation (R&E) tax credit is the main fiscal tool (outside of grants or loans) for stimulating R&D in the private sector. The federal R&E tax credit offers 20 percent reductions on year-to-year increases in R&D

\(^{20}\) PricewaterhouseCoopers Money Tree Survey, [www.pwcmoneytree.com](http://www.pwcmoneytree.com).

\(^{21}\) National Science Board, Science and Engineering Indicators 2006, op cit, Chapter 6.
expenditure. Most state governments also offer R&E tax credits, many of which are tied to national tax credit levels. The federal R&E tax credit was originally established in 1981 to temporarily stimulate R&E activity in the private sector. The major concern with the US federal R&E tax credit is that it is not permanent. The R&E tax credit expired in 2005 (for the twelfth time in its history), although a temporary extension was passed. The American Competitiveness Initiative (ACI) calls for making the R&E tax credit permanent, which has been a consistent priority of the current administration, but has yet to be enacted. If implemented, the ACI estimates the cost of the R&D tax credit will be $4.6 billion (€3.7 billion) in FY 2007.

6.2.6. Corporate research strategy, management and financial reporting

The major organization representing the business perspective in Australia is the Business Council of Australia - an association of the CEOs of 100 of Australia’s leading corporations. The Council was established in 1983 as a forum for Australia’s business leaders to contribute to public policy debates and build Australia as the best place in which to live, to learn, to work and do business. In 2006, the document ‘New pathways to Prosperity: A National Innovation Framework for Australia’ was released. It argues for five priorities in the creation of a comprehensive National Innovation Framework for Australia:

1. Recognise innovation as a critical national priority, and align efforts by governments and business to boost innovation
2. Strengthen linkages and collaboration between all elements of Australia’s innovation system
3. Implement specific policy and investment measures to strengthen Australia’s research networks and institutions
4. Enhance policy focus and strategic investment in education and training to improve the innovation capabilities and culture of our people
5. Undertake continuing micro-economic reforms to improve and sustain a business environment suitable for innovation.

In Brazil, large firms like Petrobras (oil & gas), Embraer (airplanes), Oxiteno (fine chemicals) and CVRD (mining) have integrated R&D into their strategy, but an innovation strategy is still being built even in these cases.

In Canada no single association or organization represents the entire Canadian business community. Major horizontal trade associations that conduct analyses and develop positions on issues related to innovation policy in Canada are the Conference Board of Canada, the Canadian Chamber of Commerce, and the Canadian Federation of Independent Business. Most industries have a peak organization, such as the Canadian Advanced Technology Association. The Conference Board of Canada focuses on the needs of the larger R&D performers in Canada and offers expertise and services in Technology Transfer and Commercialisation, Organizational Practices, Policy, Taxation and Financing, Partnerships and Clusters, Skills, Learning and Training, Information Technology and e-Business, Knowledge Management, and Measurement and Benchmarking.

In China, the R&D investment from the business sector grew over 1995-2005 from ¥34.9b to ¥ 236.7b. In 2004, a reported share of 39% of the 23,267 large and medium-sized enterprises had special R&D departments. The corporate management ability to integrate research and innovation into business strategy and management has been exposed. Many of the managers of state-owned enterprises, former “state cadres”, are gradually changing into “businessmen”. In recent years, state enterprises have moved gradually to the market economy together with the private sector.

so that innovation management has become a common theme for both state and private sector. A recent study issued in January 2007 (IPR Strategy and Management of Enterprises) showed that innovation in Chinese enterprises is mainly based on market factors (needs and pressure). In the past, the R&D departments of enterprises were mainly oriented on product development, rather than applied research, and ignored basic research. At present, they need various new technologies and imported equipment, collaboration and internal R&D. Since late 1990s, applied research has increased and moved towards Indigenous Innovation. The innovation networks spread out from the domestic to the international environment. Corporations started to use hierarchical management structures, and R&D is increasingly integrated into the firm's strategy and management.

In India the Confederation of Indian Industry (CII), Federation of Indian Chambers and Commerce (FICCI) and Associated Chambers of Commerce (ASSOCHAM) are the three main bodies representing the corporate world in commerce and industry. They develop corporate strategies and policies relating to research and innovation. The heads of these bodies are also consulted by the ministries of industry, commerce, finance and the Planning Commission on various matters dealing with corporate policies. Professional management bodies, such as the All Indian Management Association and National Productivity Council, DST and CSIR-based Technology Management groups have the role to forge horizontal links between different actors of the innovation system regarding R&D management and innovation.

In Japan, corporate restructuring in response to economic downturn is now seen as having run its course (OECD 2006). Companies are still continuing to reduce labour costs and the size of labour force, and, as firm exposure to the three excesses of employment, capital stock and debt has been reduced, the overall business investment has been increasing since 2003. Overall investment in R&D has decreased slightly between 2002 and 2003. Furthermore, there is also greater move to outsourcing R&D activities and use of universities as sources for innovation, where externally sponsored contract research has doubled over 1995 to 2003.

In terms of corporate R&D, the main challenge in New Zealand is to get firms to investing resources in R&D. Only very few firms in New Zealand engage in R&D. In industry the amount allocated to R&D is NZ$ 613 million, which accounts for only 38.5% of all funds spent in New Zealand on R&D. This very low level of investment should be seen in the light of the fact that New Zealand does not have any activity of significance within industries that traditionally allocate a lot of funds to R&D, e.g. pharmaceutical industry and chemical industry.

Corporate research strategy in the US is both varied and dynamic. While the average R&D intensity of companies performing R&D in the United States was around 3.2% in 2003, there are significant variations by sector (computer, electronics, and pharma/medical are among the highest in R&D intensity) and by size (most R&D is concentrated in larger companies). A growing share of US R&D is occurring in services (although most is still focused in the manufacturing sector). The importance of aligning research with business strategy, management, manufacturing and marketing has been recognized since the 1980s (when US firms took insights from Japanese approaches to integration). There are concerns about the sliming down of long-term basic R&D in corporations (such as IBM), and an increasing focus on shorter terms R&D. Additionally, under new decentralized competence strategies, there is awareness that some larger companies are reallocating R&D away from traditional corporate head office locations, including overseas. Financial reporting in the US has been viewed as a controversial area with respect to the ability of firms to allocate resources to innovation. The Sarbanes-Oxley Act of 2002 was passed in the wake of

several high profile accounting scandals. It requires publicly traded and privately held firms to implement a series of internal auditing and reporting controls, with requirements being especially comprehensive for publicly traded companies. Information technology systems are an important element of implementing Sarbanes-Oxley, resulting in some new investment in enterprise resource planning (ERP) systems to comply with requirements. However, it has also been observed that the cost of compliance with Sarbanes-Oxley is high.
7. CONCLUSIONS

This study examined recent developments in the research investment policies in the nine countries of concern organised around four major areas: a) research policy coordination; b) public support to research and innovation; c) redirecting public spending towards research and innovation; and d) improving framework conditions for private investment in research. An account of the main conclusions arising from the analysis is briefly presented below:

7.1. RESEARCH POLICY COORDINATION

- Common trend towards increasing coordination between different levels of research and innovation policy-making (public administration, sectoral, stakeholders, regional and international) as an institutional and policy response to emerging pressures arising from more dynamic and more complex economic and social developments;
- Institutional set-ups for coordination mechanisms bear the imprint of national historical developments and path dependencies, but tend to promote increasing coordination and integration between and across institutions, to create synergies between the innovation potential of various sectors.
- Research and innovation policies are no longer considered to be the exclusive remit of agencies in charge with science and technology development, but are increasingly integrated in other policy fields, such as enterprise, taxation, competition, regional policy, education, intellectual property rights, employment, trade and environment, suggesting significant advancements towards the so-called ‘third generation innovation policy’.
- Coordination mechanisms at the public administration level tend to evolve along two main directions: 1) development of broader framework policies to create a better and more comprehensive agenda for innovation policy (e.g. China, New Zealand, which is often linked to industrial policy or social inclusion policies, thus giving innovation policy a specific role in increasing horizontal coordination between strategic economic areas (e.g. Brazil); and 2) refocusing of S&T and innovation-related institutions (e.g. Korea) to create a broader and more focused innovation policy agenda. In both cases, the effectiveness of the co-ordination mechanisms is closely related to the clarity and legitimisation of the policy objective, which in their turn increase the public support for R&D and innovation.
- A common pattern in coordination mechanisms seems to emerge in most cases, including: 1) a lead ministry/agency in STI policy formulation and implementation in the national/federal government, which collaborates with other ministries/agencies with responsibilities in STI policy-making, 2) inter-ministerial coordination agencies, and 3) various forms of advisory bodies to the prime-minister or the government. Variations in the specific features of this institutional setup arise from the “centralized” vs. “decentralized” nature of the administration, ranging across a continuum from highly centralised (China, Brazil) to highly decentralised (USA, Australia), with various degrees of centralisation in between (Canada, India, Japan, Korea, New Zealand). Such variations often emerge from differences in the broader or narrower remit of the respective institutions, the strength of their executive and advisory powers, as well as from the nature of stakeholder representation in the inter-ministerial coordination agencies (e.g. government representatives only vs. a mixed representation of government and other stakeholders). This top-down approach is often complemented by bottom-up initiatives that draw together various mission-oriented S&T agencies in different sectors of industry and economy to reach a common objective.
- Sectoral priorities are established in a dual approach: top-down in centralized countries and bottom-up in decentralized ones, and are expressed through various forms, ranging from thematic/sectoral priorities (e.g. Australia, Brazil, South Korea) to strategic technology roadmaps (Japan, New Zealand) or clusters development (Canada, India). Commonalities in terms of prioritised areas (usually ICT,
environment, health, biotechnology, nanotechnology, etc.) appear to exist in both “large” and “small” countries, which tend to focus on existing resources in parallel with looking at the global research frontier. In large countries sub-priorities relating to special local themes and resources can be identified, belying the general perception that a few themes rule. Furthermore, selective investments in areas with high potential for growth (e.g. Canada, Japan, Korea) led to rapid advances in the international arena;

• Increasing trend towards enhancing **stakeholder participation** in a policy advisory capacity, to legitimise public action, build consensus and appropriate understanding of the respective countries’ long-term challenges, and improve co-ordination and coherence. Various forms of more or less intensive stakeholder involvement have been observed, but a clear focus on this issue exists in all countries. Notable differences have been observed in the stakeholder representation, ranging from a rich mix of actors from industry, research and higher education, government and civil society, to predominantly government agencies, or industry and civil society. The policy focus varies: from fostering industry leadership and helping industries develop strategies for growth (e.g. Australia, China) to including private industry and civil society groups represented by NGOs (India) with the objective to strengthen public-private partnerships and the human resource base in specific areas, particularly in high-tech sectors. Furthermore, stakeholders’ participation may also encompass not only industrial actors, but also research and higher education institutions, as well as civil society groups (e.g. Canada, Brazil, New Zealand, Japan);

• Inter-agency collaboration and cross-fertilisation of ideas are often promoted by policy entrepreneurs at the regional and national government levels, in universities and industry associations, who may take the lead in inventing new programmes and measures that are later generalised (e.g. Brazil). Policy entrepreneurship in government is an extension of entrepreneurial tradition in academia, introduced through a flow of academics into the government research management system.

• **At the regional level**, decentralisation and accountability of regional agencies suggest a shift towards the so-called process of ‘agencification’[^24], which reflects a changing division of labour between the upper and the lower levels of government, leaving the upper levels (ministries) responsible for policy and the lower levels charged with co-ordinating a number of instruments often financed by separate ministries. While in some cases, this measure can reduce complexity and redirect the roles of institutions, in others it may contributes to increased fragmentation. Reshaping of regional policies to make them better suited to economic and competitiveness needs appears to be present in many countries (e.g. New Zealand, Japan, China) and is accompanied by further devolution of funding towards regional governments. Growing involvement of universities in regional economic development is a common feature for all the countries examined, with a combination of top-down and bottom-up approaches. An increasing interaction between the central and regional levels of coordination has been observed, with central governments tending to give stronger powers to the regions, and federal governments tending to intervene to correct regional imbalances. S&T developments tend to be growingly used in reducing regional disparities (China, Brazil).

• **International cooperation** in research is usually promoted through various bilateral programmes and scientists exchange programmes funded at national or regional level, and in some cases, through bilateral agreements on S&T collaboration with the EU (e.g. US, New Zealand, India). The development of more strategic international consortia focusing on selected high-tech areas is a recent trend (e.g. Japan, Canada).

### 7.2. PUBLIC SUPPORT TO RESEARCH AND INNOVATION

• The development of **human resources for S&T** is a key policy issue in all the countries examined and is pursued through wide-ranging policy measures, from improvement of the higher education system to the provision of skilled workforce for industry, attracting young scientists and improving women’s participation in S&T related careers. Strong emphasis is placed on the public and private funding for improving the higher education system (e.g. Korea, Japan). Early identification of talent and full support for training needs, at least through the PhD, is becoming commonplace, with some notable developments in China, India and Australia. The supply of trained human resources for S&T takes a specific dimension in the context of Japan's ageing population or the USA's concern for declining flows of international scientists after the 9/11 events, and is often combined with initiatives to attract foreign researchers or increase women’s participation in S&T.

• The initiatives meant to strengthen the **links between the public research base and industry** typically involve various forms of support for university-industry-government links or small businesses. The increasing inability to distinguish R&D from industrial policy is reflected in disputes over “subsidies” to industry and how they are to be defined. The government can play a key role in promoting the use of advanced technology to revive declining industries. An activist trend in this direction may be discerned, especially when one country’s emerging industry may be another country’s mature industry. Another trend consists of initiatives designed to fill gaps in the innovation process, whether forward linear from the science base or reverse linear from firm needs, whether expressed by the players themselves, imputed to them by policy-makers, or increasingly through interaction. The common emerging objective, whether implicit or explicit, is to create a “seamless web” from enhancement of the science base to economic growth.

• Two main approaches have been identified in the efforts to **improve the mix of public financing instruments**: (1) making funds available directly to firms to assist in the commercialisation of new technology, either through grants, loans or some combination of the two, with differing emphases on funding approaches in different countries and (2) making funds available for collaborations with universities and/or other intermediaries and quasi-intermediaries, including not-for-profit institutes and government labs to assist the innovation process. These two basic approaches are not mutually exclusive. They may be combined in various mixes, with sectoral emphases and other priorities mandated or left open-ended to take advantage of new possibilities that may not be foreseen in advance. A remarkable efflorescence of publicly inspired venture capital instruments targeting different phases and stages of firm formation and growth was observed across the nine countries, irrespective of their stage of development, suggesting that the translation of R&D into economic goods may be the driving force that reaches back and stimulates the increase in R&D spend as the pump priming mechanism for these emerging venture capital industries. Public venture capital instruments have evolved, carefully balancing mixes of public and private funds with the weighting coming out differently in various financial environments, depending upon the readiness of private capital to act.
7.3. REDIRECTING PUBLIC SPENDING TOWARDS RESEARCH AND INNOVATION

- The increase in the proportion of GDP devoted to R&D is a general objective within a stronger trend of linking R&D more directly to innovation and commercialisation. There is a related trend toward identifying niche areas within broad technology themes, relevant to current national issues, with a focus on increased partnering between national and regional authorities in federal systems, especially since strengths in niche areas are typically location-specific. The increase in R&D spend is oriented towards (1) attaining economic value from R&D spend, especially from potentially discontinuous innovation in universities and; (2) appropriate mechanisms to aggregate research collaborations across distance, looser than large-firm R&D structures but tighter than EU networks e.g. the Canadian Network Centres of Excellence Programme.

- Identifying key themes building upon local strengths and/or creating new ones that a broad range of stakeholders can rally around is an emerging trend. A shift from incremental to discontinuous innovation may also be discerned in these broader projects that typically rely on an emerging S&T area, even when building them upon traditional knowledge as in India, and create “hype” and hope around them. Narrower policies focused on specific firms as “national champions” may be ebbing at least by contrast with the growing trend to focus on new technology-based firms and clusters how to promote their growth.

- State aid appeared to be interpreted in different ways in the countries examined, but is generally understood as industrial policies and government subsidies to firm R&D that may be limited by competition policies. Encouraging university-industry partnerships is generally viewed as a mechanism to resolve that issue while also bringing firms together to co-operate around pre-competitive themes when action is believed appropriate.

- There is a general, although not universal trend, to using public procurement to promote innovation in advanced areas of technology that have been identified as foci of interest. Unified information policies and programmes have not been identified as a “strong suite” with the notable exception of India, which is expanding its capabilities.

7.4. IMPROVING FRAMEWORK CONDITIONS FOR PRIVATE INVESTMENT IN RESEARCH

- There is a general trend toward enhancement of intellectual property as an innovation strategy. IP tends to evolve along contradictory trends in developing and advanced industrialized countries, with developing countries becoming more interested in adopting IP strategies to protect unique local knowledge, and advocates of collaborative technology development in advanced countries arguing against IP protection as retarding the pace of technological advance. In addition, on the one hand, government agencies are performing an educational role in enhancing the awareness of industry and academia of the importance of IP, (e.g. Australia) and on the other, changes in the legal framework are introduced to incentivise universities to protect and commercialise IP (e.g. Japan).

- There is a concomitant shift to seeing IP and R&D measures, in general, as a means to the end of economic growth rather than as an isolated policy area. Different emphases may be discerned in various countries but the general direction is more or less similar in all countries examined. Japan may be seen as the strongest case of IP strategy, through legal change and funding of IP protection in universities, while Canada may be seen as the exemplar of a spin-off focus. The US pursues both strategies more indirectly, with a shift in emphasis in universities, over time, from IP protection as an end in itself to facilitating start-ups. The process, instantiated in academia as a re-organization of technology transfer into enterprise development occurs isomorphically, by example, rather than through central direction, as in S. Korea. Interestingly, the Indian focus is on systematizing
traditional knowledge that may be useful to contemporary product development and, especially, in developing an IP strategy to protect this knowledge form foreign appropriation.

- A general trend exists towards enhancement of standards as a key part of innovation strategy and the strengthening of the role and funding of Standards Agencies. Although most agencies are focused on expanding traditional functions tied to metrology, the US agency has been given a more direct role in creating programmes to encourage industry collaboration and university-industry cooperation based on an underlying theme of identifying areas for co-operation and collaboration bottom-up but with the encouragement of Agency experts who identify potential areas to address and then seek out potential proponents and collaborators in developing specific programmatic initiatives e.g. ATP focused programmes on particular technology themes.

- Competition policy walks a tightrope between encouraging collaboration among firms to promote innovation and discouraging collaboration to set prices. In most countries, competition policies are formulated and implemented by specialised national agencies, except for Brazil, where the regulation of competition is rather confusing, with multiple institutions competing for a mandate in this area.

- The definition of ‘financial markets’ is broadening to include early stage seed capital for new enterprises and creation of equity markets for emerging firms with growth potential. Developing countries, like Brazil, have also recognized that it is not only necessary to create new financial mechanism but it is equally important to educate technology entrepreneurs on how to address these opportunities. Again, as with IP, government play an educational role in running and training programmes to enable potential users to take the fullest advantage of new opportunities.

- Trends in corporate R&D are contradictory. Large firms, in many countries that traditionally invested heavily in R&D have downsized and reduced their R&D spending. On the other hand, a significant number of both large and mid-sized firms have increased their collaborations with universities, often aided by government programmes, especially in the area of so-called pre-competitive R&D, a relatively new term that reflects the trend toward collaboration and provides a means of conceptualising and justifying this trend. There is also a relatively new trend of high-growth firms establishing relatively small R&D units adjacent to universities, often located in science parks, to take advantage of collaboration opportunities, gain a window on commercial opportunities from basic research and, of course to provide opportunities for recruitment. Brazil, for example, has used tax incentives to encourage multinationals to establish R&D units and encourage learning about the innovation potential in local universities.
8. POLICY RECOMMENDATIONS

The policy recommendations formulated in this section address the main weaknesses of the European Research Area as identified in the Lisbon Strategy and also in the recent ERA Green Paper:

- Fragmentation of research activities and dispersal of resources, poor integration and coordination in research and innovation policies at national, EU and regional levels;
- The need for creating an environment that stimulates research and exploitation of results, across six main axes: human resources, infrastructure, stronger public research organisations, sharing of results and experience, coordination and integration, and internationalisation.

The suggested policy recommendations to address these issues include:

- Incentivise government institutions below the national level to take new initiatives. However, this bootstrapping should not be managed from top as it would block search for local solutions that could be up-scaled later on if successful. These may later become a model for national level policies as in Brazil and U.S. The Brazilian and U.S. federal systems have provided a clear channel for regional S&T/economic development initiatives. The achievement of regional autonomy in Scotland and the introduction of regional government in the Madrid capital region have led to a significant increase in activity indicating the potential for further activating the regional level to operate with a higher level of autonomy, especially in countries where it is still an extension of the national government. As a relatively new policy area, the economic potential of R&D provides an impetus for regions to design collaborative projects, typically under the rubric of Science City or Knowledge region. Having the ability to respond to EU initiatives is a driver of regional innovation capacity and commitment of local funds. Encourage creation of R&D agencies at the regional and even local levels as in Brazil. Competition among states to take leadership in fields such as stem cells drives R&D spend up in the US.

- Strengthen the lateral collaboration among R&D and innovation agencies within and across national boundaries, to create critical mass in emerging technology areas. A relevant example in this sense could be the Canadian Research Centres of Excellence that bring together academic and industrial R&D groups to collaborate over long distances and periods of time.

- Encourage links among universities to create critical masses of expertise in special fields regionally and across regions. A notable development in this sense is the development of strategic international consortia, such as Japan’s Strategic Fund for Establishing International Headquarters in Universities (JSPS) or Canada-California Strategic Innovation Partnership (CCSIP).

- Identify specific individuals as “thought leaders” around whom major programmes linking university-industry and government can be built e.g. Kalyeros nano chip design initiative among New York State University at Albany and IBM.

- Build upon cyclical trends to expand R&D expenditure, but also develop measures to incentivise counter-cyclical increase. It is in the downturn that human resources are especially available to form new enterprises. For example the 2000 bubble burst in Silicon Valley led to a wave of firm formation in India as resources became available in that country. Brain drain became brain re-drain. The return of some of the Silicon Valley diaspora that was impelled by economic necessity has also been encouraged by programmes to attract persons to reconnect to their home countries. To gain the benefit of their expertise, it is
not necessary to bring them home fully. Indeed, persons moving back and forth between the Valley and local technology conurbations may provide the missing link to connect firms to larger markets. Replicating some of the clubs of Indian and Chinese entrepreneurs in major world technology centres with significant EU populations through policy initiatives might be considered.

- Encourage the emergence of distributed firms across technology regions, taking advantage of complementary capabilities. Joint professorship in universities in different countries and regions are one basis for creating these linkages. For facilitating such developments, new academic arrangements could be introduced, such as reducing the usual length of university positions to more flexible commitments encouraging multiple positions. This is a measure that can be taken, with and without financing to enhance the process. Of course, new positions could be created as a multi-national initiative by the EU. Such positions could also be across university-industry lines, such as the Newcastle University’s ‘Professors for Practice’ initiative, which gives half-time positions in university and industry R&D.

- Develop counter-cyclical R&D funding strategies, less dependent on the vagaries of the business cycle i.e. debt funding. Utilizing financial mechanism originated to support construction of moderate-priced housing on a long-term self-financing basis in California, bonds are expected to be issued, once legal challenges have been surmounted, to support academic research and facilities construction as well as government supported venture funding for new firms. The expectation for payback is two-fold (1) return to government of a share of IP generated; and (2) equity held in firms funded by state government supported venture capital initiatives. The implicit premise of this initiative is the venture capital expectation, dating from the founding of the venture capital industry in the early post war, initially in mini-computers (Digital Equipment Corporation) that one significant growth firm will cover all losses while producing a step change in revenue generated and subsequent economic growth by creating a new industrial area.

- Develop a significant number of start-up entrepreneural universities at the European level, combining the highest levels of academic activities with societal involvement, as a challenge to existing foundations, on the one hand, and as potential collaborators on the other. This policy can only work if it is not seen as reducing funds at the national level, but providing a clear add-on as a way of realizing Lisbon and Bologna objectives simultaneously.
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<th>No.</th>
<th>Name</th>
<th>Institution</th>
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<tbody>
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<td>21</td>
<td>Prof. Jan Youtie</td>
<td>Georgia Tech</td>
<td>Country Correspondent USA</td>
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ANNEX 2 – Structure of the Country Profile template

• Overview
  o Basic characterisation of research system
  o Main challenges for research policies
  o New research policy developments
• Current Status of Research Policy
  o Broader policy context of research policy
    • Recent political events with major influence on research policy
    • Impact of EU enlargement
    • Relevance of Research Policy in the general policy
  o Research Policy
    • Current research policy goals
    • What type of research is prioritized
    • Key priorities
    • Main elements of research policy
    • Research Policy Trends
    • Other Policies Influencing Research
      • policy mixes to stimulate research
  o Impact of EU developments
  o Regional Research Policies
    • Research policy debate: current issues and concerns
• Important Policy documents
• Structure of Research system
  o Organogram
  o Brief description
  o Evolution of the research governance structures
  o Role of the regions
• Main Research policy setting mechanisms
• Research funding system
  o Overview of structure
    • Graph/organogram on funding flows
    • Brief description
  o National Public Research Funding
    • Overview
    • Basic research funding
    • Thematic priorities and other targeted funds
    • Institutional funding
    • Co-funding and indirect funding of private R&D
  o Role of European and international funding
  o Private research funding
    • intramural
    • extramural
  o Charitable Foundations / not-for-profit-funding
  o Important Research Programmes
• Research performers
  o Universities
  o Public Research Organisations
  o Research and Technology Organisations
  o Private research performers
  o Partnerships
• Key research indicators
  o Research activities by sources of funds
  o Additional relevant indicators
• Additional Remarks
Please provide a brief summary and assessment of research investment policies in your country that can be included in the broad categories defined below. The Fiche should only include a short description of the issues of concern, while the broader description should be left for the Country Profile. If applicable, please highlight distinctions between policies at federal and state level and provide an assessment of coherence/consistency between the two levels.

### 1. RESEARCH POLICY MIX AND COORDINATION

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. At public administra-</td>
<td>Policies that support the horizontal co-ordination and the development of a systemic view of the various actors and resources which need to be mobilised to foster investment in research and innovation, in different sectors of the public administration, between which co-ordination needs to be strengthened.</td>
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<td>tion level</td>
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<td>2. At sectoral level</td>
<td>Research policies in sector-specific issues, specific objectives and milestones, e.g. in ICTs.</td>
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<td>3. At stakeholders level</td>
<td>Policies to support stakeholders involved in the development and deployment of key technologies (as exemplified by the European Technological Platforms), who develop a common strategic agenda addressing research, regulatory and standardisation issues, etc.</td>
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<tr>
<td>4. At regional level</td>
<td>Policies to reduce regional disparities and allow regions to benefit from increased research and innovation.</td>
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<tr>
<td>5. At international level</td>
<td>Policies that facilitate mutual learning between countries to increase and improve research investment, or exemplify coordinated actions for developing human resources in S&amp;T, or the development and deployment of key technologies.</td>
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### 2. PUBLIC SUPPORT TO RESEARCH AND INNOVATION

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<th>Area</th>
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<tbody>
<tr>
<td>1. Human resources</td>
<td>Policies on labour market, employment, education and training, and immigration to attract world-class researchers, make research more attractive to various categories of the population, especially women; reduce losses at the various stages of education and during the research career.</td>
</tr>
<tr>
<td>2. Public research base and its links to industry</td>
<td>1. Policies supporting university-enterprises partnerships aiming at sustained, long term interaction; regulatory and administrative reforms; support measures to enable public research institutions to develop more effective links with industry, in particular SMEs, while safeguarding their public mission in education and fundamental research; establishment of incubators, science parks, seed funds and new types of public-private partnerships and the performance appraisal of researchers.</td>
</tr>
<tr>
<td></td>
<td>2. Policies to increase the participation of industry and other stakeholders in the determination of priorities for public research;</td>
</tr>
<tr>
<td></td>
<td>3. Policies to change national IPR regimes governing the ownership, licensing and exploitation of IPR resulting from publicly-funded research, with the aim of promoting technology transfer to industry and spin-off creation.</td>
</tr>
</tbody>
</table>
### 2.3. Improving the mix of public financing instruments and their effectiveness

- **1. Mix of financing instruments**: (major financial instruments that complement R&D and innovation expenditure, optimisation of national mix of financing instruments taking into account the characteristics of research and innovation systems, international experiences, needs for different industry segments)

- **2. Direct measures for research and innovation**: (grants, conditional grants or loans, elimination of rules and practices in national programmes that impede international cooperation and technology transfer, foreign funding of organisations, etc.)

- **3. Fiscal measures for research**: (use of fiscal incentives to encourage creation and early growth of research-intensive firms, fund raising by new or existing foundations supporting R&D activities, use of fiscal incentives to raise attractiveness of research careers, improvement of fiscal measures for research)

- **4. Support to guarantee mechanisms for research and innovation in SMEs**: (equity investment of venture capital funds or loans, use of guarantee mechanisms to improve access to debt and equity financing for research and innovation activities in SMEs, national and regional guarantee programmes to improve access to debt and in particular equity financing for research and innovation in SMEs)

- **5. Support to risk capital for research-intensive SMEs**: (Networking activities for risk capital fund managers and business angels, encouraging the emergence of co-ordinated risk capital activities, seed and early stages, including incubators and funds established jointly by networks of universities), increasing awareness of research-intensive SMEs about appropriate use of risk capital notably through actions at regional level).

### 3. Redirecting public spending towards research and innovation

#### 3.1. Refocusing public spending towards more productive investments, notably in support of research and innovation

| Policies supporting investments that lead to higher sustainable growth in the future |

#### 3.2. State aid

| Policies to redirect State aid towards R&D as part of the more general redirection of State aid towards horizontal objectives |

#### 3.3. Public procurement

| Health care, education, transport, environmental protection and defence where the public sector can act as a launching customer |

#### 3.4. Development and diffusion of information

| Policies informing on the best available technologies for key categories of products, enabling public buyers to procure technologies that best fit their needs, in particular in sectors such as health, environment, transport and education where they are often first customers |

### 4. Improving framework conditions for private investment in research

#### 4.1. Intellectual property

| Incentives to innovate and invest in research, IPR in academic institutions and smaller businesses, IPR awareness and training activities targeting in particular the research community, specific research-related aspects of IP law, legislation applicable to technological know-how, basic awareness/training regarding intellectual property and technology transfer |

#### 4.2. Regulation of products and standardisation

| 1. Policies to support research required for completing the development of standards; awareness of standards to allow business, notably SMEs, to take them better in account in their research and innovation projects.  
2. Technological areas where existing legislation or the lack of legislation impedes the development and deployment of new technologies;  
3. Links with European standardisation organisations |

#### 4.3. Competition rules

| Anti-trust laws, block exemption, technology transfer agreements, effects of research and innovation activities in merger decisions, etc. |

#### 4.4. Financial markets

| Risk capital markets at start-up and growth stage, secondary markets for the financing of initial public offerings and subsequent expansion, debt markets, integration of capital markets and the emergence of rating mechanisms appropriate to technology-based companies, including SMEs, the tax and regulatory environment of risk-capital. |

#### 4.5. Fiscal environment

| Double taxation (investors and funds), technology rating to assess the value of an innovative technology-based product or service |

#### 4.6. Corporate research strategy, management and financial reporting

| Corporate policies for integrating research and innovation into business strategy and management, integrated approach to R&D management within the overall business strategy. |
ANNEX 4 – Minutes of the Seville meeting and conference calls Newcastle University-IPTS

4.1. Minutes of the Seville meeting (2 February 2007, Room 97, IPTS, Sevilla)

The First Co-ordination Meeting of the RIP-WATCH International Overview took place on 2 February 2007 (Week 5) at IPTS Seville, according to the provisions of the Specific Contract of the project. The agenda of the meeting is presented in Annex 1.

The meeting was attended on behalf of IPTS by Dr. Mark Boden, Dr. Gaston Heimeriks and Dr. Andries Brandsma. In the afternoon part of the meeting, the IPTS Country Desk officers responsible for the nine countries covered by the project were also invited to participate (see Agenda). On behalf of Newcastle University the meeting was attended by Prof. Henry Etzkowitz and Dr. Marina Ranga.

The meeting started with an ERAWATCH overview by Dr. Mark Boden, who presented the background and rationale of this joint initiative of DG Research and IPTS Seville, the key elements of the Base load Inventory and the functioning of the Knowledge Management Infrastructure, the structure of the ERAWATCH country profiles, the coordination role performed by the ERAWATCH Network asbl and its links with IPTS, as well as the future development prospects of ERAWATCH.

Dr. Andries Brandsma continued with a presentation of the Research Investment Policies Monitoring and Analysis undertaken by IPTS in the framework of its Support to the implementation of the 3% Action Plan (WP1). Dr. Brandsma referred to the close links between RIP-WATCH and ERAWATCH in the process of structuring the collection and analysis of information and data on R&D related policies and initiatives in the Member States. He emphasised the particular focus of RIP-WATCH on such issues as: the public research spending and other policies influencing R&D intensities in the private sector, the increasing need for benchmarking based on a coherent set of indicators on the national (and regional) capacities for research and innovation, including human resources, and the support for policy learning on research investment policies in non-EU countries. Dr. Brandsma also referred to the broader context in which the RIP-WATCH project is being undertaken, including the Open Method of Coordination (OMC) and the CREST expert groups (on science-industry links, fiscal incentives, IPR, SMEs, policy mixes) created to apply the OMC to the 3% Action Plan, as well as the RIP-WATCH development prospects beyond 2006.

The meeting continued with an overview presentation of the RIP-Watch International Specific Contract by Prof. Henry Etzkowitz, who gave an account of the aims of the project, the approach adopted by the Project Management team, the participants and the phases of the project. Among the aims of the project, Prof. Etzkowitz included: to improve understanding of research investment policies and trends in nine non-EU Countries and draw conclusions relevant to the Lisbon Strategy, to identify lessons for EU policy-makers from research investment policies elsewhere and assess the impact of the nine non-EU countries research strategies on EU competitiveness.

Prof. Etzkowitz mentioned that, in order to achieve these goals, the Project Management team of Newcastle University adopted a multi-sided approach, centred on the creation of a Project Network (including the Project Manager – himself, the Deputy Project Manager – Dr. Marina Ranga, two Senior Policy Analysts – Mr. Ken Guy and Dr. Sachi Hatakeneka, a Quality Manager – Prof. Slavo Radosevic, and 14 Country Correspondents - see Annex 2). The Project Network members have already started their work, in line with their specific tasks, focusing on the data collection methodology, the assessment of the existing Country Templates in the ERAWATCH Base load and suggestions for additional template fields, the reviews of the First Phase Reports (for Canada, China, Japan, South Korea, USA) and the existing Base load Inventories (for China, Japan, USA). The Project Management team is thus implementing a differentiated country approach, taking into account the previous work done for some of the countries of concern, in parallel with a common core of rules and principles that reflects the ERAWATCH/IPTS quality management rules and standards.
Prof. Etzkowitz also emphasised that the very structure of the Project Management team and country correspondent teams proposed for the project illustrates this multi-sided approach that combines academic and policy expertise. The Newcastle University’s Triple Helix Group provides a global RDI perspective that is complemented by the broad international R&D policy expertise of the two SPAs (Mr. Ken Guy and Dr. Sachi Hatakenaka) and the in-depth evaluation experience of the Quality Manager (Prof. Slavo Radosevic). The country correspondent teams comprise in most cases two people, in order to ensure a balanced distribution of tasks within the team. In two cases where country teams included one person only (South Korea and Brazil), efforts are currently being made to add a second person. As the proposed additions are of a similar category of expertise, this change will only affect the distribution of workdays and the budget allocations within the team, and will not change the overall funding allocated to the country team. The issue of adding another correspondent to each of the South Korea and Brazil teams was discussed with the IPTS representatives and the technical aspects of the procedure have been clarified.

A revised form of the Specific Contract including the changes in the number of workdays per correspondent and budget allocations within the country team will be submitted by Newcastle University to the ERAWATCH office by 5 March 2007.

Regarding the phases of the project, Prof. Etzkowitz mentioned that the project team is now moving towards the completion of the Inception phase, and is preparing for the Implementation phase, which includes the completion of Country Profiles and Summary Fiches, as well as Network Review Meeting. The last phase of the project will include the preparation of the Draft and Final Synthesis Reports, which will be submitted to IPTS on 22 April and 22 May respectively.

The next phase of the meeting included a more detailed discussion of the existing Country Profiles in the ERAWATCH Base load inventory and use of KMI, Quality Assurance issues, day-to-day liaison with IPTS, meetings/teleconferences and the role of the IPTS Country desks.

In terms of the existing Country Profiles in the ERAWATCH Base load inventory, use of KMI and Quality Assurance issues, Dr. Mark Boden asked Dr. Marina Ranga, to provide the names and emails of RIP-WATCH country correspondents in order to make arrangements to grant them access to the KMI. He stressed the need for the RIP-WATCH country correspondents to carefully examine the structure and length of the existing Country Profiles in the ERAWATCH Base load Inventory (especially some that were recognised as very well done, e.g. for Ireland, Japan, etc.) and provide similar structure and length in their own Country Profiles, to ensure horizontal consistency and comparability. The Country Correspondents should also look in detail at each others’ profiles to help ensure horizontal consistency.

He also mentioned the need for regular updating of the Country Profiles and a mainly descriptive presentation of national developments, based on facts and figures and avoiding value judgements. Dr. Boden recommended that the last available version of the ERAWATCH guidelines be made available to the RIP-WATCH country correspondents.

In terms of day-to-day liaison with IPTS, Dr. Boden mentioned that communication should be addressed to Dr. Gaston Heimenks, with a copy to him, while communication regarding KMI issues should be addressed to Dr. Viola Peter (ERAWATCH Office). Telephone conferences will be organised on a monthly basis, to discuss progress on administrative, technical and content issues. The first telephone conference will be organised on Friday 2 March at 12.00 (IPTS time).

The parties also discussed the date and location of the Network Review Meeting and agreed that the meeting will be held in the first week of May in Newcastle. The dates of 3-4 May 2007 were found to be most convenient for travel arrangements. Dr. Boden informed that IPTS will be represented by max 2 people. Dr. Ranga mentioned the Newcastle University team’s wish to invite a number of key people related to the project (e.g. DG Research) to attend the meeting and asked Dr. Boden’s advice in identifying such people. Dr. Boden agreed to provide suggestions regarding DG Research representatives to be invited at the meeting. Further consultations regarding the Network Review Meeting will also be held with the ERAWATCH Office in Brussels.
The meeting continued with a presentation of the Inception report by Prof. Henry Etzkowitz. He mentioned the main focus of the report on a common theme: the dynamic change and trans-national learning, as well as the factors affecting the efficiency of research investment policy: rate of change, amount of investment, use of intellectual property rights to encourage R&D investment, the relationship between public and private venture capital, the role of university-industry-government links in fostering innovation, entrepreneurship and start-ups, etc.

The common theme was complemented by special foci, such as: the emergence of Triple Helix issues in China; human resources and poverty or the differentiated R&D agenda of the government, firms, NGO's etc. in India; the private vs. public R&D debate in South Korea, R&D-based entrepreneurship in Brazil, etc. He also presented a few issues related to the structure of the Country Summary Fiche proposed by the country correspondents.

Dr. Mark Boden expressed IPTS' general satisfaction with the Inception Report and asked for a few changes to be made, particularly in the Methodology section of the report, which should be presented in a more structured way and a more readily comparable format, and the addition of a draft structure for the summary fiche. He mentioned that a complete list of changes required by IPTS to the Inception report, as well as to the Review of First phase reports will be sent to the ERAWATCH office in the coming days. With regard to the structure of the Country Summary Fiche, Dr. Boden recommended to keep the headings of the Country Reports and define further sub-headings. The overall length of the Country Summary Fiche should be of max. 3 pages. Dr. Boden also recommended the involvement of the Senior Policy Analysts, especially Mr. Ken Guy, in the elaboration of the Country Summary Fiche structure.

After lunch, the meeting continued with a presentation of the Review of the First Phase Reports, by Prof. Henry Etzkowitz. The Country Desk officers in charge with the respective countries (see Agenda in Annex) have been invited to attend this part of the meeting. Prof. Etzkowitz expressed the general view that the First Phase Reports are useful overviews of R&D systems in the respective countries, but in most cases updates and extensions have been recommended in order to capture new developments and special features, such as the federal/regional dimension (in China, Brazil, USA); the top-down innovation model (in China), civil vs. Defence R&D (in USA), human resource issues (ageing) in Japan.

The Country Desk officers expressed their views on the reviews. In general inconsistency between them in terms of length, style and elements included was noted. Regarding the Canada review, Mr. Alex Grablowitz suggested that the connection with Europe should be better described. Regarding the US review, Dr. Paul Desruelle found the short length of the review rather disappointing and suggested a more elaborated analysis of the impact of defence R&D on public policy. Regarding the China review, Mr. George Chorafakis suggested that a more geographical distribution of R&D resources and regional disparities be addressed.

In the last part of the meeting, the work plan for the next phases of the contract and the main action points by Newcastle University and IPTS were discussed.

For the Newcastle University team, the following action points and deadlines have been agreed:

• Send IPTS a list with the names and emails of RIP-WATCH country correspondents in order to provide them access to the KMI.
  Deadline: immediately (Dr. Ranga gave Dr. Boden the required list at the end of the meeting)

• As soon as the access to the KMI is granted, the RIP-WATCH correspondents will be sent an information pack including all the necessary guidelines for the work on the Country profiles. The information pack will be prepared by Dr. Ranga and will be circulated to the ERAWATCH office (Dr. Viola Peter) and IPTS (Dr. Mark Boden) for possible additions.
  Deadline: 28 February 2007

• Initiate the arrangements for the Network Review Meeting.

• Produce the revised version of the Inception Report and Review of the First Phase reports, including a proposal for the Country Summary Fiche. The fiche should be produced in consultation with the SPAs and IPTS.
• Send a revised version of the Specific contract and the Declarations of absence of conflict of interest for the new correspondents to the ERAWATCH office in order to finalise the contractual procedures.
  Deadline: 5 March 2007
• Produce the minutes of the meeting.

For the IPTS, the Action points included:
• Send the formal response about the first deliverables.
  Deadline: 7 February 2007
• Send contact information regarding the Country Desks.

Dr. Boden recommended that the minutes of this and other meetings (including teleconferences) be included as an annex to the Final Report.
4.2. Minutes of the 1st conference call (2 March 2007, 12.00 IPTS time)

The first conference call related to the RIP-WATCH International Project was held on 2 March 2007, with the participation of Dr. Mark Boden, Dr. Andries Brandsma and Dr. Gaston Heimeriks, on behalf of IPTS, and Dr. Marina Ranga, on behalf of Newcastle University.

The conference call focused on the following issues:

1. Minutes of the Seville meeting and issues arising/action points
Dr. Mark Boden confirmed receipt of the Minutes of the Seville meeting (2 February 2007), sent by Dr. Ranga in advance to the conference call. The main action points agreed upon in the Seville meeting have been included as agenda items for this first conference call, in order to assess progress.

2. Revised versions of the first deliverables:
   a. Inception Report, including the Country Summary Fiche
   b. Review of the First Phase reports.
Dr. Boden confirmed receipt of the RIP-WATCH first deliverables and informed Dr. Ranga on IPTS’ decision to approve them, with the formal letter of acceptance following shortly. With regard to the elaboration of the Country Summary Fiche, Dr. Boden suggested that a pilot phase be adopted, in which one or two fiches would be prepared, assessed and then sent as reference to the Country Correspondents. Upon consultation, it was agreed that two fiches will be prepared in this phase, for Japan and Australia, and sent for evaluation to the two SPAs (Dr. Sachi Hatakenaka and Mr. Ken Guy), the Quality Manager, Prof. Slavo Radosevic, and the IPTS (M. Boden, A. Brandsma, G. Heimeriks).

3. Changes arising from the inclusion of new country correspondents in the project team network
   a. People included
   b. Contractual procedures (sub-contract, Declarations of absence of conflict of interest)
   c. Revised version of the Specific Contract
Dr. Ranga informed the IPTS team about the inclusion of a second member in the South Korea team: Dr. Hoon-Gi Kim, Visiting Scholar at the State University of New York, USA, without affecting the overall budget allocated to the Korean team. As the two Korean experts have the same expert category, the only change involved was the re-allocation of the total number of 10 workdays, i.e. 6 days to the initial team member, Dr. Woosung Lee, and 4 days to the new team member, Dr. Hoon-Gi Kim. Dr. Ranga told the IPTS team that Dr. Kim was informed about the contractual procedures and was asked to send the necessary documents to the ERAWATCH Network Office as soon as possible in view of concluding the sub-contract. She also confirmed that the revised version of the Specific Contract, including the changes arising from this inclusion, had been sent to the ERAWATCH asbl Office a few days in advance to the meeting. IPTS require a formal letter from the EWN asbl.

4. Access to KMI for RIP-WATCH correspondents and start of the work on the country profiles
   a. Interaction with the ERAWATCH office to provide access details to the CCs
   b. Preparation of the information pack for the CCs
   c. Interaction with the IPTS Country Desks
Dr. Ranga informed the IPTS team on the interaction with the ERAWATCH office (Dr. Viola Peter) in order to provide access to the KMI for the RIP-Watch International correspondents, including the newly-added member of the S. Korea team. Dr. Boden announced the intention of the IPTS Country Desks responsible for the nine non-EU countries of concern for the RIP-WATCH International project to introduce themselves and their role in the project through a note to the Country Correspondents. Dr. Ranga informed that the information pack for the Country Correspondents was close to completion and asked for additional advice regarding some of the issues addressed in the document.

5. Arrangements for the Network Review Meeting (3-4 May 2007, Newcastle)
   a. Status of preparations
   b. Possible additional funding sources for inviting all the CCs, not just one per country
   c. Other invitees (DG Research, etc.)
Dr. Ranga informed the IPTS team that the preparations for the Network review meeting had been started and an invitation letter was sent to network members, proposing the meeting to be held in Newcastle on 3-4 May 2007. She also informed the IPTS team that an invitation letter for the IPTS representatives (including a draft agenda of the meeting) will be sent shortly. She mentioned that additional funding is being actively sought by the Newcastle team in order to complement the project budget and ensure participation of additional Country Correspondents, as well as other UK and international guests who could actively contribute to the works of the RIP-WATCH network. Dr. Boden will send the names of a few possible other invitees shortly.

N.B Following the telephone conference these dates subsequently turned out to be impossible for several network members, and the Newcastle team proposed by e-mail the alternative dates of **30 April-1 May**, which seemed to be more convenient and were confirmed as definitive.

**6. Other issues**

The date of the next conference call was agreed for **30 March, 12.00 (IPTS time)**.
4.3. Minutes of the 2nd conference call (30 March 2007, 12.00 IPTS time)

The second conference call related to the RIP-WATCH International Project was held on 30 March 2007, with the participation of Dr. Mark Boden, Dr. Andries Brandsma and Dr. Gaston Heimeriks, on behalf of IPTS, and Dr. Marina Ranga, on behalf of Newcastle University.

The conference call focused on the following issues:

1. Minutes of the previous conference call (2 March) and issues arising/action points
Dr. Boden mentioned that all the action points arising from the previous conference call have been fulfilled and asked for a formal request letter to be sent to IPTS on behalf of the ERAWATCH office seeking approval for the extension of the Korean team with a new member. To this purpose he suggested that a draft letter be prepared by Newcastle University and sent to IPTS for consultation before the formal submission.

2. The pilot phase in the completion of Country Summary Fiches:
   a. Overall assessment of the pilot phase
   b. The two pilot fiches for Australia and Japan
   c. The revised guidelines
Dr. Boden expressed his satisfaction with regard to the pilot phase of the Country Summary Fiche preparation and mentioned that it has been a useful exercise that has clarified many of the issues involved by these deliverables.

3. Access to KMI for RIP-WATCH correspondents and progress in completing the Country Profiles (based on the Progress Report of the CCs on 23 March)
   a. Interaction with the ERAWATCH office to provide access details to the CCs
   b. Technical Problems
   c. Interaction with the IPTS Country Desks
Dr. Ranga informed the IPTS team about the interaction with the ERAWATCH office in order to provide KMI access to all the Country Correspondents and confirmed that this aspect was solved satisfactorily. Several correspondents, however, reported technical problems accessing the KMI, including Canada, India, South Korea and New Zealand. These problems have been reported to the ERAWATCH Helpdesk and followed up by Dr. Ranga. Dr. Boden suggested that the IPTS representative Mrs. Jan Nill be informed about these technical difficulties in order to provide further help.

4. Arrangements for the Network Review Meeting (30 April-1 May 2007, Newcastle)
   a. Status of preparations
   b. Provisional agenda, IPTS input
   c. Additional funding sources
   d. Other invitees (DG Research, etc.)
Dr Ranga informed the IPTS team that the preparations for the Network Review Meeting to be held in Newcastle are progressing well and asked Dr. Boden’s advice regarding some agenda items and the participation of a DG Research representative. Dr. Boden provided very useful suggestions that have been incorporated into a revised version of the agenda, and mentioned he would confirm the name of the DG Research representative very soon.

5. Other issues
   a. Financial issues (first invoice for 30% of the total amount)
   b. Date of the next conference call
Dr. Ranga informed the IPTS team that the Newcastle University administration was currently preparing the invoice to the ERAWATCH Office for the first 30% interim payment. The date of 26 April, 12.00 (IPTS time) was agreed for the next conference call, which will briefly assess the status of preparation of the network meeting and the draft deliverables (Country Profiles and Summary Fiches).
4.4. Minutes of the 3rd conference call (26 April 2007, 12.00 IPTS time)

The third conference call related to the RIP-WATCH International Project was held on 26 April 2007, with the participation of Dr. Mark Boden, Dr. Andries Brandsma and Dr. Gaston Heimeriks, on behalf of IPTS, and Prof. Henry Etzkowitz and Dr. Marina Ranga, on behalf of Newcastle University.

The conference call focused on the following issues:

1. Minutes of the previous conference call (30 March) and issues arising/action points
   Dr. Boden mentioned that all the action points arising from the previous conference call have been fulfilled.

2. Situation of the submission of draft deliverables (Country Profiles and Country Summary Fiches)
   The situation of the submitted draft deliverables was examined on the basis of an account sent by Dr. Ranga in advance of the meeting. The draft Country Profiles have been submitted in their majority on the KMI, with the exception of a few countries (India, Korea, New Zealand), for which some technical difficulties in accessing the KMI have prevented that. The technical problems have been reported to the ERAWATCH technical desk and are being followed up. With regards to the draft Country Fiches, Dr. Boden expressed IPTS’ general satisfaction with their content and emphasised the three objectives that the fiches should attain: coherence in addressing specific issues and in style, consistency and horizontal coordination. He suggested that the draft fiches and country profiles be circulated to all the network members in advance to the meeting to enable a cross-country analysis of key issues during the network meeting.

3. Arrangements for the Network Review Meeting (30 April-1 May 2007, Newcastle)
   a. Status of preparations
   b. Agenda
   c. Preparation of the Draft Synthesis report
   d. Other issues (extension of the Korea team with two new members)
   Dr. Ranga informed the IPTS team that the preparations for the network meeting have been finalised. The final version of the agenda was discussed with the IPTS team and some final details have been agreed on. Dr. Boden suggested that the Draft Synthesis Report should provide a synthesis of findings highlighted primarily in the fiches, as these are a specific ‘product’ of the RIP-WATCH study. He also suggested that the Draft Synthesis Report should keep the main headings of the fiche, in order to facilitate the presentation of findings. It was agreed that an outline of the synthesis would be presented and used at the meeting to help structure discussion. The extension of the S. Korea team with two new members (Dr. Kim and Dr. Hwang) was also discussed. A formal letter seeking IPTS’ approval for this extension will be sent shortly by the ERAWATCH office, based on a draft prepared by Dr. Ranga, outlining the reasons for this change and the fact that it will not affect the current allocation of funds within the project budget.

4. Other issues
   a. Date of the next conference call

The date of the next conference call was left open, in view of discussing further details related to the project at the network meeting in Newcastle.
ANNEX 5 – Reflections of the Country Correspondents on the ERAWATCH Research inventory and implications for its further development

Ron Johnston (Australia)

With regard to the Summary Fiche, an understanding of the reasons for the particular structure in advance would have been an advantage. However, once that was accepted, the open structure made it relatively easy to enter relevant information. If it had been requested, I could probably have deleted some marginal material to bring the length back to 8-9 pages.

With regard to the Country Profile, the KMI system required a degree of learning, and obviously still has a series of bugs with respect to format, inserting tables, etc. But once mastered, and with the recognition that text should be separately prepared in Word, and then pasted in, it was reasonably straightforward. With regard to the structure, there were a substantial number of instances where it was not clear whether information should be inserted in one category or another, or where apparently the same information was required in more than one place. As emerged at the workshop, some of the categories and their wording are anything but transparent, particularly to non-European correspondents or users.

Antonio Botelho (Brazil)

I found that the templates have a lot of undue repetition, definitions are sometimes unclear and the purpose and logic of some of the headings and sub-headings is at time elusive.

The KMI system is rather unfriendly, particularly in regard to inserting anything but text, which also happens to be problematic.

As I perused through the inventory of other countries’ CP I found them quite uneven in their quality, scope and breadth. This posed a problem for me to find the right tone and scope for Brazil’s CP.

Finally, the fact that there’s virtually no material available in English coupled to the fragmentation of available knowledge on the topic and the highly dispersed nature of relevant information, made the process extremely time consuming.

James Dzisah (Canada)

General Observation:
In all it was a very practical experience as S&T and R&D activities are scattered all over the place. Synthesising the relevant policy documents and activities into the fiche and the KMI has provided a one shop avenue for future research.

Specific Observation:
Like the KMI, the fiche contains an abundance of redundant and overlapping categories. It seeks high level summary information of truly encyclopaedic comprehensiveness and detail.

The task has not been smooth as we anticipated. The work became clearer after the meeting in Newcastle and perhaps in future, an initial meeting should be held to explain what exactly is expected to be included in the fiche and the meaning of such terms as ‘state-aid’.

The KMI template was not user friendly. There were instances where research activities by sources of funds were required but no provision was made to upload any
document. It was very frustrating indeed while this task could not even be completed by simply inserting a completed word document table. If provision were made for either of this, this will have saved a lot of time.

**Lee Woolgar and Fumi Kitagawa (Japan)**

**General**
- Having one country expert with previous experiences of ERAWATCH was a big advantage. This resulted in some concentration/imbalance of workload particularly in the earlier stage of the project; but lessened as the objectives of the project became clearer.
- The Networking Meeting was useful, but would have been of much greater value at the beginning of the project.
- The inputs, commentary and pointers from the SPA and IPTS were of great value.
- RIP-Watch International has provided a very rich source of information on a diverse set of country research investment policy structures. It has been a profitable exercise for the Japan team.

**Country Summary Fiche (CSF) Structure**
- The comprehensive sub-headings of the CSF were useful to gain a broad overview of the range of R&D policy instruments; however, we would have needed to describe which sub-headings/sections attract more policy attention in each country policy structure as the influences of each policy dimension differs substantially in different countries.
- In relation to the above point, we would need a short description of country R&D characteristics (a few paragraphs) at the beginning so that the basic structure is laid out before going into specific policy dimensions.
- References to the 3% goal – the discussion at the networking meeting was useful. Is it really meaningful to use this as main reference point? As the SPA for Japan commented earlier, “some absolute/comparable measure of characteristics and perceived weaknesses of each country (e.g. by clarifying the different contributions by different sectors such as private businesses)” would be useful. We started to discuss this point during the networking meeting, but somehow it remained unresolved. If further work was to be conducted, this is an area that would desire further consideration.
- As we did not work on a new Country Profile this time, which would have been complementary to the CSF, the constraints of the CSF remained throughout the process.

**Further Progress**
- It would be both very interesting and a useful to link the RIPWATCH project more closely with the ERAWATCH Baseload inventory. There are many complementarities that would be of value.