Alliances for innovation and economic development:
the Australian experience

A study prepared for the United Nations Economic
Commission for Latin America and the Caribbean (ECLAC)

Dr Terry Cutler
2008
This paper has benefited from the iterative process used by ECLAC in the development of a series of country case studies, and the authors’ workshop and the ECLAC and SEGIB Seminar held in Sevilla, Spain, in September 2007. Robert Devlin and Graciela Moguillansky have been rigorous in their interrogation of drafts and unstintingly generous in the intelligent discourse they have promoted around difficult and challenging issues of great import to any country in its pursuit of economic development and competitiveness. I have also benefited greatly from the dialogue with the authors from the other countries, and the wise and reflective comments on drafts by Professor Mary O’Kane.

It should be noted that the administrative arrangements around government described in this paper were those current prior to the national election at the end of November 2007. The new Australian Labor Government has initiated a major review of Australia’s national innovation system to be conducted during 2008. Unless otherwise noted, dollars ($) represent Australian currency. Finally, it should be noted that the viewpoints expressed in this paper are the personal perspectives of the author, and should not be interpreted as reflecting the positions of any of the organisations with which the author has been affiliated. Where appropriate, relevant interests have been disclosed in the text.
Public and private sector alliances for innovation and economic development: The Australian experience

Contents

Overview

1. Australia’s economic development

2. The approach to this study, and reference models
   2.1 Theoretical constructs around innovation
   2.2 Innovation time frames and orientation
   2.3 Linking outcomes and capabilities
   2.4 Roles of government in the innovation system
   2.5 Operating parameters

3: Structural overview of Australia’s innovation system
   3.1 Federal or fragmented institutional structures?
   3.2 Path dependencies and institutional evolution.
   3.3 Leadership: tensions over policy paradigms and national priorities.
   3.4 Cross-current: the emergence of Australia’s National Research Priorities

4. Case studies of alliances and incentives in action
   4.1 Export facilitation
      4.1.1 Austrade
      4.1.2 Export Market Development Grant Scheme
      4.1.3 EFIC
   4.2 The Rural R&D Corporations
   4.3 The Innovation Xchange (IXC)
   4.4 Financing innovation, and the Innovation Investment Fund (IIF) scheme
   4.5 The Co-operative Research Centre (CRC) Programme
   4.6 The R&D Tax Concession
      4.6.1 R&D Tax Syndication
   4.7 Peak research funding agencies: The National Health and Medical Research Council (NHMRC):
   4.8 Institutional roles: The CSIRO
   4.9 Telecommunications: a case study of the unintended consequences of deregulation

5. Instruments and incentives

6. Some challenges and issues

7. Design principles and criteria

8. Lessons and general principles

Glossary
An overview of the Australian experience

The country challenge

The Australian industrial development challenge has been:

- diversification off a resources-based economy;
- integration into the global economy as, first, a hitherto protected and domestically focussed market and, secondly, a relatively small economy; and
- sustaining productivity growth.

The country context

Australia is deeply defined by its economic geography as a remote island continent and market, subject to:

- the tyranny of distance, both within the country and with major trading partners; and
- a compounding tyranny of low density, with a small population of 21 million people occupying the world’s sixth largest country land mass.

The resultant weakness of its trade gravity, in terms of separation from major or potential trading partners, reduces Australia’s trade performance below that which it would deliver were it more proximate to the major markets of the world. The rise in power of North Asian markets may, however, now work in Australia’s favour relative to European and North American markets.

Furthermore, Australia’s land mass and geography provide global opportunities arising from the diverse natural endowments of seas, space, land, resources and biodiversity, and from the economic development challenges and imperatives arising from isolation and a small market.

Recent economic performance

Australia’s performance scorecard shows mixed results.

Over several decades we have seen that Australia’s standards of living, measured as GDP per capita, have been declining relative to the leading OECD economies. The decline has been even more pronounced for neighbouring New Zealand.

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Over the past century we can discern three major inflection points in Australia’s industrial development; these have all been external shocks.

1. The two World Wars, and particularly the First, exposed Australia’s vulnerability to disruptions to global supply chains and its limited local industrial capability. This led to major initiatives around local capability building.

2. The floating of the Australian dollar and the dismantling of tariff barriers in the 1980s required major structural adjustment across the Australian economy, leading to major productivity growth and new industry incentive schemes.

3. Climate change and environmental adjustment is the major externality influencing the Australian economy at the start of the 21st century, particularly as remediation and adjustment issues affect Australia’s core traditional export industries (resources and agriculture).

The challenge is how to drive sustained and sustainable economic performance without reliance on externalities and on crises arising from a lack of global competitiveness.

The Australian trade base is highly concentrated. Resources and agriculture make a disproportionate contribution to exports relative to their share of GDP. Both these areas have developed strong industrial clusters, and are highly integrated into global supply chains. The services sector now dominates GDP (circa 80%) but, with a few notable exceptions, trade intensity in the services sector is very low.

Australia’s federal innovation system is distributed across national and provincial government arenas. Over time a plethora of business support programmes have developed. There is now considerable duplication and fragmentation of effort, and there is scope for the rationalisation and focusing of activities. Central government co-ordination is weak. Different arms of government deal with export facilitation and industry development. Industry participation is uneven across sectors.

One the one hand Australia’s ‘federated’ system of innovation insulates industry, to some degree, against sudden policy changes across the board. One the other hand the federated system gives strong impetus to the need to address the challenge of collaboration within distributed, complex systems – this is increasingly part of a global challenge but one in which Australia has a special stake.

With less than a 2% stake, and shrinking, in the global economy, a major challenge for Australia is how to insert itself effectively into global innovation systems, and to prioritise its local efforts around areas where Australia can establish sustainable competitiveness. As a first step, in 2002 Australia promulgated a set of national research priorities. In 2008 the incoming government in Australia plans to develop national innovation priorities to provide a strategic framework for coordinating and directing national effort.
Institutional development

The Australian experience exemplifies the importance of well-established, semi-autonomous institutions within the innovation system. Robust educational and regulatory institutions and frameworks are also of great importance.

Australia’s, and the West’s, neglect of theoretical frameworks around innovation.

Innovation policy in the West has lacked conceptual rigour. We need micro-economic theories of innovation around socio-economic change at the firm, institutional and project levels. The value of essaying theoretical constructs is that they:

- establish policy propositions which can be tested empirically;
- focus attention on comprehensive policy frameworks; and
- focus attention on innovation system linkages and interdependencies.

It needs to be understood that alternative theoretical models give rise to quite different policy approaches and priorities. Given that the policy implications are substantive, then it is clearly worth testing, and making explicit, the underlying policy assumptions we bring to bear on innovation and industry policy. Innovation is a classic example of a ‘wicked problem’.

The working model of innovation underlying the thinking in this paper is based on an open, learning system that works through a cycle of ideas generation, deployment, and diffusion and adaptation in use.

As a general observation, Australian innovation policy hitherto has emphasised a supply-side, technology-push model of commercialisation, at the expense of a more demand-side model of entrepreneurship. There has also been a relative neglect of the diffusion of innovation and the absorptive capacity of existing firms and industries.

The role of government

Government is the necessary custodian of a country’s innovation policy as there is no other ‘natural owner’ of the innovation system as a whole. Government plays a necessary role around innovation and economic development in addressing areas of systemic failure. It can be argued that this role is superordinate, but not antithetical, to more familiar propositions about the role of government in addressing market failure. It could also be argued that a robust national innovation system is a public good in its own right, optimising the flows based on the nation’s investment in stock.
Governance of the innovation system

Structuring how government exercises its roles and promoting sound governance for its innovation policy framework is promoted by distinguishing three distinct functions between which there is, ideally, a high level of transparency.

Instruments and mechanisms for economic development

Case studies and a review of the range of economic development programmes in Australia and elsewhere show that there are a wide variety of programme instruments which may be deployed, often in combination. A critique of the possible mechanisms used for possible policy interventions suggests that there is considerable scope for improved programme design. There is also a need to consider gaps in the current suite of instruments.

Design principles

Good policy design starts with being absolutely clear about the problems that policy programmes need to address. A stronger focus on design principles, and their application, would strengthen the efficacy of economic development strategies.

Some challenges and issues

Some general challenges and issues which arise from a consideration of the Australian experience include:

• Strategic adaptation to a changing global innovation environment
• Specific innovation challenges for smaller country economies
• The difficulties of collaboration and the limits to ‘partnerships’
• The role of formal versus informal networks
• The role of SMEs within innovation systems
• Maintaining complementary support strategies, especially around skills
• ‘Soft’ versus ‘hard’ company development paths
• The commercialisation of public sector research
• The challenge of evidence-based policy and evaluation
• Aligning capabilities with desired outcomes
• Maintaining robust frameworks for governance

Lessons and ‘first principles’.

First principles around industry development and innovation-driven competitiveness can be categorised as either generic - of general application - or country and context specific. Possible principles arising from this review of the Australian experience include:
**Generic:**
1. Align policies with (changing) global environment and realities;
2. Develop clear reference models for innovation and development;
3. Adopt a portfolio model for managing the components of the innovation system;
4. Pursue evidence based policy, and embed *ex ante* evaluation criteria;
5. Actively manage a capability to output matrix;
6. Develop open innovation market mechanisms; and
7. Strike a balance in collaborations and network linkages (loose versus tight).

**Australia - country specific**
1. Align policies with (changing) local environment and realities;
2. Recognise structural realities, such as the:
   - impact of economic geography and demography, and the
   - role of natural endowments versus built competitiveness;
3. Recognise and work with path dependence;
4. Promote bi-partisan consensus around long-term directions;
5. Explore and develop ‘small country’ strategies and principles; and
6. Adjust generic strategies for local industry structure and capabilities

**The review of the Australian experience with industry development reveals some instructive strengths**

A global assessment of Australia’s innovation system indicates that the parts of the system which appear to work *best* are where:

1. There has been a long history of industry ‘self organisation’ (such as in mining, primary production and, more recently, computer games). These are:
   - industries where Australia is fully integrated within global supply chains;
   - industries overwhelmingly focused on export markets;
   - cases where industry arrangements span the whole value chain (from R&D to marketing); and are
   - industries that drive diversification into support industries; and attract technology innovation (e.g., mining and agriculture).

2. There is reciprocity and mutuality in partnerships around outcomes (‘skin in the game’)

   - Rural R&D Corporations, Cooperative Research Centres, former Partnerships for Development scheme; IIF scheme, and some industry assistance schemes
   - Current responses to climate change and environmentally-based industries

3. There are strong, semi-autonomous institutions with scale, within which the competing pressures for sustained capability building and of responsiveness to new challenges can be assessed and balanced. (An example is the CSIRO).

4. A distributed, federated model of innovation promotes an inherently systemic, non-pogromatic framework for a national innovation system (focusing attention on diverse and complementary roles rather than contests for hegemony).

5. National structural challenges fuel innovative solutions (around issues like logistics, environment, systems integration and project management...
and distributed collaboration)

The parts of the system which appear to work least well and which represent major challenges are:

1. Where “innovation” is unhappily or inappropriately coupled with structural adjustment and palliative interventions. This can create conflicting messages and lack of transparency (such as in aspects of arrangements in the automotive, pharmaceuticals and textiles industries).

2. Where industry sectors are not self-organising, or where there is no natural market organiser such as is some areas of manufacturing, and in emerging markets; there is an issue around the role of government in such areas.

3. When sectors are dominated by strong local oligopolies, which are not greatly trade exposed. This includes many parts of Australia’s services sector (retail, banking, telecommunications) whilst other areas have been highly successful (such as asset management, financial services, logistics, education etc).

4. When market interventions are disconnected from upstream or downstream activities (and accompanying feedback mechanisms). This is the challenge with schemes like the R&D tax concession, EMDG, and S&T commercialisation incentives.

5. There is a lack of authoritative and continuing agencies with responsibility for strategic directions setting and consensus building around national priorities and interests.

There is no ‘one size fits all’ model of innovation and industrial development.

The disruptive changes associated with the crafting of innovation policies within a globalised economy bring to mind Heisenberg’s ‘uncertainty principle’ from the field of quantum physics which can be paraphrased as:

If you know where you are,
Then you don’t know how fast you’re going;
If you know how fast you are going,
Then you don’t know where you are.

One way of addressing Heisenberg’s principle is to look backwards to past ambitions for the future, and assess their currency today. This involves destabilising fixed assumptions about the status quo. The corollary is to postulate new strategies against emerging challenges. The greatest challenge revolves around making judgements about the optimal pace of change.
Chapter 1 Australia’s economic development

Australia is a relatively wealthy economy. For most of its history Australia has relied on resources and agricultural exports, but over the past twenty years Australia has diversified its trade. By 2004 manufactures and services had grown to 45% of the export base. Nonetheless, the strength of the Australian economy continues to be underpinned by the strong demand for resources, especially from China. The following charts show that the sectors underpinning Australia’s export performance are the inverse of their shares of GDP.

COMPOSITION OF AUSTRALIA’S GDP, 1900–2000

COMPOSITION OF AUSTRALIA’S EXPORTS, 1900–2000

The resource hungry emerging economies, particular China, and the continued importance of commodity exports to Japan, fuel Australia’s export strength. At the same time, however, the emerging Asian economies are increasingly putting Australia’s manufacturing sector at a competitive disadvantage, with low cost imports challenging industries previously protected behind tariff barriers, by proactive government procurement policies, and through remoteness from global suppliers.

In the nineteenth century, mining – especially gold – and wool were the platforms for Australia’s wealth. In this period the Australian economy significantly outperformed the US. One economic historian has attributed this leadership not to productivity but to aspects of Australia’s demography and labour market. The new immigrant population had a strong gender bias to males, producing high workforce participation rates relative to other countries. In addition, Australia has had a much higher stock of farming land per capita than the United States. Not surprisingly Australia’s workforce participation rate normalised over time, and access to ‘frontier’ grazing land eventually dried up.

Australia’s colonial status retarded industrialisation – swapping resources for manufactures was part of the imperial business model. It is often forgotten that Australia’s independence from Empire was a slow process. Whilst the colonies federated to form a new Commonwealth of Australia in 1901, Australia’s ‘Dominion’ status persisted until 1942. The 1931 Statute of Westminster which effectively ceded control by Britain over its ‘dominions’ was adopted by the Commonwealth Parliament only in 1942, and Australia’s first citizenship legislation was only enacted in 1948. The British Crown remains Australia’s nominal head of state. For most of the Twentieth Century Australia was strongly committed to a trade policy of Imperial Preference within, and protectionism outside, the UK trading hub.

In 1901, at the time of the Federation of the Australian colonies and self-government, manufacturing represented only 12% of GDP, and remained largely static until well into the 1920s. Both World Wars in the Twentieth Century accelerated industrialisation and the diversification of the Australian economy. The wartime disruption to global supply chains caused an awareness of economic vulnerability arising from Australia’s narrow production base. Australia’s distance from major markets and its small domestic market reinforced the desirability of greater self-sufficiency. Interestingly, these factors not only promoted the new focus on heavy industries, but also medical and health facilities, with the Government owned Commonwealth Serum Laboratories, for example, assuring public health supplies. Industrialisation accelerated in the post war period, fuelled by an influx of European migrant labour.

Until the 1980s large State owned enterprises played a key role in national development as agents for economic development. The OECD driven agenda around micro-economic ‘reform’ saw the privatisation of these enterprises and the deregulation of markets. In Australia, however, the approach to competition policy has had little connection to innovation policies. Nonetheless, many of the policies, agencies and programmes examined in this paper date from the late 1980s and early 1990s, as responses to the growing need to re-think industry policy as the old frameworks of tariffs, offsets, and government procurement lost their currency in the face of new orthodoxies.

1983 was a watershed in Australia’s economic development, with the floating of the Australian dollar and the abandonment of its inward looking protectionism:

Australia’s eventual rejection of generalized protection was a delayed reaction to conditions which had started to change in earlier decades. By far the most important of these changes was

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1 Ian McLean, “Why was –and is – Australia so rich?”, Unpublished paper, July 2003, University of Adelaide, p. 6
the loss of markets in Europe and the rapid emergence of the high-performing East Asian economies as major trade partners…. the potential benefits from engaging in multilateral trade became increasingly apparent3.

Australia in an international context

Cross-country comparisons often risk under-emphasising the contextually driven, path dependent factors that shape options and influence policy priorities and programmes. It is instructive to consider the similarities and the differences in the evolution and structure of national economies.

Within a globalised economy, it behoves any country to be mindful of its position relative to the dominant global players. The following table looks at Australia relative to the major ‘triad’ regions of the European Union, North Asia, and the US. These comparisons dramatically highlight the fact that Australia, whilst it may occupy a respectable land mass, is a small albeit advanced economy on any other measure.

AUSTRALIA RELATIVE TO DOMINANT ‘TRIAD” REGIONS

<table>
<thead>
<tr>
<th></th>
<th>EU</th>
<th>North Asia (Japan, China, and Korea)</th>
<th>USA</th>
<th>Australia (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>461,500,000</td>
<td>1,490,284,147</td>
<td>298,444,215 (2006 est.)</td>
<td>20,264,082 (2006 est.) (0.9%)</td>
</tr>
<tr>
<td>Land mass</td>
<td>3,976,952 km²</td>
<td>10,073,275 km²</td>
<td>9,631,420 km² (32.5%)</td>
<td>7,886,850 km²</td>
</tr>
<tr>
<td>Population density (per km²)</td>
<td>116 (UK=246)</td>
<td>148 (Japan=339)</td>
<td>31</td>
<td>2.6</td>
</tr>
<tr>
<td>GDP</td>
<td>$12.33 trillion (2005)</td>
<td>$4.67 trillion</td>
<td>$12.49 trillion (2005 est.)</td>
<td>$612.8 billion (2005 est.) (2.1%)</td>
</tr>
<tr>
<td>GDP per capita (PPP)</td>
<td>$26,900 (2005)</td>
<td>Japan: $31,600</td>
<td>China: $6,800</td>
<td>Korea: $22,600</td>
</tr>
<tr>
<td>Exports (US $m)</td>
<td>1,318,000* (2004)</td>
<td>1,568,600</td>
<td>927,500</td>
<td>103,000 (2005 est.) (3.5%; 1.1% of world exports)</td>
</tr>
</tbody>
</table>

Sectoral composition:

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>China</th>
<th>Korea</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>1.7%</td>
<td>12.5%</td>
<td>3.3%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Industry</td>
<td>28.3%</td>
<td>25.8%</td>
<td>47.3%</td>
<td>26.2%</td>
</tr>
<tr>
<td>Services</td>
<td>69.4%</td>
<td>72.5%</td>
<td>40.3%</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>Netherlands: 72.37</td>
<td>China: 35.47</td>
<td>Korea: 41.09</td>
<td></td>
</tr>
</tbody>
</table>

Sources: CIA, World Factbook, IMD. * External trade only.

Many comparable countries are equally small participants in this global world. It is therefore instructive to examine some of the similarities and differences between smaller country economies.

The following table compares Australia with a small sample of countries.

3 ibid.
AUSTRALIA RELATIVE TO SELECT SMALLER COUNTRY ECONOMIES

<table>
<thead>
<tr>
<th></th>
<th>Australia</th>
<th>Ireland</th>
<th>Chile</th>
<th>Malaysia</th>
<th>Argentina</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td>7,686,850 km²</td>
<td>70,280 km²</td>
<td>756,950 km²</td>
<td>329,750 km²</td>
<td>2,766,890 km²</td>
</tr>
<tr>
<td><strong>Coastline</strong></td>
<td>25,760 km</td>
<td>1,448 km</td>
<td>6,435 km</td>
<td>4,675 km</td>
<td>4,989 km</td>
</tr>
<tr>
<td><strong>Median age</strong></td>
<td>36.9</td>
<td>34</td>
<td>30.4</td>
<td>24.1</td>
<td>29.7</td>
</tr>
<tr>
<td><strong>Main exports</strong></td>
<td>Coal, gold, meat, wool, alumina, iron, wheat, LPG, machinery and motor vehicles</td>
<td>Machinery and equipment, computers, chemicals, pharmaceuticals, live animals, animal products</td>
<td>Copper, paper and pulp, seafood, stonefruit, chemicals, wine</td>
<td>Electronics, oil and gas, timber, palm oil, rubber, textiles, chemicals</td>
<td>Edible oils, fuels and energy, cereals, feed, motor vehicles</td>
</tr>
<tr>
<td><strong>Export partners</strong></td>
<td>Japan (20%), China (11.5%), South Korea (8%), US, NZ, India</td>
<td>US (18.7%), UK (17.4%), Belgium (15.2%), Germany France, Netherlands, Italy</td>
<td>US (16%), Japan (11.5%), China (11%), Netherlands, South Korea, Brazil, Italy, Mexico</td>
<td>US (19.7%), Singapore (15.6%), Japan (9.3%), China, HK, Thailand</td>
<td>Brazil (15.8%), US (11.4%), Chile (11.2%), China (7.9%)</td>
</tr>
<tr>
<td><strong>GDP ($USD ppp)</strong></td>
<td>$666.3 billion</td>
<td>$177.2 billion</td>
<td>$203 billion</td>
<td>$308 billion</td>
<td>$599.1 billion</td>
</tr>
<tr>
<td><strong>GDP growth rate</strong></td>
<td>2.8%</td>
<td>5.2%</td>
<td>4.2%</td>
<td>5.5%</td>
<td>8.5%</td>
</tr>
<tr>
<td><strong>GDP pc (ppp)</strong></td>
<td>$32,900</td>
<td>$43,600</td>
<td>$12,700</td>
<td>$12,700</td>
<td>$15,000</td>
</tr>
<tr>
<td><strong>GDP by sector:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>3.8%</td>
<td>5%</td>
<td>6%</td>
<td>8.3%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Industry</td>
<td>26.2%</td>
<td>46%</td>
<td>49.3%</td>
<td>48.1%</td>
<td>35.8%</td>
</tr>
<tr>
<td>Services</td>
<td>70%</td>
<td>49%</td>
<td>44.7%</td>
<td>43.6%</td>
<td>54.7%</td>
</tr>
<tr>
<td><strong>Trade dependency ratio</strong></td>
<td>19.3%</td>
<td>73.2%</td>
<td>36.4%</td>
<td><strong>112.9%</strong></td>
<td><strong>19.3%</strong></td>
</tr>
</tbody>
</table>

Sources: CIA Factbook 2007; World Competitiveness Report database.

A range of factors differentiate Australia. Australia is the only continental nation in the world. It is the sixth largest territory, after Brazil and China. By contrast, Australia has one of the lowest population densities in the world, but it is also highly urbanised. Australians represent 0.3% of the world’s population, ranking in 53rd place.

An intriguing point of difference in the foregoing summaries is the variations in trade intensity. Trade intensity is a surrogate indicator for the extent an economy is outward looking, although measures of capital and innovation flows around economies like the US provide some alternative indicators. Australia stands out as one of the few smaller country economies with such a low ratio of trade to GDP, and this is despite it having grown strongly over the past twenty years. The other countries with similar rankings – like Japan and the US – all have huge domestic markets. Many relatively small economies have high levels of trade intensity: Singapore, Hong Kong, Malaysia and Ireland.

Several recent papers by economists from the Reserve Bank and Treasury have homed in on the structural impacts of Australia’s geography. Guttman and Richards from the Reserve Bank highlight the importance of trade gravity – and show that unfavourable economic location and large land mass account for most of the differential in Australia’s trade.

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performance relative to other economies\textsuperscript{4}. They conclude that “countries with small populations tend to trade more and countries that are located closer to potential partners also trade more”. A recurrent theme in the literature is the importance to innovation of being close to customers, and learning from customers, so that industry strategies built around economic geography are of central importance to a country like Australia. Globalisation and trade exposure increases the challenges for Australian firms and their remoteness from customers. Nonetheless, economic history reinforces the value of being alert to long-run ground shifts\textsuperscript{5} that change trading patterns. The increasing internationalisation of Asian markets brings large markets that much closer to Australia, and this will create future opportunities.

The tyranny of distance has had a profound influence on Australia’s economic development. Nothing illustrates better the underlying influence of geography and demography on Australia than NASA’s Earthlight photographs.

\begin{center}
\includegraphics[width=\textwidth]{apod001127.jpg}
\end{center}


Communications and transport links to the world, and across the country, are vital. The distribution of settlement around the coast, combined with the distributive effects of a federal political system, means Australia has required much more infrastructure investment than its population would suggest. More airports, more ports, more road and rail links, than most countries with comparable populations need to support. This is compounded by the key role of rural industries. Many remote mines and rural industries have required dedicated port and rail infrastructure.

Australia’s federal system, and its population distribution have created a series of strong regional economies, which often share more in common with regionally concentrated country economies – like Ireland or Singapore – than each other.

\textbf{Industry structure and innovation performance}

Another key structural factor in the Australian experience is the dominance of small companies in the industrial landscape and the relative lack, with some notable exceptions, of large Australian-owned multinational corporations. The dominance of small businesses creates particular challenges in the absorption of new technology and, with the compounding


\textsuperscript{5} See the magisterial work by Angus Maddison, especially The World Economy: A millennial perspective, OECD, 2001, re-issued 2006.
effect of remoteness from global markets, significant hurdles to breaking into global supply chains.

**SIZE OF AUSTRALIAN FIRMS, BY EMPLOYEES**

<table>
<thead>
<tr>
<th>Size of employing firm</th>
<th>Number</th>
<th>% of total firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-19</td>
<td>754,504</td>
<td>90%</td>
</tr>
<tr>
<td>20-199</td>
<td>77,656</td>
<td>9.3%</td>
</tr>
<tr>
<td>200+</td>
<td>4,918</td>
<td>0.6%</td>
</tr>
<tr>
<td>Total</td>
<td>837,078</td>
<td></td>
</tr>
</tbody>
</table>

*Source: ABS, Cat. 8161.0.55.001*

Surveys of both exporting and of R&D investment show highly skewed distributions of activity. In the case of exports a small group of larger firms generate the bulk of export earnings.

**EXPORTING BUSINESSES AND REVENUE**

*Source: ABS and Austrade 2000*

The Australia Bureau of Statistics carries out periodic innovation surveys which attempt to capture the relative investments in R&D and other forms of innovation.

**THE RELATIVE SIGNIFICANCE OF R&D AND INNOVATION SPENDING, 2002-03**

*Source: ABS 2006, Innovation in Australian Business 2003, Reissue, March, Cat. no. 8158.0.*
The Australian Bureau of Statistics’ 2005 Innovation Survey shows that for every dollar spent on R&D, Australian businesses spend almost four dollars on non-R&D innovation. Almost 47,000 firms— that is nearly eight times the number of firms registering for the R&D Tax Concession — report investing in non-R&D innovation\(^6\). This activity on the ground, however, is not matched by commensurate policy attention. Given the importance of service industries to GDP and employment in Australia, this is an area that merits more attention.

Australian industry tends to score poorly in international rankings of technology intensity, as categorised by the OECD. These figures, based on innovation models built around technology industries, are immensely misleading. What they ignore is the role of technology inputs to the viability and productivity of traditional mining, agricultural and, more recently, service industries. These have been areas of consistent R&D strengths and innovation in Australia. Analysts often forget that technological innovation is especially important for resource-based economies. As Australia’s foremost economic historian has written:

*Most of Australia’s massive deposits of minerals were of no use until new technology liberated them. In the last two centuries Australia has depended as much on the rise of new technology as on its own soil, grasslands, minerals and other resources*\(^7\).

Nonetheless, in manufacturing Australia does appear to perform relatively poorly with technology-based innovation inputs.

**INTERNATIONAL COMPARISONS — MANUFACTURING INDUSTRIES GROUPED BY R&D INTENSITY, AS A PERCENTAGE OF GDP**

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\(^6\) ABS, 2006. There is often considerable confusion between the use of metrics around R&D and broader measures of innovative activity. A focus on R&D metrics usually indicates a policy bias to direct investment in technology-driven innovation, but this can take attention away from the take-up and use of technology through capital investment and the adaptation of technology in use. For the purposes of the survey, the ABS excludes innovation that took the form of small incremental improvements. Consequently, the measure will understate, probably significantly, the extent of spending actually related to innovation.

Until recently there has been relatively little attention to productivity driven by innovation in the services sector. A recent analysis of productivity growth in Australia compared with the UK and the US has found that service industries dominated the acceleration of productivity growth in the Australian economy since 1992, especially through the wholesaling and financial intermediation industries. (The other main contributor to productivity growth has been agriculture). In his Australian study Alan Hughes from the Centre for Business Research at Cambridge has noted that the sources of productivity growth have been much more concentrated in Australia than in the US:

> In most comparisons of changes between periods and sub-periods three or four sectors account for all or more than all of the total acceleration in productivity growth.

In his cross-country analyses, Hughes has highlighted the key role of platform technologies in underpinning innovation in services:

> The transformation of productivity growth in the services sectors is intimately linked to the innovative development and application of information technologies. These innovative applications require the effective development of a wide range of complementary investments in IT infrastructure, management and other organisational and often intangible assets.

Disappointingly, however, this productivity performance has not been reflected in aggregate services exports even though some individual sectors like education and some areas of financial services have performed strongly. Overall trade intensity in the services sector has stagnated: the trade ratio for services is less than 5% and declining.

**Export performance**

Australia’s exports have doubled over the decade 1996 to 2006, and exports as a share of GDP have increased by 5% over the past twenty years although, as we have noted, off a low base. The composition of Australia’s exports is highly concentrated.

During the 1990s the Australian Bureau of Statistics conducted longitudinal surveys of business activity. While this data is now a little old, subsequent but less systematic information suggests the picture has not changed much. This picture shows that:

- only a small proportion of all Australian businesses export – around 4% (2001);
- while small businesses represent the majority of exporting firms (77%), they account for only around 13% of total export earnings;
- foreign-controlled firms represent about 15% of Australia’s exporters, but account for almost half the export earnings;
- exporting firms are almost three times more likely to be innovative than non-exporters (highlighting the learning that comes from international exposure); and
- exporters pay higher wages than non-exporters.

The 1990s longitudinal study suggested that regular exporters averaged an export intensity of 27%. (Export intensity is the ratio of exports to the total earnings of the firm). There is some subsequent evidence that suggests that export intensity tends to increase over time (bearing in mind that there have not been significant changes to the structure of the exporting base). It is noteworthy that the top exporting firms have much higher export intensities, and tend to

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10 Brian Pink and Charles Jamieson, A Portrait of Australian Exporters: A Report Based on the Business Longitudinal Survey, Australian Bureau of Statistics and Austrade, Canberra, 2000. It is unfortunate that Australia does not have better longitudinal data. In the UK the Centre for Business Research, Cambridge, has been collecting longitudinal panel data on firms since 1990.
be in industries or industry niches where Australia has commanded a significant and sustained global market share.

In manufacturing, road vehicles are the largest single export (representing 14% of total manufacturing exports in 2001)\(^1\). By 2006 40% of passenger vehicles were exported, compared to 5% twenty years earlier. Interestingly, the automotive industry receives the highest level of government industry assistance, and leads in the R&D stakes (by value). Much of this assistance is geared around maintaining these export levels, which are necessary to the retention of an automotive industry in Australia.

Interestingly, and unfortunately, there is little analytical evidence on whether or not there is a correlation between innovation and export performance. One’s hypothesis is that there should be a link, but that causality may be hard to establish or interpret. While the longitudinal study data is now a little old, it showed that 35% of exporting businesses were classified as innovative compared to 13% of non-exporters. The difficulty of assembling matched data sets for the analysis of the relationships over time between R&D and other innovation inputs, and firm or industry performance outputs, highlights the importance of investing in the information needed for evidenced-based policy.

**Australia’s performance scorecard**

Overall, Australia’s performance scorecard shows mixed results.

A recent overview of the structural parameters of the Australian economy summarised its position in the following terms\(^2\). According to this account Australia’s productive sector is characterised by:

- Few local multinational companies
- A somewhat beleaguered manufacturing sector
- A mineral resources sector which plays a key role
- A strong, but declining, agricultural sector (and one now threatened by climate change)
- A dominant services sector (approaching 80% of the economy)
- An economy of small businesses
- Relatively low levels of business R&D
- Low trade intensity

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Australia’s knowledge generation and training systems are characterised by:

- Small scale institutions (by world standards)
- Limited international linkages
- Restricted innovation and R&D career structures
- Underinvestment in infrastructure
- Limited investment in continuing training
- Incentives for internal competition, not collaboration

Australia’s public policy systems have been characterised by:

- A federal polity with regional contests
- Undeveloped policies for knowledge diffusion
- Cargo cults around knowledge commercialisation (and the pursuit of a linear technology-based innovation model)
- Challenges around the alignment of complementary assets (such as science and technology policy, education, transport, and communications)
2. Approach to this study, and reference models

The terms of reference for this country case study focus on the role of alliances across the public and private sectors in:

- developing strategies and policies for promoting innovation and economic development; and
- the way public institutions formulate and execute strategic action plans to promote innovation for economic and trade development.

There are two inter-twined themes to this study. First, the focus is on understanding the nature of the alliances and partnerships underpinning a national innovation system and economic development policies. This involves looking at the patterns and the efficacy of the cross-sectoral linkages and relationships. The second theme involves examining the operations and impact of key institutions and mechanisms established to address industry innovation and export development.

The first theme involves looking at the processes and inter-plays underpinning the evolution of policy frameworks over time within a national innovation system. The second theme involves looking at the function and operations of institutions in the public administration of national policies. The discussion that follows sets out an analytical framework for addressing the terms of reference and for exploring the issues they raise.

2.1 Theoretical models of innovation

There is a lack of coherent theories of innovation to underpin development policies. Innovation policy in the West has lacked conceptual rigour. We need micro-economic theories of innovation around socio-economic change at the industry, institutional, firm and project levels. The value of essaying theoretical constructs is that they:

- establish policy propositions that invite empirical testing;
- focus attention on the comprehensiveness – or otherwise - of policy frameworks; and
- focus attention on linkages and interdependencies within an innovation system.

One of the greatest difficulties with systematic thinking about innovation is the contest between different paradigms for analysing and understanding its political economy. With innovation we often see a complete standoff between theorists grounded in the neo-classical tradition in economics and other people either trying to advance alternative economic models – such as the evolutionary economists – or applying conceptual models drawn from other social sciences or management studies. The result is a public policy stand-off between opposing factions. How to resolve this dilemma? It seems to me that little progress can be made by trying to assert that one approach is right because the other is wrong.

The answer, it seems to me, lies in starting out by trying to understand the nature of the problem we are trying to solve. The fundamental questions around innovation revolve around trying to understand change processes. The challenge in studying change or innovation is that both exhibit all the characteristics of a ‘wicked problem’. Wicked, or messy, problems “spawn new problems in their solving, not black and white answers”13. According to Jeffrey Conklin14, the four defining characteristics of wicked problems are:

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1. The problem is not understood until after formulation of a solution.
2. Interested parties have radically different world views and different frames for understanding the problem.
3. Constraints and resources to solve the problem change over time.
4. The problem is never solved.

Thus the fundamental questions around innovation revolve around trying to understand change processes. Innovation is socio-economic change brought about by the introduction of something new, the introduction of forces for disequilibrium, and the systemic learning and adjustment that follows. The change processes we try to understand as a society involve more than just the marketplace. They also require us to consider societal and ecological changes. Thus a purely market based theory of innovation will be inadequate to comprehend the broader issues around change, and the interplay between market and non-market forces at work in change processes. History, and the evidence from the various disciplines looking at living systems – whether biology, medicine, psychology, or ecology – tell us that change is not a zero sum game. There are winners and losers. Some changes we deem good if they lead to greater community prosperity and a better quality of life. Other changes we deem bad if they lead to unemployment, a poorer quality of life, and a diminished capability to pursue opportunities for developing a better society.

In other words, we need to try to understand not just how a system works, but how a purposeful system works; one in which we are trying to achieve some particular objectives and avoid others. The implication is that this needs to be a transdisciplinary inquiry, and one that may need a ‘meta-language’ that transcends the constraints of traditional, specialised modes of explanation. Evolutionary theory and general systems theory both fit this description, and provide a useful conceptual framework for thinking about innovation. From them we might derive a general theory of innovation to guide and inform both public policy and industrial practice.

I contend, therefore, that innovation can be described and explained as an evolutionary system for socio-economic change and development. Neo-classical economic models cannot adequately or fully account for innovation, being based on equilibrium assumptions, leading to the notion of ‘market failure’ as the primary rationale for government involvement. Noting the limits to macro-economic policy in the context of innovation is not to deny a role for it. One of Australia’s foremost scholars of public administration, Ian Marsh, has noted that:

> Neo-classical approaches may be most appropriate where the growth and efficiency generating potential of markets has been inhibited. The aim then is to change the incentive structure surrounding firms through the wider application of market-based cost pressures. This was the strategy introduced by the Hawke and Keating governments in their opening of the Australian economy post-1983 and has since provided the primary framework for the development of economic strategy

He notes, however, the limits of price signals.

> ... individuals faced by genuine uncertainty may rationally choose different courses of action. Further, knowledge is assumed to be sticky and differentiated between applications. Finally, competition involves first mover advantages and the active pursuit of (albeit perhaps temporary) distinctive advantages by individual firms. Dynamically, this means the economic system has no automatic tendency to a benign equilibrium. On the contrary, selective intervention may contribute to desired outcomes

This contrasting ‘mixed market’ (or partnership) paradigm of political economy will encourage a more comprehensive focus on the national innovation system as a whole. This is likely to increase the attention to systemic linkages between inputs and outputs and to the

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16 ibid., p. 46
interdependencies between the private and public sectors. The pursuit of a robust innovation system could, itself, arguably be represented as a public good.

The ultimate market test of innovation is the sustainable competitiveness of an activity (be it at the level of an individual’s work, the firm, an industry, or a regional cluster of industries). Sustainable competitiveness may be measured by the quality of jobs and global market share. Market outcomes are the central measures but they are not easily correlated with R&D inputs alone. My working theory of innovation is based on an open, learning model which works through a cycle of ideas generation, deployment, and diffusion and adaptation in use. The best way to represent innovation is as a circular process, constantly re-fuelled by the energy of fresh ideas.

Source: © T. Cutler, 2006

At the heart of innovation as change is the notion of disequilibrium. This way of thinking owes as much to General Systems Theory as it does to Charles Darwin. There are thus three facets to innovation, and each needs balanced attention within a national innovation system. Each invokes possible roles for government, and each may have implications for particular styles of interface between public and private sector stakeholders.

**Creativity**
The generation of ideas and invention. Requires fresh thinking and inventiveness

**Entrepreneurship and commercialisation**
Linking good ideas to the right market needs and opportunities. (Good ideas or patents without customers or users are worth nothing). Requires entrepreneurs and risk taking.

**Diffusion and adaptation**
Rolling out high potential innovations across industry or the community. Requires awareness of, and access to, new know-how and tools. This is the path to capturing national benefit.

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17 This section is based on T. Cutler, Submission to the Productivity Commission Inquiry into Public Support for Science and Innovation, July 2006, and work in progress to expand on the thinking in this submission.
If there are different roles and challenges within different parts of the innovation system then the risk is that we will address parts of the system or challenge, and not the whole. Reducing this multi-dimensional process to intelligible representations is a bit like producing a Mercator projection of the globe. The following schematic represents the Mercator projection version of this working model of innovation. This construct provides a framework against which the span and depth of country initiatives or programmes can be mapped, and evaluated.

Within such a view of the world, R&D is a necessary but, of itself, not a sufficient part of the landscape. Good ideas and developments might become stranded if not matched to the right opportunities, or if there is not the right pool of firms competing to pick up the ideas and run with them. Even the best new technologies or services may fail if they don’t reach a tipping point in their take up by users. It is only at the point of market adoption and take up that publicly desired outcomes like sustainable employment, export sales and enhanced firm profitability are secured.

As a general observation, past Australian innovation policy has emphasised a supply-side, technology-push model of commercialisation, at the expense of a more demand-side model of entrepreneurship. There has also been a relative neglect of the diffusion of innovation and the absorptive capacity of firms and industries. Some Australian agencies have mandates that span the whole innovation system; others focus on specific aspects. The general challenge is to pursue balanced attention to the whole system and its interdependencies. Standalone, ‘silo-like’ interventions risk upstream or downstream distortions. It is also important to recognise that there are different levels of activity within an innovation system (in jargonistic terms, levels of sub-systems or clusters of activity). Distinguishing the different levels within this complex system that is innovation helps to “create a connecting path between global and individual activities”18.

Optimal outcomes require balanced attention across this spectrum of activity shaping innovation. Top-down policy processes probably skew our attention to the shaping and support of formal institutional arrangements and organisational linkages represented by the left hand side of this spectrum, to the relative neglect of attention to the activities within the engine rooms of creativity and innovation.

18 This discussion draws inspiration from Robin Batterham’s unpublished paper, “Sustainability – the next chapter”, 2004.
Levels Four and Five remind us that innovation fundamentally revolves around the activity of individuals and their collaborations. The policy challenge is not only how to invest in building pools of talented people, but also in how to invest in them over their careers so as to maximise the national benefit that it is possible to accrue from these valuable people assets. It also means investing in platforms and programmes to support their collaboration in project teams and knowledge sharing. People strategies need to be at the heart of innovation policy. What motivates and empowers people to exercise their talents is largely intrinsic. Increasingly skilled professionals are pursuing self-managed careers, increasing the importance of informal networks and linkages over structured organisational relationships. Robin Batterham comments that “specific projects are the small finite steps which can lead the way forward … for the rest of the enterprise and even the rest of the industry”\(^\text{19}\). At the other end of the spectrum, Levels One through Three crucially shape the environment in which real people think, experiment, and act. Combining this hierarchy of different levels of innovation activity with the different elements of the innovation process, examined earlier, produces a framework matrix for mapping relevant activities and requirements, and for assessing possible policies and approaches for promoting innovation.

**THE MATRIX OF POSSIBLE INTERACTIONS WITHIN AN INNOVATION SYSTEM**

\(^{19}\) Ibid.
This matrix serves three useful purposes. First, it starkly reminds us of the importance of formulating a coherent set of policies across the five hierarchical levels. Gaps or inconsistencies of treatment on the vertical axis will undermine the effectiveness of the innovation system. There is, moreover, no one level which is more important than the others. Each is important, and mutually reinforcing. Second, a comprehensive innovation framework will address each of the elements in the innovation process. Again, these are mutually reinforcing but each will require distinctive supporting infrastructure and capabilities. Third, the matrix reminds us that any national system is part of a global economy and environment, and this may pose particular challenges for smaller country economies particularly with respect to the depth of participation in global knowledge networks and innovation flows\textsuperscript{20}. Participation is, however, resource intensive. The role of key institutions and of government in promoting and supporting effective integration within global networks is a neglected subject in discussions of innovation systems.

This systemic view of innovation creates a useful framework for thinking about the areas for appropriate government intervention. In a recent article Chaminade and Edquist\textsuperscript{21} have begun to develop a roadmap of some of the systemic problems which may arise in innovation systems. These have been echoed in the writings of Australia’s Keith Smith\textsuperscript{22}. Edquist and Smith identify a range of potential systemic challenges within innovation systems.

1. Inadequate infrastructure provision for transport, communication platforms and scientific facilities.

Smith notes that “two types of interaction between firms and infrastructures seem to be important: firstly, with physical infrastructures usually related to energy and communications, and secondly with science-technology infrastructures such as universities, publicly-supported technical institutes, regulatory agencies, libraries and databanks, or even government ministries”.

2. Structural adjustment issues and transitional problems in economic change.

Particular challenges include technology innovations that are not supported by available national capabilities, and any industry ‘lock in’ to obsolescent production systems. Smith notes that “there is considerable evidence to suggest that even relatively minor shifts [in technology] can provide serious problems for firms who have no background in the new technology. This is particularly a problem for small economies which possess relatively small numbers of players in many sectors; relatively minor discontinuous shifts can provoke major changes in the industrial structure”. Smith further notes that “actions at the level of individual agents are unlikely to overcome lock-in. External agencies, with powers to generate incentives, to develop technological alternatives, and to nurture emerging technological

\textsuperscript{20} Diane Stone, currently at the Centre for Policy Studies at the Central European University and an expatriate Australian, is a leading thinker about the role of global knowledge networks. Stone distinguishes between:

- global knowledge networks;
- trans-national advocacy networks, involving information exchanges between parties with common beliefs; and
- global public policy networks, concerned with addressing global public goods and shared problems. Joint action on global warming is a classic example.

See Diane Stone, “Knowledge networks and global policy”, in Diane Stone and Colin Maxwell, Global Knowledge Networks and International Development, Routledge, 2004


\textsuperscript{22} Keith Smith, “Innovation as a Systemic Phenomenon: Rethinking the Role of Policy”, Enterprise and Management Studies, Vol. 1, 2000
3. Inadequate institutional development and evolution, both formal and informal.


The challenge here is finding the right balance between tight and loose networks. Bounded peer networks may become self-referential, and less open to renewal from lateral inputs. Less bounded multi-disciplinary networks may lack structure for continuity and purposeful interaction.

5. Capability and learning problems.

Weaknesses in underlying capabilities will impede the extent to which local actors can respond to and learn from emerging developments. This is the problem of weak receptors for information signals and market feedback.

In addition to these factors identified by Edquist and Smith, I believe that two additional generic problems can be identified.

6. Heterogeneity versus specialisation.

A robust innovation system needs diversity as a pool of choices for entrepreneurial action. On the other hand, countries and regions will tend to focus on areas of successful specialisation. This is particularly true of smaller country economies. Specialisation or the pursuit of niche global opportunities implies a narrowing or focusing of underlying capabilities, but this may work against the maintenance of platform capabilities in areas of general science or expertise which are necessary to underpin a wide range of vertical market specialisations. ‘Horizontal’ capability specialisation is often overlooked: examples include project management and systems integration skills, or the pursuit of answers to societal challenges like pollution, climate change, or water shortages.

7. Imbalances within and across the innovation system.

The challenge here is to promote the best balance across the innovation sub-systems we have identified (the sub-systems of origination, deployment, and diffusion) and how these constituent parts interact.

In concluding this brief survey of theoretical constructs, the key point I want to emphasise is that alternative theoretical models give rise to quite different policy approaches and priorities. Given that the policy implications are substantive, then it is clearly worth testing, and making explicit, the underlying assumptions we bring to bear on innovation and industry policy.

It is a pity that today more people cite than actually read Adam Smith’s *Wealth of Nations. Book V* of this work, which is often omitted from modern editions, deals with the role of the state in security (defence), justice and the legal framework, education, and the administration of ‘public goods’ including infrastructure. Smith’s infamous ‘invisible hand’ of market forces can be read today as a prophetic insight into the functioning of complex systems and of the role of feedback loops in open innovation systems. What is incontestable is that civil government and markets are not orthogonal and at cross purposes, but inextricably intertwined. This is what makes the subject of the interfaces between the private and public sectors so important.

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24 This is a recurring theme, and comes up again in addressing the challenge of accessing offshore knowledge and innovation.
The challenge is how to translate these insights into practical, real life decision making. How does government prioritise its efforts across providing incentives at the level of the individual firm, versus targeting the promotion of industry clusters of interdependent firms for mutually reinforcing economic development, or concentrating on the broad macroeconomic settings of the economy? This quandary is not new, and it calls for the articulation of a structured policy framework within which decision makers can assess competing claims and look at the balance of investment and returns across short and longer term capability building.
2.2 Innovation time frames and orientation

Socio-economic change takes place over different time frames. Public policy and industry discussions frequently ignore the sage advice that we tend to overestimate the short-run impact of technological change, and underestimate the long-term economic and social transformations taking place. We often forget, in responding to exceptionally disruptive change, that such levels of change and transformation are not the norm. In these situations we often tend to concentrate on what appears new, and not on the business and social fundamentals which endure. We ignore ‘the shock of the old’, and the long run aspects of change.

Ironically, therefore, and despite our preoccupation with the new, we can make the mistake of focussing on the superficial indicators of more diffuse, underlying drivers of change. The account of innovation is often distorted by the dominant industry players with the loudest voices and those who control the megaphone. This is particularly true when the sources of innovation are distributed and cannot be associated with an iconic individual effort or a corporate champion. Taking a long run view allows us to distinguish between bubbles on the surface and deep undercurrents.

The wise governance of public policy will, therefore, look backward and be conscious of path dependencies as much as looking forward with foresight. Looking forward means locating short-run initiatives within the context of the longer term. Australia’s primary industrial research organisation, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has adopted a strategic planning framework that recognises the different focus and, usually, the different timeframes of change drivers.

In addition, the impetus for change can either come from industry-facing activity, or from social and community challenges. Good contemporary examples of the latter, with major flow-on impacts on the former, are climate change, energy sources, preventable health problems like obesity and diet, and the threat of pandemics.

There is a spectrum of activities and outcomes associated with innovation, and not to have regard to the whole spectrum in considering public policy will weaken any national innovation system. In considering innovation over the life cycle and growth stages of firms,

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The US business strategist Geoffrey Moore\(^2\) has identified seventeen varieties of innovation at play at different times and in different circumstances. These range from the revolutionary “disruptive” innovations that transform markets and industries through to the submerged endeavours of continual improvement.

### THE VARIETIES OF FIRM LEVEL INNOVATION

[Image: Diagram showing various types of innovation]

Putting all these considerations together enables us to construct a *portfolio* model to shape national effort against national priorities and to guide and manage investment. An innovation *portfolio* encompasses the spectrum of activity from breakthrough science through to incremental innovation, all underpinned by crucial national facilities and capability building. In addition, by highlighting the point that a robust national innovation framework will be a portfolio of activities, this framework makes explicit the trade-offs and interdependencies in the allocation of scarce resources.

[Image: Diagram showing national policies and priorities]

This model can be applied to investment planning and decision making at both broad institutional and regional levels.

Roles in the portfolio are not standalone, with definitive boundaries; rather they are porous, with high levels of inter-dependence and mutual reinforcement. For example, public funding of science and research to address defence, security, health or environmental challenges can open up new industry and firm level opportunities off the back of new capabilities and breakthroughs.

Key points to note about this model are that:

- specific capabilities and infrastructure will be required for the different roles and there will be different requirements for how this supporting infrastructure is provided and in how it may be accessed;
- different funding models may be appropriate for different roles;
- there will be different issues around intellectual property constructs and their management;
- differing models of technology flows and knowledge diffusion may apply for different roles;
- measures of impact and return on investment will vary according to role; and
- different groups of interested parties will be associated with each role.

This model provides a heuristic device for aligning the objectives and incentives of different parties. This, therefore, becomes a valuable way of representing where people and programmes fit within a big picture.
2.3 Linking outcomes and capabilities

In attempting to operationalise and ground innovation theories it is useful to consider a ‘T-Bone’ policy model\(^2\). This forces attention towards two things. First, there is a ‘horizontal’ axis which spans and represents the relevant universe. Second, there is a vertical axis which represents depth or specificity as in, for example, a particular industry sector or a region. The intersection of the two axes forces attention towards the alignment and interdependencies between the generic or macro-economic, and the targeted or sectoral in the architecture of a policy framework. A further aspect involves considering the best ways of linking and aligning capabilities or inputs on the one hand, and desired outcomes, impacts or results on the other. This matrix results in a multi-dimensional ‘T’.

A ‘T-BONE’ POLICY MODEL

This model combines the role of market signals with collaboration and ‘negotiated co-ordination’ around capabilities and the prioritisation of activity to pursue desired national outcomes. A useful working description of capabilities in this context has been developed by Australia’s principal public research agency, CSIRO. This highlights three underpinnings to capability.

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\(^2\) I am indebted to John Wilbanks, the CEO of Science Commons at MIT, for this metaphor and construct.
The important point in this equation is the interdependence and integration of the three elements:

“capability is the integrated set of skills, experience and know-how of our people together with the assets and relationships which enable us to undertake research and effectively manage the outputs towards adoption, use and impact”.

The development of potential national initiatives around priority goals needs to be grounded in an examination of required capabilities. Part of the challenge in thinking about the balance of investment in innovation is in ensuring that there is an appropriate match between the investment in ‘outputs’ and the investment in the capabilities to support these desired policy outcomes. The resulting matrix for decision making and policy administration can be represented in the following schematic.

This discussion puts the spotlight on the question of the role of government in investment in capability building and raises the issue of the nature of linkages between public and private sector capability. In this context it is worth noting that disinvestment in capability is often irreversible. Decisions about de-prioritising, therefore, while a necessary corollary to consideration of investment trade-offs, need to tested against possible unintended consequences. Another key issue around capabilities is the question of the development and support of capabilities against possible future needs.
2.4 Roles of government in the innovation system

Government is the necessary custodian of a country’s innovation policy as there is no other ‘natural owner’ of the innovation system as a whole. Government also plays a key role in the structuring of the markets within which innovation occurs through its regulatory role that shapes market operations and industry structures. (The way in which governments may exercise this regulatory role can be influenced by legacy industry structures.) The innovation theory introduced earlier in this paper raises the important role of government in addressing systemic failure and market creation. It can be argued that this role is superordinate, but not antithetical, to more familiar propositions about the role of government in addressing market failure. It could also be argued that a robust national innovation system is a public good in its own right, optimising the flows based on the nation’s investment in stock.

Australia’s Ian Marsh posits three crucial roles for government in market collaborations within the innovation system:

(i) Leadership: strategic scanning and foresight, leading to the establishment of national priorities and the articulation of desirable outcomes.

(ii) Execution: the formulation of the rules (regulation) and of the programmes to deliver outcomes. Government’s indisputable role in rule making means that it also plays a key role in ‘market design’ (whether overt or covert).

(iii) Review: the ongoing process of monitoring outcomes and impact. At an institutional level, this is a function of governance arrangements and public accountability.

This provides a useful framework within which to examine the operations of public and private partnerships in economic development and, especially, in considering the robustness of mechanisms for managing tensions over policy paradigms and national priorities. There is also a useful alignment here with Peter Hall’s three broad categories of policy innovation, as follows:

1. shifts in a policy paradigm
2. shifts in the means by which an existing objective is sought; and
3. a shift in specific instruments.

The notion of policy innovation is important because, as Marsh notes, “collaborative relationships are not without hazard”:

The most likely hazards are lock-in to a dysfunctional over-arching strategy or lock-in to programs that serve sectional interests at the expense of wider public interests.

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29 See William Baumol, Robert Litan and Carl Schramm, Good Capitalism, Bad Capitalism and the economics of growth and prosperity, Yale, 2007
31 Peter Hall, “Policy Paradigms, Social Learning, and the State: The Case of Economic Policymaking in Britain”, Comparative Politics, Vol. 25, No. 3 1993
32 Ian Marsh, op.cit., p.47
Marsh’s suggested remedy is to clearly differentiate the role of government (and its associated collaborations) in the execution of strategic assessments, operational implementation, and in regular review. He further suggests that:

... there are distinctive policy learning and coalition building challenges associated with these strategic, operational and review activities which underwrite the desirability of locating organisational responsibilities in distinct settings.

In what follows I summarise Marsh’s outline and elaborate upon these challenges.

**STRATEGIC assessments and environmental scanning**

This innovation function may be either crisis driven or, preferably, based on institutionalised learning and innovation mechanisms. This role requires:

- a capability to destabilise existing understandings (which is precisely what the disequilibrium and ‘learning’ of open systems theory is about);
- mechanisms for bringing together diverse perspectives;
- institutional settings that support sustained deliberation and problem-solving;
- settings that help straddle or erode boundaries between policy domains and affected constituencies; and
- an ability to reconfigure policy networks and build new coalitions (or collaborations) – ideally based on a bipartisan consensus.

**OPERATIONAL policy implementation**

This innovation function requires governance mechanisms that promote learning and innovation. It requires:

- the capability to question and re-evaluate existing programme frameworks;
- settings that encourage decentralised experimentation;
- mechanisms that produce and diffuse information on innovation;
- the sharing of good practice and experimental results;
- encouraging actors to compare results with the best performers; and
- obliging actors collectively to redefine objectives and policies.

These requirements call for a strong focus on policy and programme design, and appropriate governance frameworks.

**REVIEW and evaluation**

Evaluation by an independent agency enhances transparency and reduces the risk of policy capture by sectional interests.

Marsh suggests that there are two broad metrics for assessing success:

“At a strategic level, this involves the quality of the analysis used both to define situations requiring a collective response and to identify the capabilities that need to be developed to respond to that situation. Such analyses could affect the whole polity or one or more policy communities. At an operational level, the effectiveness which appropriate capabilities are developed by the relevant programs would be an appropriate metric.”

Later sections of this paper will examine the Australian experience and some lessons in each of these areas.
There are several areas where government plays a special role within a country economy. These are in the areas of largely non-market services largely, in Australia, operated within the public sector. These include defence, community services, education and health, and collectively they represent a significant share of gross domestic product. In addition, and particularly within a small economy like Australia, government represents a major customer. This means that policies around government procurement will have an impact on, and often be a lever for, market innovation and the diffusion of innovation.

Within a federal polity, a further question arises about the extent to which the roles of government in innovation policy can be clearly delineated against the three Australian tiers of government: national, regional and local.

Finally, in this context of this study, it is useful to distinguish between the role of government as an initiator of action and partnerships, and its role as a backer and supporter of private sector initiatives. The focus, usually, is on government initiatives at the expense of those situations where the government can get behind private sector initiatives in order to, either, accelerate the development of a market mechanism or to expand its scope to deliver public goods. In Australia, as we will see later, there are some noteworthy examples of government backing private sector initiatives.

2.5 The operating parameters within innovation systems

This section begins by setting up a framework for looking at public and private sector alliances for innovation in the context of country policy formulation and decision-making. It highlights the point that the nature and focus of collaborations will vary according to whether the policy focus is general and economy-wide, or targets a specific area of industry. Examples of a generic policy are Australia’s R&D Tax Concession scheme and the Export Marketing Development Grant (EMDG) programme. In these schemes any eligible party is entitled to beneficially participate in the scheme. Participation is self-selecting. In such instances the initial private sector input will be largely in the nature of lobbying about the design of the programme. The on-going participation by industry will tend to be informal, or in an advisory capacity through co-option to participate in the oversight of the administration of the scheme.

THE SPECTRUM OF STRATEGIC POLICY FORMULATION

By contrast, with targeted and industry-specific schemes the terms of engagement will tend to be more formal and involve negotiated or contractual terms, and often co-investment. Australian examples include the Rural R&D Corporations, and the automotive and pharmaceutical assistance schemes. Other examples include specific bids under the merit-
based allocation of generic programme funds, as in a specific multi-party application for funding under the Cooperative Research Centre programme or an application to be licensed under the Industry Innovation Fund scheme.

An important point to note is that the spectrum and nature of the involvement and participation of interested parties will most likely, or properly, vary across the lifecycle of a policy or a programme.

This framework can be further elaborated to examine how policy parameters might shape the role and functions of institutions, and their operation. It identifies four dimensions to determining the mandate, structure and governance of institutional arrangements. These parameters will determine or affect the scope and focus of possible linkages and relationships within agency operations.

**A MATRIX OF INSTITUTIONAL CHARACTERISTICS AND OPERATING PARAMETERS**

The first dimension is whether the industry policy is applied on a general or on a targeted, industry specific basis. Examples of this distinction have already been raised, above.

The second dimension is whether the policy is entitlement or merit based. Under an entitlement scheme, any industry player can benefit from the scheme as long as they meet the eligibility criteria. There is no selection process or competition. The classic example is a tax-based scheme. A merit-based scheme involves a competitive selection process. The classic cases are grant or licensing schemes. Both entitlement and merit-based parameters may be deployed in generic as well as industry-specific schemes.

The third dimension is the legal framework for relationships. The spectrum ranges from schemes established under a legislative charter, through to ‘one-off’ interventions negotiated and determined on a transactional basis. In the middle of this spectrum are legislated schemes with broad powers over implementation delegated to agencies, including the power to develop and promulgate detailed administrative guidelines.

The fourth dimension is the spectrum from input to output-oriented interventions. R&D measures, for example, tend to be highly supply-side oriented, whereas other arrangements – like AMIRA in the mining industry – are market driven and controlled by industry players.

Together, these four basic dimensions will shape the environment for relationships and linkages between public and private sector parties, and the form of their alliances or
collaborations. These conceptual models have been used to shape the selection and analysis of case studies illustrating the Australian experience in Chapter 4 below. The models are also useful in drawing out possible conclusions and general principles.
Chapter 3: Structural overview of Australia’s innovation system

Australia’s mechanisms for industry promotion and economic development are fragmented. Any survey of them confronts the difficulty of the complexity arising from the lack of an organising framework or political philosophy. Innovation, competition, and trade promotion policies and programmes have largely developed independently of each other, and operate in silo-like bureaucracies. This reflects the recent political philosophy that has eschewed any explicit industry policy: the dominant paradigm in Australia over the past eleven years until late 2007 has been a neo-classical free market philosophy which gives priority to competition policy and sees little role for purposeful government interventions in markets.

In practice, of course, political pragmatism and concessions to special interests do give rise to policy interventions that contravene pure neo-classical economic theory. The resulting confusion is compounded by the active role of State governments competing with each other for investment, and over economic development. Following the change of the Commonwealth Government in November 2007 the landscape is likely to change significantly. The incoming Labor Government has famously pronounced that “innovation policy is industry policy” and has anticipated a far-reaching review of the national innovation system. The review process will also look at rationalising Federal and State government roles and activities within ‘a new federalism’. For the purposes of this discussion, however, it is necessary to present Australia’s innovation system as an incoming Government finds it.

3.1 Federal or fragmented institutional structures?

Both Commonwealth and State governments play key roles in Australia’s innovation system. Until recently, however, there has been little formal or effective co-ordination between the levels of government. In addition, at each level, activities are spread widely across different ministries. This means that a lot of co-ordination occurs at the inter-agency level, rather than from a top-down policy framework. There are two factors behind the distributed nature of Australia’s innovation system. The first is the universal dilemma of securing effective ‘whole of government’ coherence around a policy area like innovation that is one of those horizontal policy themes that cuts across the various ways in which public administration is compartmentalised. The following schematic illustrates how innovation intersects with the various domains of public policy.
The second factor is the function of a federal system of governance. The following schematic attempts to provide a mapping of the major activities at a national level, noting that there are related regional schemes at a State level.

**ADMINISTRATIVE ARRANGEMENTS FOR MAJOR PROGRAMMES AND AGENCIES UNDER THE HOWARD GOVERNMENT (pre December 2007).**

This does not purport to be a comprehensive mapping and it does not reflect changes introduced by the incoming Government in Australia.

This mapping highlights the ‘silo like’ balkanisation of policy sponsorship. As such, the resulting policy landscape it is not untypical of the compartmentalism that characterises many contemporary Western bureaucracies. The emergence of these fiefdoms based on territorial specialisation makes it difficult to achieve policy leadership around overarching national interests or aspirations. It becomes difficult to articulate, much less promulgate, a clear statement of the problems that governments exist to solve.

It is noteworthy that there is an almost complete bureaucratic and policy separation between domestically oriented industry programmes, and exports and trade facilitation. Until very recently administrative arrangements also split science and technology policy from the industry ministry, and multiple ‘sectoral’ ministries develop and administer their own programmes.

This mapping of innovation-related activities and functions can be variously interpreted as:

- uncoordinated, decentralised and fragmented, or
- as representing a microcosm of the global challenge of managing complex systems.

Another way of looking at this challenge is to argue that Australia’s structural characteristics - small and sparse - put a premium on collaboration and partnerships. This, and Australia’s

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federal system, could position Australia well for learning about ‘open innovation’ models within a global economy. Australia’s situation gives it a strong incentive to do so.

This general mapping can be extended to examining where major programmes sit within the conceptual model for an innovation system discussed earlier.

**MAPPING THE FOCUS AND SCOPE OF PROGRAMME INTERVENTIONS WITHIN THE INNOVATION SYSTEM**

The value of this mapping is to highlight potential issues arising from the mix of ‘vertical’ and ‘horizontal’ points of innovation. The majority of programmes involve interventions at a particular point of the system. The issue that then arises is whether there is due attention to the upstream and downstream effects of such standalone interventions, including unintended consequences. Other programmes and institutions span the innovation system from production to diffusion. Taking such mapping to more disaggregated levels can provide a useful heuristic for identifying potential gaps or coordination challenges.

The ‘silo like’ character of government arrangements is reflected and amplified by a similar balkanisation of industry associations and lobby groups. There is no single peak body speaking for Australian industry at the interface with government. The Australian Chamber of Commerce and Industry (ACCI) is a peak body of State-based Chambers and national associations (claiming 350,000 members employing 4 million people). The Australian Industry Group (AIG) claims to represent 10,000 employers in “manufacturing, construction, automotive, telecommunications, IT & call centres, transport, labour hire and other industries”. At the other end of the spectrum is the Business Council of Australia, the voice of “the CEOs of 100 of Australia’s leading corporations with a combined workforce of one million people”. It represents the big end of town, including multinationals. Then there are hundreds of associations around particular industries or professions. The influential National Farmers’ Federation, is a peak organisation of about fifteen State or commodity associations and is “the embodiment of Australian farmers’ need to speak with one united voice”. The thinking side of business is represented by the Committee for Economic Development of Australia (CEDA), with a membership base of about 800 organisations, and the Australian Business Foundation which promotes evidenced-based policy.

The rivalry between different industry associations provides a government with considerable scope for ‘forum shopping’, and many have run the risk of being co-opted, sidelined, or muted through engagement with government funding programmes. Under the Howard Government (1996-2007) the voice of NGOs had been somewhat stifled in policy-making, and there has been a lack of integration and cohesion between economic and social policy frameworks. One feature of government policy interactions over the past decade has been the decline or dismantling of tri-partite consultative bodies, such as the Australian Manufacturing Council.
Vertical policy specialisation makes horizontal programme collaboration difficult. In practice, in Australia, a lot of collaborative co-operation and partnerships therefore tend to be driven at an agency level, not from the top. What this highlights is the need to find ways of applying emerging models of ‘open innovation’ and co-production to government.

Within the landscape mapped in the preceding diagramme we can observe three generic models of public sector governance and service delivery:

1. policy control and command of programme delivery under the direct control of an arm of executive government;
2. policy and programme delegation – usually under a broad statutory charter – to an ‘arms length’ agency with its own governance framework; and
3. standalone programmes administered on a project management basis.

The Australian Government has been implementing a clarification of the role of different bodies within this framework, following a major review of governance arrangements\(^\text{34}\). This review recommended that statutory authorities and similar bodies be assessed against two governance templates. An ‘executive management’ template involves an organisation reporting directly to executive government, whereas under the ‘board’ template a body has been delegated full power to act. These reforms have brought greater clarity to governance frameworks, although the rationale for the government’s choice of the appropriate template has not always been transparent or self-evident.

One result of both the compartmentalisation of responsibilities and the different governance models is that private sector players need to navigate their way through a complex territory. This may reduce the scope for collaborative flexibility in their own approach to alliances with government, and may incur high transaction costs.

As illustrated, but not fully mapped, the national arrangements are mirrored at a State, regional level. At worst, this federal model can promote duplication, inconsistency and the fragmentation of scarce resources. At best, it offers a framework for moving to more collaborative and ‘networked’ policy and service delivery models\(^\text{35}\). Currently there are moves to promote a National Reform Agenda through the federal co-ordinating forum, the Council of Australian Governments (COAG). It was this body that developed a national competition policy, albeit with a narrow focus on the micro-economic restructuring of public service delivery and infrastructure provision.

This examination of the structural framework of Australia’s innovation system highlights the desirability of distinguishing between the role and nature of public and private sector alliances in the different circumstances of institutional relationships as against standalone programmes or projects. Institutions encompass programmes and projects within an operational context that involves different possibilities for private sector engagement than in standalone programmes devised and administered directly by the executive government.

\(^{34}\) Review of the Corporate Governance of Statutory Authorities and Office Holders, (the “Uhrig” Review, Canberra, June 2003

\(^{35}\) Tom Bentley, in Parker and Gallagher (2007), op cit.
3.2 Path dependencies and institutional evolution.

A survey of the major public sector bodies associated with economic development and innovation shows that many of the dominant contemporary players have a long institutional history, stretching across significant swings and changes in policy paradigm and priorities. The emergence of new agencies or programmes usually indicates new priorities associated with a political or economic cycle. It is also noteworthy that there is usually considerable clumsiness and messiness around attempts to terminate or re-direct major industry or economic development programmes.

As a backdrop to institutional development, it is useful to chart the key developments and drivers shaping the evolution of institutional structures in Australia.

<table>
<thead>
<tr>
<th>Period</th>
<th>Key Developments and Drivers</th>
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<tbody>
<tr>
<td>19th century</td>
<td>Superior economic performance to US - off the back of mining (gold) and wool</td>
</tr>
<tr>
<td>1901</td>
<td>Institution building around the new Commonwealth of Australia and the consolidation of a key role for government enterprises</td>
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<tr>
<td>1914-1918 war</td>
<td>Disruption to civil imports; vulnerability from the lack of local defence materiel and industrial capabilities</td>
</tr>
<tr>
<td>1920-1940</td>
<td>Push for greater local industrial self sufficiency, especially in defence industries and public health capabilities. New focus on agricultural productivity</td>
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<tr>
<td>1940-1960</td>
<td>Sunset of Imperial influence and a shift from a UK to a US axis. Post war reconstruction and industrialisation: “nation building” projects - including discussion of nuclear futures (off the back of uranium resources)</td>
</tr>
<tr>
<td>1960-1980</td>
<td>Manufacturing stagnates behind protectionist barriers; beginning of second mining boom (iron; coal; uranium)</td>
</tr>
<tr>
<td>1980-2000</td>
<td>Internationalisation of economy (with reduction of tariffs and floating of currency); programmes for structural adjustment and micro-economic reform; privatisation of government enterprises. Focus on new ICT and biological technologies. Strong productivity growth</td>
</tr>
<tr>
<td>2000 -</td>
<td>New challenges from global warming, energy futures, terrorism and preventable diseases focus new national priorities; emergence of competition from BRIC economies; China now biggest trading partner</td>
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Over the past century we can discern three major inflection points in Australia’s industrial development: these have all been external shocks.

1. The two World Wars, and particularly the First, exposed Australia’s vulnerability to disruptions to global supply chains and its limited local industrial capability. This led to major initiatives around local capability building.
2. The floating of the Australian dollar and the dismantling of tariff barriers in the 1980s required major structural adjustment across the Australian economy, leading to major productivity growth and new industry incentive schemes.
3. Climate change and environmental adjustment is the major externality influencing the Australian economy at the start of the 21st century, particularly as remediation
and adjustment issues affect Australia’s core traditional export industries (resources and agriculture).

It is instructive to chart the institutional evolution of innovation and industry agencies against this historical backdrop. This chart does not purport to be comprehensive, but it helps to draw out some instructive observations.

THE INSTITUTIONAL EVOLUTION OF INNOVATION AGENCIES
Illustrative, and not comprehensive

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<tr>
<td>Establishment</td>
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<tr>
<td>Change or major review</td>
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<tr>
<td>Termination</td>
<td></td>
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(Note: see Glossary for the many acronyms)

The first point that emerges from this snapshot is that some of today’s major public sector innovation agencies have had a long history. This has entrenched their institutional status and has helped to minimise the impact of political cycles and pogroms on their operations. For example, organisations like CSIRO have an almost iconic status in the community and are accorded high levels of public trust and confidence.

Second, many of the current programmes originated as responses to the processes of structural adjustment and reform in the mid 1980s. However the world has changed greatly over the intervening years. Yet it is rare for programme objectives and incentive mechanisms to be reviewed in the light of major changes to the operating environment.

Third, the focus and role of some agencies has changed considerably over the years. For example, the antecedents of the Productivity Commission were directly involved in the setting and regulation of tariffs and related offsets, whilst today’s body is strictly an independent review agency.

Fourth, taking a longer view of institutional development draws attention to non-current programmes or agencies. A good example is the abolition of the Australian Manufacturing Council in 1996. Its demise reflected a wider shift away from formalised and broadly based standing consultative bodies advising on industry and innovation policy. This is particularly true of tripartite forums bringing together government, capital and labour. More recently the tendency has been to rely on ad hoc or one-off consultations, usually with the directly involved parties rather than more expansive communities of interest; the implicit danger with
such approaches is that a process of consultation substitutes for effective engagement and that significant constituencies can become marginalised.

Conducting this review highlights the extent of the cuts to institutional arrangements and programmes following the change of government in 1996. Many of these have faded from the collective policy memory. Reassessing past, terminated programmes and what might be learned from them should be an integral part of policy renewal.

Fifth, Australia’s state owned enterprises and utilities historically have played a significant, if largely unacknowledged, role as agents of industry policy and economic development. One hundred years ago Australia’s experiments and innovation with state enterprises was keenly observed and studied by other countries. In the 1980s the missing part of the debate over deregulation and privatisation was the consequences for industry policy and national capabilities and infrastructure investment.

Finally, taking this long-run perspective surfaces the unexpected insight about the crucial role of national security and externalities in shaping industry policy. The insecurities and industrial vulnerabilities caused by war, terrorism and the environment have had a marked impact on industry policy and national investment priorities.

3.3 Leadership: tensions over policy paradigms and national priorities.

This structural overview of the Australian innovation system indicates a distributed, poorly co-ordinated system. What is lacking from this landscape is a central driving point, the ‘brain of the system’. Essentially this reflects the lack of a policy consensus about an appropriate innovation paradigm, and the mistrust of anything resembling industry policy.

During the 1990s virtually all the central government standing bodies or advisory Councils bearing on innovation were shut down. These included:

- the Australian Science and Technology Council (1978–1998)
- the Economic Planning Advisory Council (1983–1995); and
- the Australian Manufacturing Forum.

The last remaining central co-ordinating body is the Prime Minister’s Science, Engineering and Innovation Council (PMSEIC). This meets twice a year around an issues-based agenda developed by officials or the Chief Scientist. It is very much a representative body, with a heavy bias towards science and technology policy. It is, therefore, ill-suited to develop or support a more broadly-based innovation agenda. The incoming Rudd Government has announced an intention to establish a new National Innovation Council. It has also espoused ‘a new federalism’ around more actively co-ordinating Commonwealth and State roles, so that the Council of Australian Governments (COAG) may assume a greater role in innovation policy.

Under the Howard Government what was represented as innovation policy was mainly promulgated through executive government ‘Statements’, usually launched at the National Press Club rather than in Parliament. This recourse to special policy statements had begun under the former Labor Keating Government (with Statements like Creative Nation and Working Nation).

Under the Howard Government there were two major policy statements: Investing for Growth in 1997, and Backing Australia’s Ability in 2001. There were major differences in the gestation of each.
Investing for Growth was a combination of the re-packaging or re-badging of existing programmes together with some new initiatives, the most significant of which were:

- The Innovation Investment Funds for early stage venture capital;
- The establishment of Invest Australia as a new FDI agency;
- The establishment of a private sector Strategic Investment and Major Projects co-ordinator in the Prime Minister’s department;
- A series of ‘kick start’ investments in the roll out of the new digital revolution; and
- The initiation of Industry Action Agendas to identify barriers to growth and new export opportunities. (These Action Agendas were constrained from developing proposals which might have funding implications!).

Interestingly, this Prime Ministerial Statement pivoted off the back of three commissioned reports:

- David Mortimer, *Going for Growth: Business Programs for Investment, Innovation and Export*;
- the report of the Information Industries Taskforce, chaired by Professor Ashley Goldsworthy, *The Global Information Economy – The Way Ahead*; and
- the report of the Information Policy Advisory Council (IPAC), chaired by Dr Terry Cutler, *A national policy framework for structural adjustment within the new Commonwealth of Information*.

The Mortimer Report put considerable emphasis on “the maintenance of sound macroeconomic policies and maintaining the momentum of broad ranging microeconomic reform, including taxation reform”\(^{36}\). The big area of new priority in the Statement was on the area of information technology and the online revolution. In response to the IPAC report the government established a new central agency - the National Office for the Information Economy - and a federal-state Ministerial Council to coordinate a national action agenda. (It was ironic that this new policy focus occurred whilst other central government policy agencies were being abolished).

The 1997 Statement also registered the government’s awareness of the business backlash from its cuts to industry programmes when it came to office in 1996. Both the Australian Business Foundation and the Business Council of Australia campaigned for a stocktake of innovation policies. In the 1998 election campaign the government committed to join the BCA in a major Innovation Summit. This put in train an interesting policy process. A recent case study\(^{37}\) of the Summit and the development of the government’s *Backing Australia’s Ability* statement has highlighted two interesting aspects of the process: the nature and mix of public and private sector participants, and the contest over innovation paradigms. Rival schools of thought brought both neoclassical and ‘innovation system’ accounts of innovation to the Summit agenda. The former won out, and the resulting policy package was highly science and technology oriented. The big winner was research, but along with that came a huge emphasis on the commercialisation of research, with mixed results.

Following March and Edwards’s case study, the following table charts the progress of the process.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tr>
<td>January 1999</td>
<td><strong>Steering Committee</strong> established</td>
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<tr>
<td></td>
<td>Chaired by then CEO of IBM Australia, and comprising mainly non-government members</td>
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<tr>
<td>May/June 1999</td>
<td>Committee established <strong>six working groups</strong> to develop background papers</td>
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<tr>
<td></td>
<td>Over 70 submissions made</td>
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\(^{36}\) “Investing for Growth”, Address by the Prime Minister, the Hon John Howard MP, National Press Club, Canberra, 8 December 1997

Department of Industry Science and
Resources commissions sectoral papers
and a ‘framework’ paper.

February 2000 **Innovation Summit** held over three
days. At the end it produced a very
broad communiqué.

February 2000 **Immediately following the Summit, an**
**Innovation Summit Implementation**
**Group (ISIG) was established**

Business Council main organiser of event. 550 participants,
weighted to public sector. The
three main themes were:
(a) a competitive environment;
(b) investing in ideas; and
(c) building industry research
linkages.

**Concurrently, the Chief Scientist**
**initiated post-Summit consultations**

June 2000 **ISIG Interim Report to PMSEIC**

August 2000 **Chief Scientist’s report, A Chance to
Change**

November 2000 **Joint paper by Chief Scientist and
Chair of ISIG – “Australia’s Innovation
Future”.**

January 2001 **Prime Minister launches Backing
Australia’s Ability statement.**

Marsh and Edwards note that while participation in the process involved government, peak bodies, universities and numerous individual firms, few were involved in all the steps of the process. Only the BCA and the Department of Industry were involved throughout. Major omissions from the guest list were small business and the services sector.

The ‘science push’ model of innovation ended up winning the day. Amongst the conflicting approaches advanced, and sidestepped, there was no consensus as to the problem to be solved. When the process moved to the ‘implementation’ phase, “the neo-classical market failure view of innovation” prevailed. When Backing Australia’s Ability was launched, its major focus had become supply-side support around building capability. The package was costed at $3 billion over five years. The big ticket items were:

- a re-jigging of the R&D Tax Concession (for which see the case study in the next chapter);
- a massive doubling of the Australian Research Council’s research grants (with an extra $736 million);
- the establishment of new research centres around biotechnology and ICT;
- special new professorial and post-doctoral fellowships; and
• an expansion of the CRC programme.

In 2004 Backing Australia’s Ability II was released which extended the funding profile to 2010-11, but did not significantly alter the earlier priorities.

Marsh and Edwards conclude their case study with the observation that:

The Summit Process did not act as a ‘forcing device’ to induce a reassessment of basic policy frames…. In hindsight, it is hard to avoid the conclusion that the Summit represented an elaborate process of search and engagement that sanctioned an outcome that was, in most respects, largely pre-determined38.

It is also noteworthy that whilst the private sector played a major role in the initiation of this Summit process, by the end of the process control had almost entirely reverted to the public sector.

3.4 Cross-current: the emergence of Australia’s National Research Priorities.

The establishment of national research priorities was, and is, a seminal cross-current to the policy fragmentation and balkanisation described in much of this paper. The articulation of a set of National Research Priorities in late 2002 was possibly a more significant initiative than the development of Backing Australia’s Ability.

Talk about national priorities was not, of course, new. As highlighted in some of the case studies in the next chapter, many agency charters make reference to the ‘national interest’ although what this means usually remains in the eye of the beholder. In 1997 the Chief Scientist of the day strongly recommended that national priorities for science and technology be set, and that ASTEC be given the task of developing a framework39. The government, however, abolished ASTEC instead and the matter of priorities went into abeyance until the appointment of a new Chief Scientist, Robin Batterham, in 1999.

There are four important observations to make about the process of developing these priorities. First, the process was steered personally by the Chief Scientist, Robin Batterham, through a robust process which involved:

- the publication of a thoughtful and comprehensive issues paper to start the process40;
- extensive consultations with a wide range of interested parties; and
- the ex ante consideration of criteria and a decision framework.

Second, establishing these priorities represented government initiating a broadly-based strategic assessment process. Third, the significance of the Priorities goes wider than the research community because it actually represented a first step, a sort of Trojan Horse, towards going the next step and extending the strategic assessment into a set of national innovation priorities, something which the incoming Rudd Government has said it will do. Fourth, the exercise consciously sought to develop a ‘whole of government’ framework.

The timing was right for such an exercise as Backing Australia’s Ability had delivered significant new research funding, and key agencies such as CSIRO and the NHMRC were going through a process of strategic re-positioning.

38 ibid., p. 32f
Rationale for priorities

The initial issues paper of May 2002 began with a clear rationale for priorities. Paraphrased, the argument is that:

- as a small country economy Australia cannot afford to spread its resources too thinly. It should concentrate on areas where it can be world class; and that
- current resource allocations are not taken in “the context of broad national objectives”.

The issues paper then went boldly on to declare:

*Important questions are not addressed in a coordinated way by the research system:*

- What do we want to achieve as a country?
- What are our strengths, opportunities and needs?
- What scale and scope of research effort is needed to address identified problems and their solutions?
- How can our ability to exploit identified opportunities be enhanced by better collaboration between research agencies?

Governments internationally are aware of the critical and positive impact that research and innovation have on future economic growth, competitiveness, human welfare and the environment. Many countries are using national priorities to focus their research effort on areas of significant national need or opportunity, in response to:

- the growing pace of change and complexity in social and environmental areas
- rapid technological change in established areas such as ICT and biotechnology
- the emergence of new technologies such as nanotechnology and novel materials
- rapidly escalating costs of research facilities and programmes
- global competition for research staff
- the increasingly multidisciplinary nature of research programmes.

Excellence, connectivity, collaboration and relevance were recurrent keywords in the Chief Scientist’s vocabulary about the exercise.

Framework principles

Following consultations, in mid-2002 the Chief Scientist released a ‘framework’ document to guide the actual setting of priorities. This set out objectives, governing principles, the scope of application, priority types, and selection criteria. Portentously, this document explicitly noted that the exercise would not, “at this stage”, apply to industry support programmes or university block funding. The initial application would be to public research agencies and competitive grant funding.

Objectives:

The objectives of national research priorities are:

1. to identify and address areas of strength, opportunity or need where an increase in research effort - including collaboration, coordination or investment - would make a significant contribution to national wealth and/or well-being.
2. to determine what shift in research effort is needed, what new or improved research activities are required, and how the targeting of research effort can best be achieved.

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In other words, these priorities will highlight research areas of particular importance to Australia's economy and society, where a whole-of-government focus has the potential to improve research, and broader policy outcomes.

The framework document quietly provided reassurance that the governing principles would build on the current research system. The principles governing the framework would be:

1. Maintaining a research system that is internationally competitive and has leading edge capabilities across a wide range of disciplines;
2. Maintaining a research system with strong internal and external linkages at regional, national and international levels;
3. Complementing and enhancing existing priority setting and strategic planning arrangements in research agencies and funding bodies; and
4. Ensuring that research bodies and agencies play a leading role in advising how to best implement the research priorities.

The document spelled out a preference for ‘thematic’ national priorities. In choosing priorities the focus would be to ensure that they:

- Point to a national vision for research and are aspirational
- Capture the imagination and support of the community
- Are based on excellence and supported by strong basic research
- Stimulate a collaborative approach to solutions
- Are multidisciplinary in nature
- Are supported over an appropriate timeframe
- Produce measurable outcomes

In general, priority areas will be identified by a broad theme expressed in aspirational terms with a range of possible high level priority goals (outcomes), requiring a number of specific research actions necessary to achieve them.

Finally, the framework document spelled out the three selection criteria in the choice of priorities.

1. The scope for increased Australian Government research effort in the priority area to deliver a measurable and significant positive impact, by:
   a. achieving an appropriate ‘critical mass’ of excellent research through specific support and/or coordination and collaboration at the national level; and
   b. addressing Australia’s strengths, opportunities or needs arising from:
      i. our nation’s geography, climate, bioresources, economy, way of life and/or culture; or
      ii. issues of global importance which impact significantly on Australia; or
      iii. Australia’s competitiveness in a global context

2. The scope for Australia to build the capacity needed to achieve that impact, taking into account:
   a. existing expertise, experience and technological capacities or whether such capacities can be reasonably acquired or accessed;
   b. the availability, quality and scale of necessary research infrastructure;
   c. research conducted in other nations and the potential benefits of international collaborations; and
d. the overall magnitude of the investment required to make an impact.

3. The scope for Australia to capture the benefits of the research, through the potential of the research to:

   a. achieve commercially, socially or environmentally relevant outcomes over the cycle of the priorities regime; or
   b. enhance significantly Australia’s overall innovation capacity by broadening the knowledge base, and fostering acquisition of skills and understanding of emerging areas of ‘hot’ research.

Australia’s national research priorities were announced by the Prime Minister in late 2002 and were further enhanced and refined in 2003 to take greater account of the contributions of social sciences and humanities research. A National Research Priorities (NRP) Standing Committee was established in February 2005 to advise the Government on the implementation of the NRP’s by relevant agencies. The first formal report to the Government by the Committee was provided in May 2007. A review of the scheme anticipated for 2009 is likely to be brought forward by the new government under its overall review of the national innovation system.

There has been a high degree of compliance with the scheme, partly because it built on science investment processes already being put in place in key agencies like CSIRO. The longer-term, more fundamental significance of the scheme is that it begins, in the research domain, to treat the innovation system as a system. It would be a small step to bring industry programmes under the ambit of an expanded set of innovation priorities.

Nonetheless, some open questions remain about the scheme. These include:

- Are the priorities too broad and inclusive, taking the pressure off hard resource allocation decisions?
- What is the optimal level of compliance, without choking off serendipitous lines of research? The current Chief Scientist has indicated that about 10% is the right level for non-directed research.
- Over time, what research is not being done as a result of the scheme? Is there enough transparency around views on what should not be priority areas in Australia?
- How is the linkage maintained between investment in outcomes and investment in the capabilities needed to secure such outcomes? Is there a risk that important national capability building may become under funded? Is there sufficient investment in nurturing responsive capabilities to emergent challenges?
- How should the strategic assessment underlying the priorities be reviewed and renewed over time? There is always a risk that, after the first round process, the statement of priorities may become formulaic and not sufficiently responsive to ground shifts in the environment.
ANNEX: AUSTRALIA’S NATIONAL RESEARCH PRIORITIES

<table>
<thead>
<tr>
<th>AN ENVIRONMENTALLY SUSTAINABLE AUSTRALIA</th>
<th>PROMOTING AND MAINTAINING GOOD HEALTH</th>
<th>SAFEGUARDING AUSTRALIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRONTIER TECHNOLOGIES FOR BUILDING AND TRANSFORMING AUSTRALIAN INDUSTRIES</td>
<td></td>
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</tr>
</tbody>
</table>

Twenty-one specific goals are articulated under the four major themes.

1. AN ENVIRONMENTALLY SUSTAINABLE AUSTRALIA
Transforming the way we utilise our land, water, mineral and energy resources through a better understanding of human and environmental systems and the use of new technologies

1. Water – a critical resource
Sustainable ways of improving water productivity, using less water in agriculture and other industries, providing increased protection of rivers and groundwater and the re-use of urban and industrial waste waters.

2. Transforming existing industries
New technologies for resource-based industries to deliver substantial increases in national wealth while minimising environmental impacts on land and sea.

3. Overcoming soil loss, salinity and acidity
Identifying causes and solutions to land degradation using a multidisciplinary approach to restore land surfaces.

4. Reducing and capturing emissions in transport and energy generation
Alternative transport technologies and clean combustion and efficient new power generation systems and capture and sequestration of carbon dioxide.

5. Sustainable use of Australia’s biodiversity
Managing and protecting Australia’s terrestrial and marine biodiversity both for its own value and to develop long term use of ecosystem goods and services ranging from fisheries to ecotourism.

6. Developing deep earth resources
Smart high-technology exploration methodologies, including imaging and mapping the deep earth and ocean floors, and novel efficient ways of commodity extraction and processing (examples include minerals, oil and gas) while minimising negative ecological and social impacts.

7. Responding to climate change and variability
Increasing our understanding of the impact of climate change and variability at the regional level across Australia and addressing the consequences of these factors on the environment and on communities.
2. PROMOTING AND MAINTAINING GOOD HEALTH
Promoting good health and well being for all Australians

1. A healthy start to life
Counteracting the impact of genetic, social and environmental factors which predispose infants and children to ill health and reduce their well being and life potential.

2. Ageing well, ageing productively
Developing better social, medical and population health strategies to improve the mental and physical capacities of ageing people.

3. Preventive healthcare
New ethical, evidence-based strategies to promote health and prevent disease through the adoption of healthier lifestyles and diet, and the development of health-promoting products.

4. Strengthening Australia’s social and economic fabric
Understanding and strengthening key elements of Australia’s social and economic fabric to help families and individuals live healthy, productive, and fulfilling lives.

3. FRONTIER TECHNOLOGIES FOR BUILDING AND TRANSFORMING AUSTRALIAN INDUSTRIES
Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting-edge research

1. Breakthrough science
Better understanding of the fundamental processes that will advance knowledge and facilitate the development of technological innovations.

2. Frontier technologies
Enhanced capacity in frontier technologies to power world-class industries of the future and build on Australia’s strengths in research and innovation (examples include nanotechnology, biotechnology, ICT, photonics, genomics/phenomics, and complex systems).

3. Advanced materials
Advanced materials for applications in construction, communications, transport, agriculture and medicine (examples include ceramics, organics, biomaterials, smart material and fabrics, composites, polymers and light metals).

4. Smart information use
Improved data management for existing and new business applications and creative applications for digital technologies (examples include e-finance, interactive systems, multi-platform media, creative industries, digital media creative design, content generation and imaging).

5. Promoting an innovation culture and economy
Maximising Australia’s creative and technological capability by understanding the factors conducive to innovation and its acceptance.
4. SAFEGUARDING AUSTRALIA

Safeguarding Australia from terrorism, crime, invasive diseases and pests, strengthening our understanding of Australia’s place in the region and the world, and securing our infrastructure, particularly with respect to our digital systems.

1. Critical infrastructure
   Protecting Australia’s critical infrastructure including our financial, energy, communications, and transport systems.

2. Understanding our region and the world
   Enhancing Australia’s capacity to interpret and engage with its regional and global environment through a greater understanding of languages, societies, politics and cultures.

3. Protecting Australia from invasive diseases and pests
   Counteract the impact of invasive species through the application of new technologies and by integrating approaches across agencies and jurisdictions.

4. Protecting Australia from terrorism and crime
   By promoting a healthy and diverse research and development system that anticipates threats and supports core competencies in modern and rapid identification techniques.

5. Transformational defence technologies
   Transform military operations for the defence of Australia by providing superior technologies, better information and improved ways of operation.
Chapter 4: Case studies of innovation alliances and incentives in action

In many of the countries being examined in this survey there are strongly centralised structures supporting industry development and innovation. There is particularly the case in Europe and Asia where there is a broadly shared concord that the state has a pro-active role in the shaping of national innovation systems. Australia has been different in that the recent dominant paradigm held that the state’s role is reactive and is primarily centred on narrower areas of ‘market failure’. The result has been a far more distributed set of structures and programmes dealing with or influencing innovation and trade. Where there are concentrated and centralised arrangements, as in the case of Europe and Asia, it is easy to provide a detailed and comprehensive survey of activities. With a more distributed system, we need to make a trade-off between comprehensiveness and the depth of analytical reporting. The compromise is the uneven set of case studies which follow: the depth of analysis varies.

Twelve case studies are presented in this section. These range from demand side and ‘output’ focussed programmes through to upstream investments in R&D that are more disconnected from markets. These institutions, agencies or programmes have been included on the basis of one or more of the following selection criteria:

• their materiality in terms of scale of expenditure;
• the nature of their policy or programme co-ordination functions;
• some distinctive alliance arrangements or characteristics;
• the instructive evolution of the agency or programme over time; or
• the lessons they provide.

These case studies capture most of the main funding flows within the Australian innovation system, as summarised in the following exhibit prepared by the Productivity Commission.

AUSTRALIAN GOVERNMENT SPENDING ON SCIENCE AND INNOVATION, 2005-06

Source: Productivity Commission, 2007
It should be noted that this summary does not include export facilitation and FDI attraction outlays.

42 It is noteworthy – and reassuring - that the recent and intensive Productivity Commission inquiry ended up being equally selective. See Productivity Commission, Public Support for Science and Innovation: Research Report, Canberra, March 2007
The case studies presented in this Chapter are as follows:

4.1 Export facilitation
   4.1.1 Austrade
   4.1.2 Export Market Development Grant Scheme
   4.1.3 EFIC

4.2 The Rural R&D Corporations

4.3 The Innovation Xchange (IXC)

4.4 Financing innovation, and the Innovation Investment Fund (IIF) scheme

4.5 The Co-operative Research Centre (CRC) Programme

4.6 The R&D Tax Concession
   4.6.1 R&D Tax Syndication

4.7 Peak research funding agencies: The National Health and Medical Research Council (NHMRC):

4.8 Institutional roles: The CSIRO

4.9 Telecommunications: a case study of the unintended consequences of deregulation
4.1 Export facilitation

Direct government support for export development in Australia is both sector specific, as with primary industries and the automobile industry, and also supported by generic schemes. The public private linkages are stronger in the case of the former than the latter.

Over the past decades the range of direct policy programmes around export facilitation has narrowed, as Australia has firmly aligned itself with multilateral trade negotiations to open up world trade. It has also been a prime mover in the Cairns group of countries lobbying for greater market access by agricultural producing countries. Increasingly the mantra of ‘WTO rules’ and compliance is used to challenge export facilitation measures, often without detailed evaluation of the actual room for manoeuvre. Thus the policy culture around free trade has had the underlying effect of shifting the policy focus from downstream trade activity and outcomes to what are thought or deemed to be the upstream drivers of economic and trade performance. This has, over time and in general, reduced clarity and analysis around the linkages between trade inputs and outcomes.

Sector specific government support around export development has been driven from industry facing Ministries and, as noted repeatedly, many of these schemes form part of integrated ‘whole of value chain’ approaches to industry development. The generic support schemes discussed here are located within the Department of Foreign Affairs and Trade, which places them inevitably within the policy context of trade liberalisation and external affairs. A danger is that these administrative arrangements can promote an artificial demarcation between domestic industry development on the one hand, and export and trade facilitation on the other. This demarcation will be increasingly at odds with a world of borderless markets.

For Australia’s key commodity exporters, government provision and underwriting of key infrastructure for mining and gas producers – such as railways, ports and pipelines – represents a huge but largely under-reported category of export facilitation. The other main form of export facilitation has been import duty concessions for sectors where government has been promoting exports, especially during structural adjustment processes. These have been primarily in the area of automobiles and textiles, clothing and footwear. Such schemes are designed to reduce the input costs of export production, and are justified on the basis of the value-added captured by Australia. AusIndustry within the Department of Industry, Tourism and Resources also operates a general Tradex Scheme which provides relief to producers via an up-front exemption from Customs Duty and GST on imported goods intended for export or to be used as inputs to exports. The Scheme removes the need to claw back these charges after export. From a policy perspective, the 1997 Tradex scheme maintains a direct link between programme intervention and export outcomes.

Within the Ministry of Foreign Affairs and Trade there are two principal agencies directly concerned with export facilitation: Austrade and the Export Finance and Insurance Corporation (EFIC). The following discussion focuses on these two agencies.

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45 www.ausindustry.gov.au. This is revenue neutral for government, but provides cashflow benefits to exporters and reduces administrative overheads.
4.1.1 Austrade and the Export Market Development Grant Scheme

Austrade – the trading name of the Australian Trade Commission – is Australia’s principal export facilitation agency. Apart from providing ‘fee for service’ support to Australian firms venturing overseas, it administers the main cross-sectoral grant scheme for exporters, the Export Market Development Grant scheme. Austrade operates in parallel with Federal and State inward FDI attraction agencies.

The agency - Austrade.

Austrade is a statutory agency within the Department of Foreign Affairs and Trade. It was established in 1985. Its export facilitation charter is disconnected from the domestic industry development functions of AusIndustry and the inwards FDI agency Invest Australia, both located within the former Department of Industry, Tourism and Resources. Austrade maintains a network of overseas offices, usually co-located with Australian embassies. Senior Trade Commissioners often double as consular officers.

The policy dynamics and policy evolution.

Within an historical context, general mechanisms for export facilitation were slow to emerge in Australia. This reflected the realities of Australia’s economic integration within the British Empire, which persisted long after the Australian colonies federated in 1901 and later acquired Dominion status. Nowhere were the residual imperial tentacles more evident than in trade policy (and foreign affairs generally). British institutions largely shaped Australia’s trade policies until the Second World War, in line with Australia’s strong commitment to the maintenance of an Imperial Preference regime, and protectionism outside this regime⁴⁶.

Australia’s first Trade Commissioners were appointed to Europe and the 'Far East' from 1903, focusing on markets outside the Empire⁴⁷. In 1919 the Government resolved that “an Australian Trade Commissioner should be immediately appointed in Egypt and anywhere else in the Near or Far East and other places where opportunities for trade appear to offer”. The Board of Trade recommended the appointment of trade commissioners to “the East Indies, Mesopotamia, China, Japan, India, South Africa, South America and Siberia”⁴⁸. This growing body of trade facilitators was brought together as the Trade Commissioner Service in 1934.

Austrade in its current form was established by legislation in 1985, in that decade of structural adjustment and the internationalisation of the Australian economy that saw the initiation of numerous government support programmes for business. Austrade was initially housed within the Department of Industry, Technology and Commerce, but then shifted to the Department of Foreign Affairs and Trade in 1991.

Since its formation Austrade has gone through a range of alternative formulations of its mission. In the 1980s the ethos around Austrade was one of the promotion of ‘national interests’ in trade. By the mid 1990s the focus shifted to the increase of export revenues, and Austrade as an agency became more corporatised. Operations tended to focus on the ‘top end of town’ and the big, established Australian exporters. More recently the agency’s focus

⁴⁷ Australian Bureau of Statistics, “The Department of Foreign Affairs and Trade over the century – a chronology” in *Australian Year Book*, 2001, ABS 1301.0
⁴⁸ ibid.
and accountability has concentrated on the number of export transactions and the support of emerging exporters.49

**Mandate and scope**

The legislation50 creating Austrade establishes the following mandate:

To facilitate and encourage trade between Australia and foreign countries (in this section referred to as **Australian export trade**) by:

(i) representing the trading and commercial interests of Australia in foreign countries;
(ii) assisting, directly or indirectly, Australian organizations in trade negotiations;
(iii) promoting, or participating in or co-ordinating projects to promote, Australian export trade;
(iv) obtaining, and making available to Australian organisations, information relating to current or future opportunities for Australian export trade, including opportunities for involvement in overseas development projects;
(v) supporting and facilitating investment in foreign countries, and facilitating investment in Australia, where that investment is likely to enhance opportunities for Australian export trade;
(vi) carrying out, or assisting other persons to carry out, or participating with other persons in carrying out, in whole or in part, overseas development projects, in circumstances where that course of action will benefit Australian organisations;
(viii) administering the Export Market Development Grants Act;
(ix) developing and administering schemes to provide assistance in the development of markets in foreign countries; and
(x) facilitating access by persons to Departments of State of the Commonwealth or of a State and to instrumentalities established by or under a law of the Commonwealth or of a State where that access is likely to enhance opportunities for Australian export trade.

This represents a broad remit that spreads across both broad market development and direct firm assistance.

Austrade operates as a matrix structure of geographic posts and specialised sectoral business units. At 30 June 200751, Austrade operated in 119 overseas locations in 62 countries. The overseas network is divided into four regions: the Americas; Europe, Middle East and Africa; North East Asia; and South East Asia, South Asia and the Pacific.

**Operations**

Austrade has 1037 staff (2006), split fairly evenly between Australian-based staff and offshore staff. Staff remuneration is typical, in profile and levels, of other public sector agencies. The Chief Executive’s remuneration is around $420,000. It should be noted that the following salary data do not include posting allowances and benefits, which can provide attractive tax-free incentives for staff.

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49 Austrade, KPIs, Change and Business Strategy, December 2005
51 Austrade, Annual Report 2006-07
AUSTRALIAN STAFF REMUNERATION AS AT JUNE 2007

<table>
<thead>
<tr>
<th>Classification</th>
<th>Collective Agreement</th>
<th>AWA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Salary Range ($)</td>
<td>No.</td>
</tr>
<tr>
<td>APS 3-4</td>
<td>37,000-52,820</td>
<td>39</td>
</tr>
<tr>
<td>APS 5-6</td>
<td>55,027-67,442</td>
<td>113</td>
</tr>
<tr>
<td>APL2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exec. Level 1</td>
<td>71,826-80,793</td>
<td>145</td>
</tr>
<tr>
<td>APL3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exec. Level 2</td>
<td>84,025-97,900</td>
<td>184</td>
</tr>
<tr>
<td>APL4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exec. Level 2</td>
<td>101,837-113,719</td>
<td>63</td>
</tr>
<tr>
<td>APL5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFS</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>446</td>
</tr>
</tbody>
</table>

Note: Excludes CEO
* Where there is a possibility that payments to individuals may be identified (ie: 50 or fewer employees
at a classification level on Employee Collective Agreements or AWA); the salary range is not shown.

Source: Annual Report, 2007

Recruitment and skill mix is a challenge for agencies like Austrade. The inherent challenge is to find people who possess both relevant industry experience and the ability to operate within a bureaucratic and diplomatic framework. Cases have been observed where officers become stale, or lose touch with industry realities. There is relatively little career development and mobility across public and private sector boundaries. There are, of course, notable exceptions - but these tend to reinforce the general observation.

Austrade’s operations are funded from government budget appropriations, which totalled $172 million in 2007. This excludes direct programme funding of $153 million for the EMDG programme. It is noteworthy that receipts from client services represented only $28 million in 2007, raising a question about the usefulness or application of ‘user pays’ pricing regimes except in the case of large multinational operators. Labour costs represent almost two-thirds of Austrade’s expenditures.

Governance

Following the Uhrig Review of public sector governance, the Government deemed Austrade to be an ‘executive agency’, and so in 2006 it was brought back into direct reporting accountability within the Department of Foreign Affairs and Trade. This means that Austrade has ceased to be an arms-length agency with its own governing Board. Prior to this decision, the Board of Austrade enabled private sector and industry directors to have a direct influence over the administration of Austrade’s charter. Many industry commentators believe the removal of a governing Board has been a backwards step. Under the new regime the CEO reports directly to the Minister for Trade, and is appointed by the Minister.

Public accountability for performance is provided through the requirement for the lodging with Government of a three year Corporate Plan, and the submission of an Annual Report. The Corporate Plan 2006-07 to 2009 sets out four objectives over the period:

1. To assist more Australian businesses to become sustainable exporters;
2. To grow established exporters to increase export value;
3. To deliver more value to Australian businesses by expanding Austrade services through relationships and partnerships; and
4. To raise awareness of the benefit of export among businesses and the community.
The three priorities outlined in the Corporate Plan are:

- to drive export outcomes through existing trade agreements and increase focus on future free trade agreement markets;
- to expand Australia’s international business in key growth markets of China and India; and
- to enhance industry export development.

**Alliances**

Austrade’s interfaces with the private sector have revolved around:

- Private sector industry representation on the Board, prior to 2006;
- Strong ‘client satisfaction’ metrics and accountabilities, aimed at promoting a focus on relationship management;
- Sectoral advisory committees; and
- Corporate service delivery partnerships.

These interfaces do not provide a strong framework for interaction with the private sector. Client surveys frequently tend to be self-serving unless part of a rigorous and independent evaluation framework (including counter-factual analysis). Industry advisory committees are only as productive as the will of management to engage actively with industry representatives. Unsolicited comments from participants in these committees have not been positive (but it must be noted that this is informal feedback).

Austrade points out that the sectoral business units maintain close relationships with relevant industry associations. The role of industry associations as intermediaries in relationships between the public and private sectors merits critical examination, especially in the context of generic government business assistance programmes. Industry associations can often develop a life of their own, superordinate to the interests of their constituents. Officers of associations, especially those with diverse memberships, can develop an unhealthy interest in developing their own standing and influence with government and thus make themselves vulnerable to capture by executive government. On the other hand there have been occasions in Australia where activist associations have been blackballed or sidelined by government.

Finally, Austrade has entered into a number of Corporate Partnership Agreements with professional services organisations. These partners effectively become channel marketing and service delivery partners with Austrade. An unintended consequence of such arrangements can be to develop a cadre of advisory firms with a strong and vocal vested interest in the perpetuation of particular types of government programme.

**Evaluation and impact**

Austrade’s accountability metrics – largely self-determined - are set out below.

Two observations can be made about these indicators and results. The first is that there is a strong focus on volume or ‘throughput’ measures. There is no inherent correlation between points of engagement, and impact. Often the reverse is true. Secondly, in terms of the value of export outcomes, a problem is to isolate the additionality attributable to Austrade’s involvement. This is true of most programmes.
**AUSTRADE'S KEY PERFORMANCE INDICATORS, 2007**

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assist exporters (both new and established) to achieve export success</td>
<td>Total number of exporters achieving export success with Austrade's assistance</td>
<td>5500</td>
<td>5477 (5098)</td>
</tr>
<tr>
<td>Grow established exporters and help exporters to become sustainable in export so increasing export value</td>
<td>Number of established exporters achieving export success with Austrade's assistance</td>
<td>3600</td>
<td>3421 (3321)</td>
</tr>
<tr>
<td></td>
<td>Dollar value of export success achieved by new/irregular and established exporters with acknowledged assistance by Austrade</td>
<td>$18.0 bn</td>
<td>$22.4 bn ($18.4 bn)</td>
</tr>
<tr>
<td></td>
<td>Client satisfaction with Austrade's services</td>
<td>85%</td>
<td>89% (88%)</td>
</tr>
<tr>
<td>Assist more Australian businesses to become exporters</td>
<td>Number of new or irregular exporters achieving export success with Austrade's assistance</td>
<td>1900</td>
<td>1996 (1777)</td>
</tr>
<tr>
<td>Support more Australian businesses to achieve export success by developing relationships and working with allies</td>
<td>Number of businesses achieving export success through Austrade's services delivered via corporate alliances</td>
<td>600</td>
<td>668 (601)</td>
</tr>
<tr>
<td>Raise awareness of the benefits of export among businesses and the community</td>
<td>Community awareness of the importance of the Government's trade and international business facilitation activities through Austrade</td>
<td>75%</td>
<td>65% (67%)</td>
</tr>
</tbody>
</table>

Source: Austrade Annual Report 2006-07

**Challenges and lessons**

The biggest challenge for Austrade is how best to bridge the bureaucratic gulf between external trade policy and the other areas of government focused on domestic industry capability. Export facilitation will always be inhibited if there are inadequate linkages between upstream and downstream industry and firm settings, between inputs and outputs.

There are also tensions between cycles of consolidation and decentralisation. The 1980s were a period of consolidation and rationalisation around new policy priorities. Then, from the 1990s, there has been a shift to the greater decentralisation of agencies and programmes. With this shift of the pendulum comes the potential danger of fragmentation and inadequate policy co-ordination or cohesion. There is often a bureaucratic bias in favour of decentralisation, driven by two factors. The first is the ever-present human proclivity to empire building and turf wars. The second can be a genuine belief that distributed programmes could prove less vulnerable to electoral cycles.

Two other issues arise from this case. The first is the effect of governance models on industry and firm interfaces. The second is the tendency, on the part of government agencies, to have recourse to or strong interaction with intermediary organisations which can create a buffer or ‘demilitarised zone’ between the public and private sectors. A recourse to intermediate agents in this context can filter and weaken direct relationships, and feedback from on the ground.
4.1.2 The Export Market Development Grant Scheme

The Export Market Development Grant Scheme (EMDG) is the major assistance programme administered by Austrade. This programme operates under its own legislative mandate. Unlike most government programmes, the EMDG legislation provides for an automatic sunset review and the need for the proactive renewal of the scheme every five years. (This programme is one of the few where this sunset trigger provision has been deployed. The merits of such a provision have not been much discussed in recent times, which is a pity).

The scheme is designed to encourage small and medium sized Australian businesses to develop export markets. The scheme reimburses up to 50% of expenses actually incurred on eligible export promotion activities, above a $15,000 threshold and below a $150,000 cap for an individual firm. Eligibility for grants ceases after seven awards.

This scheme falls within the category of generic, entitlement programmes. That is, any firm which meets the criteria is eligible to claim the benefit. EMDG operates on a retrospective basis where the firm receives the benefit after the expenditure has been incurred.

Mandate

The EMDG scheme was inaugurated in 1974 with the passage of the Export Market Development Grants Act. This Act was re-written in 1997. The re-drafting of the Act was an interesting experiment in the use of simple language and an attempt “to organise the material in such a way as to make it easier for readers to understand the law”.

The programme’s objectives are set out with admirable clarity:

The object of this Act is to bring benefits to Australia by encouraging the creation, development and expansion of foreign markets for Australian goods, services, intellectual property and know-how. It does so by providing for an assistance scheme under which small and medium Australian exporters committed to and capable of seeking out and developing export business are repaid part of their expenses incurred in promoting those products.

The enabling legislation for this scheme is somewhat unusual in incorporating detailed guidelines for the scheme’s operation, rather than providing for such administrative guidelines to be promulgated under subsidiary regulations, as with the R&D Tax Concession and other assistance schemes. This has the advantage of preserving the scheme from ‘guideline creep’ and the proliferation of red tape. It has the possible disadvantage of reducing flexibility and administrative discretion, given the difficulty of amending legislation in a timely fashion. This approach to mandate is probably only feasible when the programme parameters are judged to be fairly settled and stable.

Structure and scope

Outlays under this grant scheme are capped, in two ways.

The first cap, which is not an uncommon provision, is a limit on the total amount which may be claimed by any one firm or group of companies. The maximum grant for eligible applicants is $150,000, subject to funds being available in the scheme. The maximum payable to a group of related companies in total is $250,000 per annum.

The second cap is on the total outlay in any one year, which is limited to the parliamentary appropriation for the scheme. The available funds in 2005-06 were $145 million. The

52 Austrade, Export Market Development Grants, July 2006
53 Export Market Development Grants Act 1997
disbursement challenge is how to allocate the reimbursements claims when the actual number of potential claimants, and the aggregate level of claims, are not known or knowable in advance.

The solution adopted is a split payment system. An initial payment instalment amount is calculated and promulgated at the beginning of the grant year. This amount is typically around half the total grant ceiling for a year. If the amount claimed is greater than the first tranche ceiling, a second payment is made according to the amount of funds remaining in the EMDG budget. If total claims exceed the budget, then pro rata adjustments are made. The following table shows that the payout ratio has varied considerably in the past.

<table>
<thead>
<tr>
<th>Grant year</th>
<th>Payout (cents in the dollar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996–97</td>
<td>100.00</td>
</tr>
<tr>
<td>1997–98</td>
<td>98.94</td>
</tr>
<tr>
<td>1998–99</td>
<td>100.00</td>
</tr>
<tr>
<td>1999–2000</td>
<td>100.00</td>
</tr>
<tr>
<td>2000–01</td>
<td>75.62</td>
</tr>
<tr>
<td>2001–02</td>
<td>32.84</td>
</tr>
<tr>
<td>2002–03</td>
<td>74.52</td>
</tr>
</tbody>
</table>

Source: Centre for International Economics, Economic Analysis of the Export Market Development Grants Scheme, June 2005, p. 3

This table shows that there have been periods when the payout has been considerable less than the theoretical entitlement. The disadvantage of such capped outlays is that the resultant uncertainty can reduce the predictability of the incentive, and hence the inducement impact on firm behaviour.

As with most entitlement schemes, the eligibility rules are key to the impact of the scheme on firm behaviour. Rules establish the eligibility of firms for the entitlement, and the precise activities that are reimbursable. Eligibility rules are a persistent source of contention and debate.

Firm eligibility is restricted to Australian corporate entities with turnover of no more than $30 million and eligible expenditure of no less than $15,000. Australian ownership as a precondition for eligibility is becoming a contentious issue, as many argue that what matters is the location of activity rather than the flag of incorporation. Many Australian companies, including SMEs, may have valid reasons for shifting their legal identity offshore, including gaining better access to offshore markets. The flipside is that such a restriction provides no incentive for inwards FDI. There appears to be a growing policy consensus that, within a globalised economy, it is the location of activity that matters rather than firm ownership in itself.

Operations
Austrade’s latest Annual Report highlights the focus of the scheme on small and relatively inexperienced exporters.

In 2006–07, the Export Market Development Grants scheme (EMDG) delivered 3,548 grants totalling $145.1 million to eligible businesses. Almost 80 per cent of recipients reported annual income of $5 million or less reflecting the Government’s commitment for the EMDG scheme to focus on helping smaller businesses and less-experienced exporters.

This suggests that the average grant was around $41,000. Twenty years ago the actual grant pool was $146 million, divided amongst 3530 claimants for an average claim of $41,00054. In

54 Molnar, op cit. p.23
real terms this represents a decline in the grant budget and shows that the scope of the scheme has remained fairly static.

Austrade devotes considerable effort to assisting companies to access the scheme. It advertises that it “provides free, personalised coaching sessions throughout the year to help you prepare your application and get the best out of the scheme”\(^{55}\). The Austrade website also provides a listing of ‘good’ EMDG consultants. The recourse to external consultants to gain access to the scheme can reduce claims to an accounting exercise that limits the firm’s internalisation of behavioural change or orientation. As with other assistance schemes, we see the emergence of a class of support business advisory firms who tend to become vocal lobbyists against any policy changes that might undermine this easy and predictable source of business. Such effects are seldom brought to account in assessing the overall value of assistance schemes.

**Evaluations and impact**

A distinguishing feature of the EMDG scheme is that the legislative sunset provisions trigger legislative review rather than just the more usual administrative reviews and monitoring of a programme. This promotes a high level of transparency and accountability. It also means that the EMDG scheme has been one of the schemes most regularly reviewed. Interestingly, there has been no move to mandate the subsequent evaluation criteria at the time when the scheme has been renewed. This is a design weakness.

The evidence concerning the cost-benefits of the scheme is inconclusive. The latest independent analysis concluded that:

\[
\text{taking account of inducement rates and spillover rates, the evidence presented in this report suggests it is difficult to be categorical about the net social benefits of the scheme.}^{56}\]

Nevertheless, the advice to Parliament in 2006 was that “taking the CIE research into account, noting the cautious assumptions used in the analysis and other potential additional economic benefits, the EMDG scheme appears to be delivering adequate positive net social benefits.”\(^{57}\)

**Challenges and Lessons**

Issues and lessons which have been identified in this case study include:

- the endemic challenge of establishing causal linkages between policy interventions and industry and trade outcomes;
- problems with whole-of-government co-ordination and the risk of policy balkanisation through the creation of policy silos and fragmented industry interfaces;
- the trade-offs in deciding between sector specific and generic programme interventions;
- the role and efficacy of sunset reviews; and
- the lack of attention to the setting of *ex ante* evaluation criteria.


\(^{57}\) Australian Parliament, House of Representatives, Export Market Development Grants Legislation Amendment Bill 2006: *Explanatory Memorandum*
4.1.3 The Export Finance and Insurance Corporation (EFIC)

The Export Finance and Insurance Corporation (EFIC) is Australia’s export credit agency, supporting Australian businesses internationally by providing finance and insurance underwriting. It was originally established in 1957 as the Export Payments and Insurance Corporation, and reconstituted as EFIC in 1974. Following the establishment of Austrade in 1985, EFIC was brought under the new agency as its financial arm. In 1991, however, EFIC was again spun out as a separate agency with its own legislative mandate.

The rationale for the scheme is largely one of market failure, given the risks associated with export underwriting, particularly for small firms or for major infrastructure projects. The step-in by government can, however, sometimes create greater private sector confidence over time. In 2003, for example, EFIC was able to sell its short-term credit insurance business to a private operator. There continues to be, however, little private sector capacity in the market for underwriting small and medium sized exporters, or for large-scale projects and especially where there are high levels of country risk.

Mandate

EFIC was established in its current form in 1991 under the Export Finance and Insurance Corporation Act as a statutory corporation wholly-owned by the Commonwealth of Australia. The Act charges EFIC with undertaking four key functions:

- to facilitate and encourage Australian export trade by providing insurance and financial services and products to persons involved directly or indirectly in such trade;
- to encourage banks and other financial institutions in Australia to finance or assist in financing exports;
- to manage the Australian Government’s aid supported mixed credit program (a facility which has now been discontinued, although loans are still outstanding under it); and
- to provide information and advice regarding insurance and financial arrangements to support Australian exports.

EFIC operates primarily in that part of the market that is not served by the private market. EFIC is self-funding, operating in accordance with commercial principles. EFIC’s obligations to third parties are guaranteed by the Australian Government. This guarantee has not been called in the more than four decades of EFIC’s existence. The Corporation attributes this success to the strong control framework that it has implemented for identifying, evaluating and managing risk.

Structure and scope

There are two arms to EFIC’s operations, which it characterises as commercial operations and national interest transactions.

For its commercial operations the risks underwritten are carried by EFIC as a corporation. Premiums and other fees are retained by EFIC and any losses are borne from EFIC’s accumulated capital and reserves.

In the case of the ‘National Interest’ transactions, the Minister can direct EFIC or approve of EFIC entering into a facility if they believe that it would be in the 'National Interest' to do so.

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58 The aim of this restructuring was “to achieve a more efficient and vigorous export marketing effort by rationalising and consolidating various export assistance agencies into one organisation” - Nigel Barrett and Ian Wilkinson, Australian Policies for Trade Promotion and Assistance: Review and Evaluation, Sydney, University of Technology, 1988.
The facility may be a loan, a guarantee, or an insurance policy. If EFIC suffers loss in relation to such a transaction, the Australian Government reimburses EFIC for the loss.

National Interest transactions tend to involve:

- financial commitments which are too large for EFIC's balance sheet; or
- risks which EFIC considers are too high for it prudently to accept on its own account; or
- transactions which would be commercially acceptable if EFIC did not already have significant exposures to a country or entity.

**Operations**

In 2005-06 EFIC signed $270 million in underwriting of new facilities, supporting exports and investments worth a total of $626 million⁵⁹. EFIC currently has a net assets of $322 million.

The small specialist staffing includes industry specialists which are grouped in the following sector teams:

- Metals and Mining
- Oil and Gas
- Utilities, Infrastructure and Construction
- Shipping, Transport and Defence
- Technology, Manufacturing and Services.

These grouping indicate the focus of EFIC’s activities, which are skewed to major, higher risk projects. Even while it is estimated that 50% of EFIC’s clients are small businesses, this is a much lower proportion than for most support programmes. EFIC is increasing its attention to smaller enterprises.

**Governance**

As a statutory corporation EFIC has been deemed to be an ‘arms length’ agency governed by a Board. The Board comprises mostly private sector persons, from a finance or industry background. In addition to its annual reporting responsibilities, the Board is required to respond annually to a Ministerial Statement of Expectations which sets out the Government’s broad expectations of the agency’s operations.

**Alliances**

EFIC notes that it works closely with other Federal and State agencies and with industry associations and financial institutions. EFIC has established formal alliances with a number of these, primarily as ‘channel partners’ to access target firms.

**Evaluation**

EFIC is a low profile agency which receives little attention in the usual round of evaluations of business assistance programmes. It occupies a niche in an area of undisputed market failure and where the underwriting, particularly of major projects, is easy to argue on national interest grounds.

⁵⁹ EFIC, Annual Report 2006
4. 2 The Rural R&D Corporations

In 1989 Australia legislated to consolidate special rural R&D schemes that date back to the 1930s, creating what are now known as Rural R&D Corporations (RRDCs). These represent a co-investment model based on industry levies on turnover matched by government funds (at ratios ranging from 0.5 to 1:1). Industry based Boards manage the disbursement of funds to priority areas for the industry. The scheme complements, and is often integrated with, arrangements for rural industry promotion and marketing. The scheme has facilitated highly networked industry clusters in wool, grains, wine and other rural industries.

There are eight statutory corporations and six industry initiated entities. Two of the agencies - Rural Industries and Land and Water Australia - are ‘public good’ authorities rather than being specifically geared to particular industry development. The scale and funding profile is summarised in the following table, drawn from a recent survey.

**INDUSTRY AND AUSTRALIAN GOVERNMENT CONTRIBUTIONS TO TOTAL RRDC EXPENDITURES IN 2004-05**

<table>
<thead>
<tr>
<th>RRDC</th>
<th>Industry contribution $ million</th>
<th>Australian Government contribution $ million</th>
<th>R&amp;D expenditure $ million</th>
<th>Government contribution per $100 of industry spending Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statutory RRDCs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>4.58</td>
<td>4.32</td>
<td>12.62</td>
<td>94.3</td>
</tr>
<tr>
<td>Fisheries</td>
<td>11.20</td>
<td>16.90</td>
<td>29.06</td>
<td>150.1</td>
</tr>
<tr>
<td>Forest and Wood Products</td>
<td>3.77</td>
<td>2.97</td>
<td>8.20</td>
<td>78.8</td>
</tr>
<tr>
<td>Grains</td>
<td>64.19</td>
<td>35.74</td>
<td>119.53</td>
<td>55.7</td>
</tr>
<tr>
<td>Grape and Wine</td>
<td>9.68</td>
<td>8.10</td>
<td>16.89</td>
<td>83.7</td>
</tr>
<tr>
<td>Land and Water Australia</td>
<td>-</td>
<td>12.50</td>
<td>26.27</td>
<td>-</td>
</tr>
<tr>
<td>Rural Industries</td>
<td>2.68</td>
<td>14.65</td>
<td>21.09</td>
<td>-</td>
</tr>
<tr>
<td>Sugar</td>
<td>5.13</td>
<td>4.56</td>
<td>8.66</td>
<td>88.9</td>
</tr>
<tr>
<td><strong>Industry owned corporations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian Egg Corporation</td>
<td>0.75</td>
<td>0.76</td>
<td>1.71</td>
<td>104.3</td>
</tr>
<tr>
<td>Australian Pork Limited</td>
<td>3.80</td>
<td>4.22</td>
<td>7.67</td>
<td>111.1</td>
</tr>
<tr>
<td>Australian Wool Innovation</td>
<td>42.04</td>
<td>13.51</td>
<td>76.49</td>
<td>17.2</td>
</tr>
<tr>
<td>Dairy Australia</td>
<td>14.53</td>
<td>14.53</td>
<td>36.11</td>
<td>31.5</td>
</tr>
<tr>
<td>Horticulture Australia Ltd</td>
<td>31.83</td>
<td>32.91</td>
<td>66.32</td>
<td>104.0</td>
</tr>
<tr>
<td>Meat and Livestock Australia</td>
<td>39.04</td>
<td>39.04</td>
<td>78.08</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>233.82</strong></td>
<td><strong>204.71</strong></td>
<td><strong>511.30</strong></td>
<td><strong>76.8</strong></td>
</tr>
</tbody>
</table>

*a* Includes other sources of income such as royalties, interest, voluntary contributions and co-investments with public sector agencies and other RRDCs. In addition, contributions in one year may not be expended in the same year. *b* These are predominantly public good RRDCs. *c* Excludes the predominantly public good RRDCs.

Source: Productivity Commission, 2007, p. 430

The scheme is a significant part of Australia’s investment in innovation and competitiveness. It has been estimated that it directly funds, or significantly influences through co-investment leverage, between 8 to 10 percent of Australia’s overall investment in R&D.

**The initial policy dynamics and policy evolution**

The main rural industries in Australia have always had a primary export focus. In addition, they have also had an ingrained concern with productivity, driven by two factors. The first factor has been the need for producers to insulate themselves against the effects of seasonal

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variations in production. Secondly, Australian producers have long struggled to compete against highly subsidised agricultural production in the main northern hemisphere markets.

The sector’s performance has been characterised by sustained productivity growth. This productivity growth has been underpinned by an ‘end to end’ innovation system and by a long tradition of collective action in research and export marketing. Rural industries have developed integrated development authorities, responsible for addressing the gamut of activities across the value chain from R&D, technology diffusion, branding and export sales. As in the United States, from early in the 1930s State Government agricultural extension services have played a major role in producer education and technology transfer.

The rural industry development functions have typically been funded through industry wide levies – whether voluntary or compulsory – controlled and overseen by representative industry bodies. Rural industries typically comprise numerous producers, whose output is not highly differentiated. None of themselves could pursue serious R&D. Collective investment in R&D and industry development makes sense as long as there are not significant numbers of ‘free-riders’ who do not participate in industry schemes but are nonetheless able to capture the benefits. This is the rationale for compulsory industry levies. This model has been congruent with the embedded culture of cooperatives and mutual aid organisations in rural communities. Towards the end of the Twentieth Century this tradition of sectoral collaboration has been weakened somewhat by the pressures favouring larger, aggregated holdings and the highly corporatised – and often tax driven - financial structures underpinning the incursion of new rural ventures such as timber plantations and novelty crops.

Formal, levy-based schemes, began in the wool industry61. In 1936 the Commonwealth Government introduced a compulsory industry tax to fund wool research and promotion, and then introduced matching government funding – for promotion, in 1945, and for research, in 1953. Additional statutory schemes for other industries were established between 1955 and 1982. In 1989 the Primary Industries and Energy Research and Development Act was introduced to consolidate these schemes under a common framework. The non-statutory Rural Corporations or industry owned corporations were generally formed from the 1990s onwards through the merger of a former RRDC and an industry marketing body.

**Mandate**

The Primary Industries and Energy Research and Development Act 1989 establishes four broad objectives for the statutory RRDCs. These are to:

- increase the economic, environmental and social benefits to members of primary industries and to the community in general by improving the production, processing, storage, transport or marketing of the products of primary industries;
- achieve the sustainable use and sustainable management of primary industries;
- make more effective use of the resources and skills of the community in general and scientific community in particular; and
- improve accountability for expenditure upon R&D activities in relation to primary industries.

Comparable mandates are established for the industry owned corporations through the terms of the funding agreements with the Commonwealth.

The RRDC Chairmen have summarised their mandate rather felicitously in the following words:

> RDCs may be viewed more broadly as custodians tasked with ensuring that their industries have the future access to leading edge innovative technologies they need to be globally competitive and to fulfil their other objectives. If their strategic analysis indicates that

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61 At the instigation of the then Australian Wool Growers Council.
investment is required, for example in areas of fundamental or 'blue sky' research, then they can and do make the investment. In a similar vein RDCs remain alert at all times to commercialisation opportunities and enhancing commercial returns to their industries, where and if appropriate, is core business for them⁶².

**Operations.**

The governing legislation requires RRDCs to develop comprehensive five-year R&D plans, and an annual operating plan. This creates a systematic framework for priority setting, and the specification of research with a strong focus on paths to market. This operating framework has been well summarised in the following schematic.

**THE OPERATING FRAMEWORK OF RURAL R&D CORPORATIONS**

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**Notes:**

⁶² Rural Research and Development Corporation Chairs Committee, *Submission to the Inquiry into pathways to technological innovation, related issues and examples of successful innovation*, House of Representatives Standing Committee on Science and Innovation, May 2005, p.7
RRDCs execute their research plans through contract R&D, and this leads to close collaborative links with public research agencies, universities and State governments. In addition, most RRDCs also participate in Cooperative Research Centres. This augments the subsidised funding flowing through to particular industries, and also enables RRDCs to promote wider R&D infrastructure which can be accessed to support ongoing RRDC priorities.

The RRDC co-investment model between industry and government has seen huge increases in the R&D investments in these rural industries, with annual outlays increasing from $63 million in 1984/5 to over $464 million in 2003/4. This is compounded, less transparently, by the co-investment by research partners, which effectively doubles the actual outlays63. This represents between 8-10% of total Australian outlays on R&D.

In their submission to the recent Productivity Commission Inquiry, the Council of RRDC Chairs spell out how the industry-specific RRDCs undertake a bottom-up process of priority setting involving the beneficiaries, end-users and co-investors64. Funding proposals are assessed and ranked by advisory bodies and considered by each RRDC Board. Ex-ante project evaluation is judged against both attractiveness and feasibility criteria, as follows.

**RRDC EX ANTE PROJECT EVALUATION CRITERIA**

**Attractiveness criteria include:**

- Is the application relevant to the RRDC’s R&D programs?
- Is the need and planned outcomes well-defined and relevant to R&D priorities?
- Is the application a priority of the potential beneficiaries?
- Does the application demonstrate user and beneficiary support and a commitment to utilise the outputs?
- Does the application describe the scope and pathway by which the nation will capture the benefits of the research?
- Is the applicant, potential beneficiary or other entity making an appropriate financial contribution to the project?
- Will the planned outcomes, if achieved, provide a high benefit-cost ratio of a sound return on investment for money?
- Is there an appropriate level of collaboration between researchers and between researchers, industry managers and industry interests?
- Is the application innovative? Does it add value to previous R&D?

**Feasibility criteria include:**

- Are the planned outputs well described and is the strategy for extending the outputs sufficient to achieve the planned outcomes?
- Are the objectives clearly specified and consistent with planned project outputs?
- Are the methods well described and consistent with the project’s stated objectives?
- Does the applicant have the capacity and commitment to produce planned outputs?
- Are the principal investigator and other researchers to be engaged on the project competent? Have they performed well in the past?
- Is there a strategy for managing data arising from the project so that they will be easily accessible to others in the future?

The brokerage role of the RRDCs in allocating funding resources against industry priorities means that RRDCs need to pay particular attention to the efficiency of the contracted activity they oversee. The RRDC Chairmen have noted that their organisations have had to devote significant, and necessary, attention to contract management. The organisations report that their R&D management mechanisms include65:

63 Rural Research and Development Corporation Chairs Committee, *op cit.*
64 Productivity Commission, *op cit.*, p.432
65 *Ibid.*, submission 96
• project management systems that integrate technical, financial and administrative data and
monitor the status of projects when key project milestones are not met;
• technical evaluations by external advisers reporting on milestone achievement;
• audits of financial and risk management, compliance with agreed project conditions;
• a range of external information sources to monitor projects between reporting periods
including workshops, management advisory committees, advisory bodies and other parties
involved in research. This may prompt intervention when projects are not meeting their
reporting schedule or other agreed performance indicators.

Governance
The statutory RRDCs are governed by Boards of directors appointed by the Minister from a
list of nominees submitted from the representative organisations in the industry. In the case
of the industry-owned corporation the Boards are elected from the shareholders, who qualify
as members of the company by virtue of their levy payments. The RRDCs collaborate in
areas of common interest through a Committee of Board Chairmen.

Both forms of Corporation submit detailed annual reports to Government and their members,
and this tight linkage with industry participants is strengthened by the consultative processes
required in the formulation of research and operating plans.

The governance requirements set out in the Act are strengthened and elaborated in statutory
regulations on the rules applying to the imposition of the industry levies. This is a good
example of how government, through its funding leverage, can induce ‘good behaviours’ in
the public interest. What is unusual is how seldom governments use their bargaining power
in alliances to insist on operating parameters which balance the public as against private
interests. Other jurisdictions, and notably agencies like the National Institutes of Health in
the US, appear far less hesitant to advance public agenda as a quid pro quo for government
funding. As one senior NIH official commented recently, there is nothing wrong with the
“piper calling the tune”.

Impact and evaluation
In 2005 the Chairmen of the Corporations attributed the success of RRDCs to “their unique
co-investment arrangements with the Australian Government, rural industry, and other
stakeholders”.

The ‘RDC model’ has equipped them to effectively network and navigate their way through the
complexities of Australia’s pluralistic system. They do this particularly through their:
• strategic management focus and processes, so enabling agreement with stakeholders on
priorities for development and uptake of world’s best practice technologies;
• corporation status, enabling them to network across the entire innovation system with
government, public research organizations and commercial market participants; and
• capacities to leverage Government matched industry funding with partner contributions
to build sound portfolios of R&D investments and collaboration with partners to drive
industry global competitiveness.

Evaluations of the RRDCs tend to focus on three areas of impact. First, the evidence of
sustained productivity performance in rural industries. In the grains industry, for example,
the RRDC claims that there have been annual productivity gains of between 2.5 and 3% over
the 20 years of operation under RRDC model type arrangements, with more than half of that
gain coming from returns from industry R&D investments.

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66 Department of Agriculture, Fisheries and Forestry, Levies Principles and Guidelines, April 2007; Primary
Industries (Excise) Levies Amendment Regulations 2002 (No. 6) 2002 No. 192
68 Submission to the House of Representatives Standing Committee on Science and Innovation, 29 April 2005
69 ibid., p.10
Second, the high rates of adoption and uptake of research outcomes and innovation, facilitated by the industry wide engagement in the scheme. Just a few examples include the development of superior cotton varieties, technologies for water efficiency in rice production, and the development of beef quality gene markers for the genetic improvement of herds and flocks.

Third, the impact of industry collaboration on export performance. As well as sustaining industries where Australia has traditionally held significant global market share, RRDCs have supported new industry development and the transformation of existing industries. Examples that are commonly cited are the canola, noodle and Durum wheat, olive and rabbit meat industries. The best example of new export growth is the wine industry where, in less than a decade, Australian wine has gone from a largely domestic product to the current position of about 60% of its value (more than $2.5 billion pa.) being derived from exports.

The association of RRDCs claim that:

As a result of the inherent advantages of their model, on the basis of a number of objective analyses, RRDCs have been shown to achieve average 7:1 benefit to cost ratios from their investments in research.

These assessments are notoriously problematic, depending on modelling assumptions that are frequently contestable. In addition, it is difficult to assess the inducement factors attributable to a given level of government subsidy.

In 2007 the Productivity Commission concluded that “the large disparities between high subsidy rates for some industry-centred RRDCs and those applying for other industries may not be justified on economic grounds”. Certainly many of the RRDC research providers echo this view in private, pointing out that different rural industries are at different levels of maturity and that a review of the respective levels of subsidy may be in order. In some cases industry organisations and research agencies have initiated major research and commercialisation ventures outside the RRDC framework, which would seem to suggest that the industry context has been changing in some cases.

The RRDCs have rebutted the Productivity Commission conclusions, citing analysis by the Australian Bureau of Agricultural and Resource Economics which stresses the productivity gains and returns on investment. The correlation between the massive increases in funding on the one hand and changes in the rates of productivity growth on the other has not, however, been tested, and return on investment estimates are all over the place for most sectors. A stronger case, perhaps, could now be made for a renewed role for RRDCs in the adaptation of rural industries to climate change, water scarcity and salinity, where the effects on Australian industry will be profound.

One of the downsides of the RRDC model is that it is inherently resistant to review and modification because of the deeply embedded and broadly-based involvement of industry participants, and the strength of rural lobbies. This is the inherent moral hazard for governments with any form of formal and contractual Public Private Partnership scheme. The only reliable safeguard is ex ante review triggers or sunset review mechanisms.

70 ibid. p. 7
4.3 The Innovation Xchange

The Innovation Xchange (IXC) is a response to the challenges of establishing market mechanisms to support the emerging environment of open innovation across organisational boundaries. It is a useful case study of a programme which arose in response to an emerging industry environment; even ten years ago it would have been before its time.

The model is one of trusted intermediaries acting as innovation brokers between research providers and firms, and between MNCs and SMEs. The network of IXC intermediaries work inside multiple member organisations, under a framework of confidentiality, to search for and to create connections for business growth and technology transfer. Confidential information is not seen by other members. When an opportunity is found, IXC intermediaries then help members engage directly through a step-wise disclosure process.

IXC was established as a standalone, not-for-profit organisation in July 2006, following a two year pilot programme sponsored through the Australian Industry Group, Australia’s largest industry association. The UK was the first international affiliate to be established as a regional node, with active negotiations in hand in several other regions. It is planned to migrate the country and regional operations into an IXC International entity in 2008.

IXC provides an interesting case study because:

- it is an example of governments swinging behind, through funding, an industry driven initiative;
- it is explicitly outcome focussed, being devised as a mechanism to underpin firm growth and to provide research providers with better ‘paths to market’ and more effective knowledge transfer;
- it is premised on the paradigm of innovation as an open system (unlike other programmes which need to be ‘force fit’ into a model of a national innovation system); and
- it surfaces the issues around the need for public/private partnerships to be conceived and implemented within an international context.

The initial policy dynamics and policy evolution

In the 20th century the dominant model of industrial research was one of proprietary and in-house R&D laboratories. Science and technology policy focused on providing incentives for more industrial research – additionality – on the rationale that such research provided spillovers into the local economy. Publicly funded research activity was funded on the basis of meeting gaps where the structure of local industry activity did not support firm investment. Implicit in the in-house R&D model is the presumption the firm itself provides the ‘path to market’ for the exploitation of R&D, and that this obviates the need for government to concern itself overly with the intermediate market for innovation and its diffusion.

In the case of publicly funded research, the perceived challenge was to promote the commercialisation of research outcomes from universities and public research agencies. Over time this has lead to too much of an emphasis on technology push and not enough attention to the demand side pull-through of technology and intellectual property to support the sustainable growth of existing firms.

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71 Disclosure: the author was a Director of IXC until the beginning of 2008. This case study draws heavily on material provided by Grant Kearney, the CEO of IXC.
72 © ICX Intermediaries and IXC are the registered trademarks of IXC Australia Limited.
Over recent years the 20th century model of in-house R&D has been challenged, and increasingly replaced with a new paradigm of open innovation. The underlying drivers of this shift have been three-fold:

- the growing recognition that the cost structures of traditional R&D models are unsustainable, highlighted most dramatically in the case of drug companies;
- the increasing speed with which skills, capital and knowledge can now be moved around the globe; and that
- increasingly, valuable sources of technology and innovation arise outside the technology trajectories and capabilities of the firm itself.

The new paradigm of open innovation has been documented and popularised by business school academic Hank Chesbrough, and by case studies of firms like Proctor & Gamble. In the words of Proctor and Gamble:

The future of R&D is **Connect and Develop** - ‘collaborative networks that are in touch with the 99% of research that we don’t do ourselves – we’ll collaborate and licence’. Connect and develop will become the dominant innovation model in the twenty-first century. For most companies, the alternative invent-it-ourselves model is a sure path to diminishing returns.

The dynamics of this new paradigm is succinctly represented in the following schematic, taken from Chesbrough.

**THE KNOWLEDGE LANDSCAPE IN THE OPEN INNOVATION PARADIGM**

This schematic illustrates how the nature of innovation is changing from a closed model of internally developed R&D, production and commercialisation of new ideas to an open model.

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based on multiple internal and external sources of ideas and channels to market. Open innovation stresses knowledge flows rather than knowledge creation as a driver of innovation.

An important contextual factor is that the locus of technological innovations tends to be disproportionately associated with the innovation within smaller rather than larger firms. The challenge for all organisations, therefore, becomes one of effective search and discovery to locate sources of innovation and collaboration. This takes place in imperfect information markets.

Initial thinking about an Innovation Xchange began from the questioning by some Australians returning from working in the United States about what mechanisms might be developed to support better intermediate markets in innovation. This question captured the attention of the entrepreneurial and then CEO of the Australian Industry Group (AIG), Bob Herbert, who has had a long track record as a promoter of innovative thinking about industry policy. The AIG administered a philanthropic trust established by Sir William Tyree, a successful Australian industrialist. Herbert recruited Grant Kearney to develop a pilot programme funded by the trust. Initially the Innovation Xchange looked to develop an Internet based ‘matchmaking’ portal, similar to the current models promoted by Nine-Sigma and other Web-based portals.

The inherent limitation of these web ‘matchmaking’ portals is that they presume that the participating parties know what they are looking for, as in traditional trade directories. If I have a plumbing requirement, it is a fairly straightforward process to search for an available plumber. It becomes more complicated when a party does not appreciate which other external parties might value the capabilities they possess, and why. It becomes more complicated when a firm cannot articulate nor anticipate the nature or sources of technology which might fuel and advance the firm’s strategic business ambitions.

Thus the Innovation Xchange migrated to a brokerage and intermediary model as a trusted third party to explore, identify and support non-obvious linkages between supply and demand. Thus research providers have a set of capabilities and expertise, but often – and usually – have but a limited appreciation of the range and identity of firms that might benefit from these capabilities. On the demand side, firms typically seek to pursue some strategic intent, without necessarily knowing about all the technology options or innovative solutions that might help them realise this strategic intent. IXC’s intermediary service is about matching supply-side capability with demand-side requirement or challenge.

During 2005 IXC undertook a pilot programme of its novel intermediary service, working with major multinational partners in IT and life sciences. Following a rigorous and comprehensive evaluation of the pilot programme, IXC was spun out from AIG as a standalone, independent service provider.

**Mandate and governance**

IXC’s mandate is set out in its Articles of incorporation as a not-for-profit company limited by guarantee. These establishment documents create an inaugural Board of Directors which is accountable under Corporations Law for compliance with the IXC Constitution.

The formal objectives for the Australian entity, IXC Australia Limited, have been established as:

(a) to promote and facilitate collaboration and co-operation between and amongst industry and public sector research organisations for the benefit of the Australian community and for the advancement of knowledge generally;

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http://www.ninesigma.com/
(b) to facilitate through intermediation and other means the forming of potential business alliances and partnerships between and amongst firms and public research institutes within Australia and overseas;
(c) to establish, support or aid in the establishment of education and training programs designed to further knowledge of intermediation and innovation amongst and between companies and research institutes;
(d) to establish and support or aid in the establishment of organisations incorporated overseas whose objects are altogether or in part similar to those of the Company; and
(e) to carry on the business of providing intermediary services on a fee for service basis to generate a commercial return for the Company.

Structure and scope of programme
Unlike traditional technology transfer, consulting, cluster or networking programmes the IXC intermediary model provides the ‘wiring’ to enable the communication and exchange of information (often commercially sensitive and sometimes confidential) that is so essential to real business collaboration. IXC Intermediaries are able to connect firms and public research institutes, large and small, with each other and outside of their traditional networks at a local, national and international level.

Through the deployment of a network of highly creative, technically skilled and cross-disciplinary IXC intermediaries, IXC helps clients to speed up their business innovation and product development by facilitating collaborations with external organisations. The IXC methodology provides a framework of trust that allows clients to:

- collaborate in confidence to solve problems or to create opportunities;
- securely access new IP including technologies, capabilities and expertise;
- find better ways to exploit existing intellectual property;
- speed up business innovation, product development and collaborative R&D; and to
- connect internal innovation and R&D programmes to the power of global innovation networks.

Importantly, IXC intermediaries are able to collaborate with each other not only across company boundaries but across national borders. Thus, an IXC intermediary in say Santiago, Montreal or Barcelona is able to share information with other IXC intermediaries in Sydney, Melbourne, Birmingham or Cambridge. In this way they are able to assist local firms or research groups to access resources and capabilities from overseas or to assist them to find vital international market relationships.

Operations
IXC intermediaries are typically deployed on an annual retainer as a trusted executive resource supporting the client’s research and technology, product development or business development functions. IXC Intermediaries develop and maintain trusted access to clients’ technologies, capabilities and needs, and their strategic business intent. They assist firms and research institutes to identify new opportunities by first deeply understanding their business intentions and their technical capabilities and needs. They then collaborate with other IXC Intermediaries, sharing information, researching and analysing technologies, gathering market intelligence and searching for opportunities for business connections and collaborations - amongst other IXC clients or, more commonly, in the broader marketplace. When an opportunity is found, IXC Intermediaries assist the parties to engage directly using IXC’s proprietary step-wise disclosure process.
All of this is done within a strict legal and ethical framework under which IXC guarantees confidentiality and the non-use of client intellectual property.

The IXC intermediary service is supported by a year-round programme of events and communications designed to promote and encourage collaboration across the traditional boundaries of research, industry and government.

The underlying performance challenge is superior client service delivery generating real commercial value and outcomes. The assessment of IXC’s performance revolves around:

- the number of trusted client relationships;
- the quality and timeliness of investigations and client reports;
- the quality and value of the opportunities identified; and
- the quality and value of the collaborations and relationships created.

**Evaluation and impact**

Much of the work undertaken by IXC intermediaries is commercially sensitive and confidential, and it is early days to assess the impact and effectiveness of IXC. Interesting case studies are already emerging, however, to demonstrate the commercial value of the Innovation Xchange model.

The Innovation Manager at Cochlear Ltd, one of Australia’s most innovative technology companies, sums up the value of their IXC engagement in the following terms:

> IXC has opened up a range of outstanding opportunities for Cochlear. Their intermediaries have worked tirelessly to understand our technical needs and to connect us with people and groups who may be able to address them. They seem to have a bottomless pit of technical contacts, many of whom we had not come across before. Joining IXC has been a very positive experience for Cochlear.

Other early examples of IXC engagements demonstrate the value proposition in the context of open innovation.

**University ‘spin out’ connected to global corporation in a totally different industry market.**

Macquarie University ‘spin out’, Applimex was focused on the mining industry when IXC identified that their capabilities could actually assist a global food corporation. The CEO of Applimex has commented:

> "... while the revenue flowing from these IXC-initiated projects has been extremely welcome, what has been even more important for our long term future, has been the opportunity to connect with leading Australian and international companies who would not otherwise have been aware of Applimex and its capabilities.

> As a direct result of our involvement with IXC, we are now actively working for, or in discussions with, a variety of major companies operating in industries such as food, medical devices and consumer goods. We would estimate that revenue opportunities with these organisations to be potentially worth millions of dollars to Applimex. In addition, the credibility of having such a "blue-chip" client base has been extremely beneficial in our general marketing activities."
Manufacturing company connected to national research capabilities

A large Australian based manufacturer has recently been connected with a large Australian research facility by IXC. The company was seeking new technologies to decrease costs whilst improving the quality of a core product. The company reports this engagement has the potential to deliver new high-tech products to the market and to significantly improve profitability.

Two global giants connected

Two global corporations, one based in Australia and the other in Europe, had been trying unsuccessfully for five months to connect to each other when their IXC Intermediaries identified a significant commercial opportunity between them. Within weeks the IXC Intermediaries had the two companies safely engaged in a collaboration conservatively valued at over $100 Million; in the clients’ opinion the opportunity would never have happened (or at best taken much longer) had it not been for the involvement of IXC.

Australian SME connected to United Kingdom based technology

IXC Australia was briefed to identify, investigate and facilitate opportunities which would add value to a Queensland based SME in healthcare products. Following input from IXC Intermediaries in the UK, the SME has engaged with a UK-based company which has a technology that not only has applications to the SME’s current line of products but has broader applications in healthcare and in other industries, for example, food processing. The two companies are now in the process of negotiating licence rights to the technology.

SME connected to two large Australian based international medical device companies

IXC Australia recently facilitated meetings for a local SME with two major listed medical device companies (who are also IXC clients). These large companies are in the process of considering the introduction of the SME’s products and capabilities into their own products and services.

Research institute connected to local SME as commercial partner

IXC worked with a small, Victorian medical research institute that had been unsuccessful in finding a commercial partner for their IP for over 4 years. IXC arranged discussions with a Victorian manufacturing SME which resulted in a short-term, focused development program worth AUD$60,000 from which the necessary data will be developed to obtain the interest of larger diagnostics companies. If successful, the collaborative technology developed would access a global market worth in excess of US$100 million.

The ultimate test and evaluation of IXC is the market test of whether is can remain a commercially viable operation.

Alliances

In both Australia and the UK governments have entered into partnerships with IXC. In the UK the government provided substantial seed funding for the establishment phase of the country node. In Australia both Federal and State governments have entered into alliances with IXC. The Victorian government committed major funding that has helped underwrite IXC’s growth phase. It has done this by being an early ‘anchor’ customer, contracting IXC to service government research agencies. The second is the contracting of IXC, by both the
Federal and State governments, to assist as a major service provider to the SME sector. This has been done through government subsidising SME access to the service.

**Challenges and lessons**

It has become evident that innovation intermediation needs to be cross-border and international within a global economy in which cross-border innovation flows are increasingly important. It is expected, therefore, that the value proposition of IXC will increase exponentially as it internationalises.

This value proposition is particularly important to smaller country economies trying to carve out competitive positions within global supply chains, and for smaller country SMEs to be assisted to link with multinational corporations, mostly domiciled within the dominant triad economies of the northern hemisphere. Hence the successful establishment of IXC International becomes the key development challenge for the organisation in the near term. The challenge then will be to establish effective platforms for collaboration amongst a culturally diversified and distributed pool of intermediaries.
4.4 Financing innovation, and the Innovation Investment Fund (IIF) scheme

The lack of risk capital for early stage ventures is a recurrent theme in the literature on innovation. The Australian case study of a government initiative to create market activity around early stage ventures, through co-investment incentives directed at putative private sector fund managers, provides an instructive case study of government intervention and public and private alliances in addressing an area of systemic market failure.

There is a global and systemic funding gap in the availability of finance for early stage ventures and small technology businesses. This, in itself, is not a market failure: it is a signal that markets are working precisely because private equity providers eschew the high risk investments in early stage ventures. Basic economic theory tells us that rational investors will gravitate around investment classes that maximise returns around the lowest available risk. It is worth noting that Adam Smith’s ‘invisible hand’ holds true even in the US heartland of private equity, as the following chart illustrates. This trend data shows that, even in the US, the share of funds being directed towards seed and early stage investment has been falling over the last decade. The ‘dot.com’ crisis and the collapse of technology stocks at the turn of the century only served to highlight what, on longer term analysis, appears to be a systemic gap in the availability of capital for new ventures.

The IIF scheme in Australia is a classic example of a ‘co-investment’ model of government intervention for industry development. In this model government seeks to change economic outcomes by reducing the risks associated with investing in new ventures and new technologies.

The policy context

There are typically three challenges with supporting the emergence of new firms and activities, especially technology based enterprises, as follows.

1. How to bridge the funding gap between R&D or an innovative idea, and its subsequent commercialisation as a viable operation? This challenge involves sourcing ‘seed’ funding either through ‘friends, family, or fools (angel investors)’ or through customer driven contract research (where the customer effectively helps fund initial development to the point where the entity becomes more attractive to traditional investors). Such funding gaps have been portrayed in various ways, but I
find the following one particularly useful because of its emphasis on the important phase of ‘exploratory development’:

2. Addressing the different characteristics of possible start-up strategies\(^7\). There has generally been an over-emphasis on speculative product development or what have been termed ‘hard start’ strategies, and a neglect of enterprises which emerge from customer-driven contract research and exploratory development. In the case of these ‘soft companies’ where industrial capability emerges from the process of engaging with the solving of customer problems, customer funding plays a key role in the early ‘exploratory’ stages of developing and exploiting new technology. In the US the Small Business Innovation Research scheme is a programme designed to direct federal agency procurement contracts to such firms\(^7\).

3. Growing and retaining a cadre of experienced professional fund managers and promoting informed financial markets. This is a particular challenge in smaller country economies, on two fronts. First, the lack of early stage equity markets of necessity means there will be a lack of professional managers, especially ones well connected into global markets and with access to later stage funds. Secondly, the

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\(^7\) I am grateful to David Connell of the Centre for Business Research at the University of Cambridge for his insights here. He expounded these ideas at a forum on government procurement and innovation which I co-convened in Canberra in October 2007. Connell’s advocacy for an SBIR type scheme in the UK has been endorsed in the recent report from Lord Sainsbury, *The race to the top: A review of Government’s science and innovation policies*, London, October 2007

\(^7\) See [http://www.sba.gov/SBIR/indexsbir-sttr.html](http://www.sba.gov/SBIR/indexsbir-sttr.html)
‘thinness’ of technology markets in a country like Australia means there will be few local financial analysts specialising in such areas of investment. One result is an undue reliance on market reports from countries like the US, where much can be lost or distorted in the translation from a very different market environment. Another has been the difficulty of launching successful technology IPOs within the Australian market78.

The initial policy dynamics and policy evolution

Since the 1980s there have been several attempts to promote greater investment in early stage technology ventures in Australia. The first was a 1983 ‘Management and Investment Company’ scheme aimed at raising new funds by offering some tax benefits. This scheme met with only limited success, and was replaced in 1993 by a Pooled Development Fund (PDF) scheme. Based on the same concept, this scheme provided for a concessional corporate tax rate of 15 per cent, and its shares were free of capital gains tax. However, losses incurred by investing in the pooled development fund scheme were not tax deductible and the scheme is generally deemed to have had limited impact. The PDF scheme itself has now been superseded by an Early Stage Venture Capital Limited Partnerships programme. This is an entitlement programme that provides new venture capital funds and their investors (both domestic and foreign) with a tax exemption on the returns from eligible investments. Despite the ‘early stage’ label, eligible investee companies can have assets up to $50 million which is inevitably going to skew the investments away from very early stage companies. As noted in a separate case study, the R&D Tax Syndication scheme was another programme that had also aimed at encouraging third party investment in R&D, but was abolished in 1996 following concerns about the financial engineering that developed around the scheme.

In the mid-1990s the Industry Research and Development Board’s (IR&D79) grant schemes saw increasing activity around the ICT and biotechnology sectors and Australia also watched the heady growth of venture capital investment in ICT and ‘dot.com’ companies in the US. Few Australian start-ups could gain the attention of Silicon Valley investors – ‘too far away’ – and the more successful Australian start-ups struggled to migrate to or expand into the US.

In 1996/7 the IR&D Board itself initiated policy studies80 around possible venture capital schemes, and Board members led an investigative mission to Israel and the US81. In particular the Board visited the US Small Business Administration and analysed and discussed the operation of its longstanding venture capital scheme. The Board secured the support of the government for the proposal on the basis of:

• overseas data on the linkage between private equity and new firm formation, job formation, and growth in firm turnover and exports; and

• the adoption of the main parameters of the US scheme (establishing that there was little that would be unduly courageous in following their example).

The Prime Minister incorporated the initiative within a major industry statement in 199782 (which was partly geared to offsetting the industry reaction to the cuts to innovation programmes made by the incoming government in 1996).

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78 This situation has improved over the last five years, but mainly for domestically oriented businesses.
79 In late September 2007 the IR&D Board was merged with the Venture Capital Registration Board and re-named the Innovation Australia Board. In this paper the earlier nomenclature is retained.
80 The IR&D Board, like many other statutory agencies, has a general remit to provide policy advice to government, but this role has usually tended to be reactive rather than proactive. Government departments tend not to like statutory Boards having too many ideas of their own.
81 This section is informed by personal recollections as Chairman of the IR&D Board from 1996 to 1998.
The Innovation Investment Fund (IIF) scheme involves the licensing of private sector fund managers to operate special purpose vehicles for early stage venture capital under IIF Guidelines. The initial incentives to the fund managers – since watered down somewhat in subsequent funding rounds – were a 2 for 1 dollar co-investment by government, with any returns to government capped so the upside remained with the VC firm. In addition the scheme provided for a management fee of 3%, that could be front-ended to a higher level, which was above the industry norm, in recognition of the additional overheads in dealing with small investee companies, and to ensure that the investee companies received ‘value added’ attention from the Fund Managers. The IIF, therefore, is a good example of the co-investment model of industry partnerships.

A special standing committee of the IR&D Board was established to conduct the licensing process and to provide ongoing oversight of the scheme’s operation. This highlighted the need to strengthen the financial expertise available to the Board. It also highlighted the difficulty, within a small financial market like Australia, of avoiding conflicts of interests in the licensing process. Having the knowledge of possible abuses of such schemes very much in mind, given the decision to terminate the R&D Syndication scheme in 1996, the IR&D Board devoted extensive attention to establishing guidelines and a licensing framework that would, as far as possible, avoid the scope for any abuse of the scheme. Because of the limited expertise within the bureaucracy, and because of the complex corporate structuring proposals for the Fund vehicles, the Board retained the services of one of Australia’s leading corporate advisory lawyers (on the basis of the proverbial ‘poacher turns gamekeeper’ strategy). This provided invaluable assurance to the Board about the robustness of the vehicles proposed. As was becoming usual practice in Government with major contracts, the Board also retained a probity lawyer to oversee the licensing process. This provided important assurance and comfort to the private sector tenderers about the integrity of the process.

Five initial Funds were licensed in 1998, and during their establishment phase the Board Committee played an active role in operationalising the governing guidelines. This raised an important issue with respect to the scope for the exercise of discretion and judgement in a governance regime. One of the first matters referred to the Committee for adjudication related to a Fund investment in Looksmart, a search engine venture. While the Guidelines specified that investee companies needed to have “a majority of its employees (by number) and assets (by value) inside Australia at the time the licensed fund first invests in the company”, Looksmart had moved to incorporate in the US to facilitate market development. In this case the Committee exercised considerable discretion and a little casuistry in finding Looksmart an eligible investment. Fortuitously, the subsequent IPO of this company recouped the entire government capital investment in the first IIF Funds. In this instance the eligibility ruling was influenced by the Committee’s cognisance of the spirit and intent of the scheme, whereas a more narrow and ‘black letter’ interpretation of the rules would probably have prevailed had the scheme been longer established and more bureaucratised. This raises the perennial dilemma of how best to maintain policy clarity and focus over the life span and evolution of a programme. A working, albeit negative, measure of bureaucratisation and the triumph of form over substance is to weigh the proliferation of rules and complexity of rules and guidelines over time.

The usual mechanism to allow for discretion is the inclusion of some ‘national interest’ test in administrative guidelines. This test appears in the charter of the IR&D Board, and also features strongly in Australia’s Foreign Investment Review Board charter. Nowhere is the national interest formally defined. There are clearly some advantages to having some ambiguity that effectively establishes some scope for judicious discretion; its use, however, relies on the calibre and standing of the administrators. The dark side is that discretions can be abused and can introduce an unacceptable lack of transparency. This has from time to time dogged particular decisions around foreign investment in Australia.

83 Several Chairmen and members of the Committee had to stand aside during the process, ending up with the Board Chairman having to step into the role.
In planning the IIF scheme it was recognised that access to finance was simply one of the requirements needed for a robust private equity market and the development of a more promising environment for technology start-ups. Foremost amongst the other factors is the whole matter of taxation, ranging from the impact of capital gains taxes to the tax treatment of employee stock options. It was decided early on that, were an integrated package of measures to be proposed that included tax measures, the likelihood of success would be low. Rather it was thought that the establishment of new Funds would lead to inexorable pressure for tax reform downstream. So it proved. This highlights the value of giving considerable thought to determining the most strategic points for intervention within an industry value chain, having close regard to the likely flow-on effects. These may be positive or negative.

**Mandate**

The IIF scheme was established by Ministerial Direction to the IR&D Board in 1998, under the general powers of the Industry Research and Development Act. This Direction established the power for the Board to promulgate Guidelines for the operation of the scheme. The latest, 2006, Guidelines were issued directly under the authority of the Minister, and included an authority for the Minister to appoint a ‘Program Delegate’, which could be a departmental official independent of the IR&D Board, to administer the Guidelines. This has, in effect, reduced the autonomy of the IR&D Board in key aspects of the decision making process. (It could also be argued that this current arrangement blurs lines of accountability).

The stated policy objectives of the IIF programme are:

- by addressing capital and management constraints, to encourage the development of new technology companies which are commercialising research and development;
- to develop a self-sustaining Australian early stage, technology-based venture capital industry;
- to establish in the medium term a ‘revolving’ or self funding program; and
- to develop fund managers with experience in the early stage venture capital industry$^{84}$.

The second objective – of promoting a ‘self-sustaining’ venture capital market – is arguably unsound, given the systemic failure of such markets in the absence of continuing incentives. This reality has been recognised in practice with the introduction of two subsequent IIF funding rounds.

**Structure and scope**

The government initially committed $230 million to the scheme, matching private sector funds on a 2:1 basis. (This co-investment rate has since been reduced to 1:1 for a third round of funds in 2007). The Government will invest up to $20 million in each fund, which have a ten year life span, and the bulk of funds must be invested within the first five years. Licensed Funds must source the bulk of their private funding from third party sources, and the Fund Managers may invest no more than 20% of funds in any one investee company. The scheme presumes that successful investee companies will be able to source later stage development financing from unsubsidised financial markets.

Eligible investment companies must have turnover of no more than $5 million. They must also now be an Australian incorporated entity – a contentious issue. The original 1998 guidelines were more open ended, stating that investee companies must have most of their activity domiciled in Australia (this was the provision which justified the investment in Looksmart in 1998).

$^{84}$ Innovation Investment Fund Program Guidelines, No 1 of 1998
The current 2006 Guidelines set out the following selection criteria for Fund Managers:

- effective strategies to promote the training and development of Australian based staff in all aspects of making venture capital investments in early stage companies;
- the proposed size of the fund;
- the level and structure of management fees proposed;
- capacity and experience in early stage equity investing;
- qualified and skilled personnel;
- understanding and experience in equity transactions sourced within Australia; and
- demonstrated willingness to operate within the programme Guidelines.

The selection guidelines provide the discretion to give preference to Fund Manager applicants who are new managers. The original 1998 selective criteria were more expansive and descriptive:

**Selection criteria - 1998**

**Management expertise and experience**

1. Applicants must demonstrate that their proposed management team is qualified and has the knowledge, experience, and capability necessary for managing an investment portfolio and making successful equity investments in small, early stage companies including:
   a) expertise and experience in actively seeking and investigating potential equity investments in small, early stage companies;
   b) expertise and experience in developing and implementing equity investment strategies to achieve returns by investing in small, early stage companies;
   c) expertise and experience in the development and implementation of successful growth and recovery strategies for small, early stage companies;
   d) expertise and experience in the successful management of investment portfolios;
   e) experience in providing financial management advice to small, early stage companies; and
   f) expertise and experience in realising returns from investments through third party transactions such as later round investments, trade sales and initial public offerings.

2. The Board expects that fund managers will:
   a) be committed to training and developing the skills of Australian based staff in all aspects of venture capital investment activities in small, early stage companies;
   b) have an appropriate ratio of investment managers to committed capital having regard to the size and type of the licensed fund; and
   c) have a balance of relevantly skilled key personnel.

**Technological expertise and experience**

3. The proposed key personnel must have an understanding of, and experience in dealing with, issues related to technology investments, products, services and markets, including:
   a) demonstrated expertise and experience in the specific technologies which will be the investment focus of the licensed fund;
   b) experience in providing advice to technology-based businesses; and
   c) experience in the internationalisation of technology investments.
Capital
4. The Board will consider:
   a) the proposed size of the licensed fund including the amounts of privately and Government sourced capital;
   b) the applicant’s ability to raise the level of private capital proposed in the application;
   c) the applicant’s ability to meet the capital requirements set out in the Guidelines, including the minimum capital requirements and management and ownership diversity requirements;
   d) the proposed sources of capital; and
   e) evidence of linkages with global capital markets.

Quality of the application
5. Applicants must demonstrate through the application that the licensed fund will:
   a) operate within the IIF program Ministerial Directions and these Guidelines; and
   b) achieve commercial returns for its investors including the Commonwealth.

Financial reporting capability
6. Applicants must demonstrate experience in generating and maintaining a variety of financial data and reports on investment funds.

Investment policy
7. Applicants must demonstrate an investment policy, which may include any regional and/or sectoral focus, for the licensed fund.

Intent of the licensed fund manager
8. Applicants must demonstrate a willingness to operate within the intent, and to promote the policy objectives, of the IIF program.

Business reputation
9. Applicants must demonstrate good character and high ethical standards, including through the general business reputation of those involved in the ownership or management of applicants and their key personnel.

Other Matters
10. The Board may have regard to additional criteria and undertake other enquiries in order to consider the suitability of applicants to be offered licences. The Board may take into account experience, expertise and abilities which, while not directly addressing the criteria, provide the applicant with experience, expertise or abilities relevant to the IIF program.

There are currently nine licensed Funds, which have to 2007 invested in about 80 early stage companies. The Funds have had a strong orientation towards the ICT and biotechnology sectors. Typically the investment exits for the Fund Managers have been trade sales or listings, primarily in the US although AIMS in the UK is becoming increasingly popular for later stage funding.

Evaluation and impact
There have been few major evaluations of the IIF scheme per se, probably because of the ongoing attention to the role of private equity in capital markets.

There can be no doubt that the scheme has increased the profile of venture capital in Australia, judged by the number of Fund Managers. The increased activity at the early stage investment phase has also strengthened downstream market activity. Several of the early IIF Fund Managers have gone on to raise new investment funds in their own right, off the back of the track record established by participating in the IIF scheme. The Australian Venture Capital Association is now an active industry association, with 64 investor members. Possibly the greatest success of the scheme has been in building the ranks of experienced local Fund managers. The scheme has also assisted in promoting stronger linkages between Australian Fund Managers and overseas venture capital firms, and this has been important for the later stage funding of investee companies. Nonetheless, there is little evidence that a self-sustaining market could be achieved in the absence of continuing Government incentives.

85 A ‘client satisfaction’ survey showed that, not surprisingly, investee companies were generally happy to receive funding! AusIndustry, IIF and REEF: Summary Report on Investee Satisfaction Survey, April 2005.
The relative success of the scheme has served to focus attention on the efficacy, or otherwise, of upstream and downstream financial markets. In particular, the operation of the IIF scheme has highlighted the continuing challenges associated with seed capital for new ventures\textsuperscript{86}. This has lead to some relatively small-scale government programmes around seed stage financing. On the other hand, Australia’s cashed up Superannuation Funds remain wary of investment in early stage private equity as an asset class, which continues to restrict the sourcing of investment funds by venture capitalists. The investment policies of these Pension Funds continues to be a major determinant of the dynamics of Australia’s capital markets.

\textbf{Challenges and Lessons}

The IIF scheme provides a good case of the importance of careful programme design, and the \textit{ex ante} consideration of possible risk factors. The history of the scheme also raises questions about the relative roles of private sector individuals in the design and implementation of programmes, through co-option to statutory Boards and supervisory committees. IR&D Board and Committee members played a significant role in the shaping of this programme, more so than with most new policy initiatives. Arguably this is a positive example of private and public sector collaboration in crafting as well as executing industry development policy. This case study also suggests that this dynamism is difficult to sustain over time, as administrative processes become more institutionalised.

The IIF scheme also provides yet another reminder of the endemic tensions between critical mass and fragmentation in the administration of industry policies. From a national perspective, it is desirable to concentrate resources where they are likely to have the most impact. Political imperatives, however, produce countervailing pressure to distribute resources both geographically and across industry sectors. A related challenge, especially for interventions in capital markets designed to support industry, is to maintain a sufficient focus on the ability of venture capitalists to maintain a diverse investment portfolio. Overly targeted government guidelines that direct funding into relatively narrow industry areas can be self-defeating. Thus the wisdom of establishing an IIF-like fund focused exclusively on renewable energy is questionable\textsuperscript{87}.

\textsuperscript{86} AusIndustry, \textit{Interim Evaluation of the Innovation Investment Fund}, 2004

\textsuperscript{87} The Renewable Energy Equity Fund (REEF) was established in 1999.
4.5 The Co-operative Research Centre (CRC) Programme

The Co-operative Research Centre (CRC) programme was established in 1990. The scheme was designed to address the perception that universities and research institutes were not sufficiently linked to industry, and *vice versa*. The programme is one of several Australian initiatives – the other central ones are the Rural R&D Corporations and the IIF venture capital scheme – which revolve around private and public sector co-investment in innovation.

Recent reviews have documented significant return on investment from the scheme. There is little doubt that the scheme has promoted considerable cultural change through greater cross-sectoral collaboration and greatly improved linkages within the innovation system.

The initial policy dynamics and policy evolution.

The early history and evolution of the CRC Programme is instructive.

During the 1980s funding for science had fallen significantly. Since a change of government in 1983 the then Minister for Science noted that budget allocations to science had fallen “by 21.6% and to CSIRO by 31.3%”.

During the 1988-89 budget negotiations Barry Jones, the Minister for Science, castigated the research community for their lack of political nous:

> Scientists have been the wimpiest possible lobbyists in their own cause... Politicians are sceptical about research workers and scientists because they cannot impose any sanctions.... Sometimes scientists tell MPs “If you don’t support my projects we’ll...” and the MPs ask “You’ll what?” The scientists reply “We’ll feel terrible”. That doesn’t involve much leverage. Having no leverage makes people vulnerable.

Spurred into action, “the wimps arose” and there was a “vigorous” demonstration when the Prime Minister opened a new National Science and Technology Centre in November 1988.

Taken aback Bob Hawke, the Prime Minister, subsequently executed a complete u-turn and created a new position of Chief Scientist reporting directly to himself, and in May 1989 delivered a major Science and Technology Ministerial Statement. The new Chief Scientist, Ralph Slatyer, crafted the CRC programme off the back of a 1989 Australian Science and Technology Council (ASTEC) report, *The Core Capacity of Australian Science and Technology*.

It is clear, however, that a key driver was not so much the lobbying of scientists, but a growing political recognition of some structural weakness within Australia’s innovation system, and growing concerns about the competitiveness of Australian industry within an increasingly deregulated market.

In 2000, Ralph Slatyer provided an instructive account of his conception and development of the CRC Programme. He recounts how the CRC programme was designed to address four fundamental challenges to research and innovation for Australia:

1. *Our combined scientific and technological resources were quite substantial but they were dispersed both geographically and institutionally. This separation made it difficult to build strong research teams. It also led to unnecessary duplication of facilities, and difficulty in ensuring that they were world class.*

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88 Disclosure: The author was the Chairman of a CRC from 2002 to 2008.
90 *ibid.*, p. 388
91 The position of Chief Scientist became a part-time post after 1999.
2. Existing funding arrangements contributed to this problem. Most research funding in Australia is from institutional sources and flows down from management through administrative channels to operational units and individual researchers.

3. Corporate R&D was not well developed in most Australian industry sectors so there was a limited capacity for corporate and other research users to benefit fully from the skills and information in the Universities and government research organisations. As we all know, information and technology are transferred most effectively when there is a similar level of knowledge in both parties, so the lack of in-house R&D capability was an important liability.

4. Graduate programs in Australian Universities still provided mainly traditional academic training, involving research only and a single supervisor. This did not prepare students well for jobs outside the academic world. It also denied students access to the skills and experience of many of Australia’s best researchers and denied those researchers the stimulus of interaction with students.

Slatyer designed the CRC programme to address these challenges.

What I envisaged to address these weaknesses was … a Centre which would be something of a "One Stop Shop" for innovation, consisting of a cooperative team of researchers and research users, drawn from various organisations, and of adequate size and composition to have a real and continuing impact in the sector where it was located. I envisaged that the research organisation participants would undertake mainly long term strategic research—in other words work at the R end of the R&D spectrum—and the research users would work mainly at the D end.

Reading Slatyer’s account of the thinking behind the CRC programme reminds us that the clarity of purpose and the rationale for such programmes is often lost over time. Subsequent reviews and commentaries lose the acuity of the founding vision. Programme administrators bolt new bits and pieces onto programmes, and go about boiler-plating arrangements against any conceivable hazard. This can cause clarity of purpose to degenerate over time. For example, the Programme Guidelines have multiplied more than six-fold from a mere 15 pages in 1990 to 97 pages in the most recent 2006 round. There is a difficult but important balance to be struck between prescription and flexibility.

In designing the programme, Slatyer identified several elements he saw as crucial to effective collaborations.

1. **Co-location.**
   Co-location might involve the development of technology parks around universities or the development of specialised precincts.

2. **Common funding.**
   (“In my experience, continued effective cooperation depends on cooperation at the individual level, motivated by a perception of mutual benefit from the joint undertaking. Even then, I believe that sustained cooperation, involving inter-institutional cooperation, the development of integrated research teams and a real commitment to the overall venture, can often only be assured when a substantial fraction of the total funds required comes from a common source”).

3. **Sustained cooperation.**
   Slatyer saw this as being underpinned by the long term, renewable funding commitment and the full recognition of participant overheads in the funding model.

4. **Effective leadership.**
   One of the indirect benefits from the scheme has been the development of large pool of entrepreneurial research managers. This has clearly had a significant impact on the culture of innovation within the sectors in which the CRCs are embedded.
**Mandate**

The focus and programme priorities have changed over time.

The current formal statement of the programme’s objective is as follows:

"to enhance Australia’s industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-private research centres that achieve high levels of outcomes in adoption and commercialisation."

This statement lack the richness of Slatyer’s original statement of purposes, or of the findings from a 1998 review of the programme:

*The CRC Programme addresses important weaknesses in the national innovation system, in particular the disincentives to collaboration among research providers and Australian businesses, the weak links between research organisations and users, the lack of critical mass due to the institutional and geographical dispersion of Australian research and research application, the lack of mobility of personnel between government research, academia and industry, and the challenges of effective international links for a country isolated from the international centres of research and innovation. The Programme complements the work of the universities, CSIRO and other research organisations. It encourages greater industry involvement in guiding R&D in the public sector. The focus and critical mass of CRCs, in addition to their leading edge research, attracts international interest and involvement."

The recent Productivity Commission review also highlighted this shift in priorities, noting that the current programme guidelines are:

*a significant departure from the previously stated objectives, which were evenly balanced across four areas: research excellence; effective collaboration; creation of new educational opportunities for graduate researchers; and the translation of research outputs into economic, social and environmental benefits to Australia.*

What confuses the picture and evaluations is the overhang from previous mandates that continue to govern the life of previously funded CRCs before the impact of programme changes emerges in outcomes from CRCs established under later guidelines. This creates a discontinuity in feedback loops, a point which was highlighted in a 2006 evaluation:

*Time lags between the formation of a CRC and the generation of measurable end impacts are still significant – time lags between the commencement of a CRC and the delivery of measurable end impacts are generally between five and ten years.*

The 1998 review synthesised a useful summary of the goals and strategies associated with the Programme. This summary helps to draw attention to the key intervention strategies which underpin the programme.

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93 [wwwcrc.gov.au](http://wwwcrc.gov.au)

94 Don Mercer and John Stocker, Review of Greater Commercialisation and Self Funding in the Cooperative Research Centres Programme, Department of Industry, Science and Tourism, 1998, p. iii


96 Insight Economics, Economic Impact Study of the CRC Programme, October 2006, p. x
### STRATEGIES TO ACHIEVE PROGRAMME OBJECTIVES

<table>
<thead>
<tr>
<th>Goal</th>
<th>Specific Objectives and Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribute to economic and social development</td>
<td>Support long term high quality science and technology research&lt;br&gt;Selected by expert panels on the basis of open applications</td>
</tr>
<tr>
<td>Strengthen education and training</td>
<td>Support postgraduate students integrated into CRC research programmes&lt;br&gt;Involve researchers from government and users in student supervision&lt;br&gt;Support industry training activities to disseminate new knowledge</td>
</tr>
<tr>
<td>Raise the effectiveness of R&amp;D</td>
<td>Require users to contribute to the support of CRC research&lt;br&gt;Involve users in the management and activities of CRCs&lt;br&gt;Strengthen the management of R&amp;D through the role of CRC Boards&lt;br&gt;Improve the mobility of graduates and research personnel</td>
</tr>
<tr>
<td>Raise the efficiency of R&amp;D</td>
<td>Stimulate cooperation among public sector research providers to achieve synergies and ‘critical mass’&lt;br&gt;Strengthen accountability through performance reviews&lt;br&gt;Enable sharing of major facilities and equipment</td>
</tr>
</tbody>
</table>

*Source*: Mercer and Stocker, 1998, p.4

**Structure and scope**

A CRC consortium must include at least one university and preferably more than one user. As well as universities, other research institutes and CSIRO participate - CSIRO is involved with almost half the CRCs. Users often include government agencies, especially in the period when ‘public interest’ CRCs were allowed, in areas like the environment. There has been a steady increase in State government participation in the programme.

Under the CRC programme there are biennial funding rounds to solicit competitive bids from industry and research consortia. The scheme is open to any area of industry. The Commonwealth Government funding is for a seven year period, after which there is an opportunity for established CRCs to re-bid. Some CRCs have been successful in re-bidding for two subsequent funding rounds, creating continuous funding over a 21 year period. In 2008 it is expected that some CRCs will bid for a fourth funding round.

Until recently the Minister for Education, Science and Training had overall responsibility for the Programme, advised by a standing CRC Committee which plays a key role in the selection, monitoring, and evaluation of CRCs.

The CRC Committee comprises up to 13 members appointed by the Minister, drawn from a cross-section of industry, research institutions and government agencies.

An industry association of the CRCs – the CRC Association – operates between the individual CRCs and the CRC Committee. The role of this Association is ambiguous: it is unclear whether it operates primarily as a government-sponsored forum to provide a centralised communication channel to CRCs, or as a lobby group and feedback loop from the CRCs.

The CRC selection process is competitive, multi-staged, and costly.
The Productivity Commission notes that there are four broad selection criteria:

- outcomes will contribute substantially to Australia’s industrial, commercial and economic growth;
- path to adoption (commercialisation and utilisation) will deliver identified outcomes;
- collaboration has the capability to achieve the intended results; and
- funding sought will generate a return and represents good value for the taxpayer.

The detailed selection criteria are appended to this section.

The selection process involves three stages:

1. Submission of initial proposals;
2. Short listing by the CRC Panels; and
3. Final interviews and submissions, leading to recommendations from the CRC Committee to the Minister.

The development of bid proposals is costly and resource intensive, so that there is a considerable opportunity cost for new consortia or established CRCs going for a re-bid. This cost is difficult to avoid. Maintaining probity and the perception of fairness in a competitive process works against programme administrators intervening to work with promoters to shape proposals which might best align with perceived national interests. The only possible way to side-step this conundrum would be to establish a special category of CRC funding for ‘strategic’ proposals, which might focus on industry areas where national capability is undeveloped or where no significant firms are domiciled in Australia.

Productivity Commission, 2007, p. 444
Operations

Around 70 CRCs are currently in place (with 158 having been funded since 1991, or a net 100 CRCs). The programme cost as at 2006 is around $200 million pa, with a total level of government funding since 1990 of $2,659 million. The typical government incentive contribution is of the order of 1.25:1 to business contributions, with the scale of the funding in the range of $20 to $40 million. Since the commencement of the CRC programme, the combined investment from all parties has been more than $11 billion (cash and in-kind) to CRCs. This total is made up of more than $2.6 billion from the Commonwealth Government, $2.8 billion from universities, $2.1 billion from industry and more than $1.1 billion from CSIRO.

The following table summarises the relative contributions from the different participants. Unfortunately, the data sets for 1990/01 to 2001/02 and for 2004/05 are not fully comparable.

<table>
<thead>
<tr>
<th>Funding source</th>
<th>1990-91 to 2001-02</th>
<th>2004-05</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Share of total CRC resources</td>
<td>Share of own resources in-kind</td>
</tr>
<tr>
<td>CRC Program — Australian Government</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Universities</td>
<td>22</td>
<td>92</td>
</tr>
<tr>
<td>CSIRO</td>
<td>14</td>
<td>98</td>
</tr>
<tr>
<td>Industry</td>
<td>17</td>
<td>59</td>
</tr>
<tr>
<td>State Government</td>
<td>8</td>
<td>82</td>
</tr>
<tr>
<td>Other Australian Government</td>
<td>5</td>
<td>78</td>
</tr>
<tr>
<td>Other participants</td>
<td>7</td>
<td>74</td>
</tr>
<tr>
<td>Other funding c</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Adapted from Productivity Commission, 2007.


Includes local government, research institute/organisations, uncategorised, other. na not available.

This data raises a number of interesting points. On face value, the direct government programme funding is low relative to total CRC funding (at 25% and 20% respectively). However, it is clear that the programme either leverages or siphons off funding from other government appropriations. The next table re-calculates this data on the basis of direct government programme funding to indirect government funding, and on total public sector funding relative to private sector contributions.

<table>
<thead>
<tr>
<th>Funding source</th>
<th>1990-91 to 2001-02</th>
<th>2004-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRC Programme funding relative to total public sector funding</td>
<td>34%</td>
<td>27%</td>
</tr>
<tr>
<td>Total public sector funding relative to industry contributions</td>
<td>74%</td>
<td>75%</td>
</tr>
</tbody>
</table>

Productivity Commission, 2007, p. 382

www.crc.gov.au
This re-calculation shows that the greatest source of public sector contributions to the programme is indirect. If we exclude university contributions from these calculations, direct programme funding contributions are matched by government funding from other sources.

The re-calculation also shows that there is a strong underlying incentive for industry participants, given that each industry $1 is leveraged by $3 from the public sector.

Contributions to the CRC scheme may be represented by either hard cash contributions, or in-kind support, mainly labour or equipment and facilities. Two-thirds of total CRC funding is represented by in-kind support, and this figure becomes higher if the programme’s government cash contributions are excluded. Operationally, one consequence of this funding mix is that CRC entities have limited cash leverage to fund initiatives outside of the participant’s pool of in-kind resource allocations. This challenge is compounded by the reality that the Commonwealth’s cash contribution is the main source of funding for CRC administrative overheads. The bulk of the participant’s in-kind contributions are represented by research-related resources; this leaves little funding available for the commercialisation of research outcomes. This lack of specific funding for commercialisation or technology transfer means that the impact of the CRC programme is constrained.

Each CRC has distinctive characteristics. Several studies have suggested useful categorisations of CRCs. The 1998 review of CRCs grouped established CRCs into four categories, based on their relationships with industrial users and the application of research outcomes.

**CATEGORISING CRCs**

1. **Specific Users**
   Commercially focussed with specific users.

2. **Industry Development**
   Commercial and public interest focus with industry development and new firm formation objectives. (In some cases the CRC is pursuing an opportunity to develop a new technology for which there is no established user in Australia)

3. **Dispersed Users**
   Commercially focussed but generally more dispersed industry involvement with the involvement of intermediaries (such as Rural R&D Corporations\(^{100}\))

4. **Public Interest**
   Primarily public interest focussed or underpinning sustainable resource use\(^{101}\).

*Source: Mercer and Stocker, 1998, p.5*

One of the significant benefits of the operations of CRCs has been in the enhancement of the national skills base; for post-graduate researchers the programme operates as a virtual industry internship programme. What is noteworthy is the scale of this impact. For example, the government estimates that in 2004-05:

*more than 2000 full time equivalent postgraduate students were studying through a CRC. In addition, some 4550 undergraduate students were receiving education and training through CRCs in the same year*\(^{102}\).

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100 “The ‘rural’ CRCs provide a capability for managing projects, involving several providers and long time scales, of which RDCs are making increasing use. Some CRCs also enhance the commercialisation of RDC supported work, either because of the close involvement of users in the CRC or, as in the case of the CRC for Viticulture, because of the commercialisation vehicles created by the CRC”.

101 Industry participants may be attracted to such CRCs because they become demanding and leading edge customers for industry innovations.

102 Productivity Commission Submission DR205, Department of Education, Science and Training 2006, p. 6
Governance

Initially the programme was located directly within the Prime Minister’s Department, under the aegis of the new position of Chief Scientist. Programme administration and CRC selections was largely controlled by a broadly based CRC Committee. The location of the programme, in its establishment phase, within the Department of Prime Minister and Cabinet sent strong signals as to the important weight being given to the new scheme.

The CRC programme has since moved home twice. First it was moved to the Department of Industry, which then had responsibility for both science and industry programmes. In 2001 both the science portfolio and the CRC programme were moved to a reconstituted Department of Education, Science and Training. These shifts have influenced the policy Guidelines for the programme, with decreased emphasis on industry development and industry’s ability to absorb new technology – including the development of postgraduates exposed to industrial users. There has been increased emphasis on the commercialisation of university intellectual property through the scheme, and the suspension of ‘public good’ CRCs.

There are two levels of governance around the CRC programme: the centralised functions around the selection and monitoring of the portfolio of CRCs, and the governance of the individual CRC entities.

As noted earlier, the Minister for Education, Science and Training has overall responsibility for the programme, advised by a standing CRC Committee which plays a key role in the selection, monitoring, and evaluation of CRCs.

The CRC Committee in turn appoints a CRC Appraisal Panel which operates a little like a peer assessment vehicle. Four specially nominated conveners organise the work of the Panel within four broad sectoral groupings:

- Manufacturing and Mining;
- ICT;
- Medical Science and Technology; and
- Agriculture and Environment.

There are two inherent challenges with this governance model. The first is the inherent bias in peer assessment towards the areas of expertise represented on the panels, and against novel areas of inter-disciplinary investigation. The second challenge is in areas of emerging industries – or radically transformed industries – where there may not be a strong or well-developed base of firms in Australia around which to organise. There is scope for the Committee to take a stronger role in ‘brokering’ consortium formation in such areas, a suggestion made by Ralph Slatyer in 2000 but, as already noted, there are governance and probity complications with such a proposal.

A strength of the governance model is the consistent involvement of the Committee – and Panel – across the lifecycle of CRC selection, monitoring and review. Apart from detailed annual reporting requirements, the Committee conducts a formal mid-point review – the Third Year Review – of each CRC. The tendency for most CRCs to re-bid towards the end of their seven-year funding cycle becomes in itself an important evaluation process.

Each CRC is governed by a formal and detailed funding agreement with the government. In the past the bulk of CRCs have been unincorporated joint ventures. From 2006 there has been a requirement for a CRC to be an incorporated entity. (It can be noted that such a model could be problematic around some ‘public good’ CRCs, especially where the main ‘users’ are other government agencies). Incorporation has two main advantages. First it creates a clear, standalone, identity for the CRC. As part of this, the government can treat with the entity in its own right, rather than each of the participants (see following schematic ). Second, it makes it easier – through not an inevitable outcome- to establish a small ‘skills based’ board
comprising independent, non-executive directors, rather than a board more resembling a committee of management with representation from the majority of the participants.

**INCORPORATED VERSUS UNINCORPORATED MODELS OF GOVERNANCE**

Incorporation can, however, have disadvantages. First, it can create barriers to wider knowledge flows and transfers across or within the participating organisations. Second, it can create additional overheads and reporting requirements (in some cases requiring duplicate reporting systems).

The governance of CRCs involves high levels of complexity, and this in a research context where many of the participants have limited experience in corporate governance and commercial operations. The 1998 review provides an insightful summary of the resulting tensions which need to be managed.

**GOVERNANCE TENSIONS**

<table>
<thead>
<tr>
<th>Loose cooperative arrangement</th>
<th>OR</th>
<th>Collaborative venture</th>
</tr>
</thead>
<tbody>
<tr>
<td>resources of each participant managed by the participant</td>
<td>unified management of the CRCs resources</td>
<td></td>
</tr>
<tr>
<td>‘research push’ focus on long term research to develop technological opportunity</td>
<td>OR</td>
<td>‘user pull’ focus on specific needs and priorities of potential users</td>
</tr>
<tr>
<td>wide generic application knowledge for a sector or large number of potential users</td>
<td>OR</td>
<td>specific direct application knowledge principally for application by core participants or a pre-determined commercial vehicle</td>
</tr>
</tbody>
</table>

*Source: Mercer and Stocker, 1998, p.19*
**Alliances**

The CRC programme exemplifies an intervention to strengthen linkages within and across the component organisations of a national innovation system. As one review study noted:

> The CRC Programme is a bridging mechanism in the innovation system, rather than another contract research mechanism to provide subsidised research to industry\(^\text{103}\).

In fulfilling this ‘linkage’ function, the programme also builds new capabilities within the participating organisations. The inherent alliance-building benefits of the CRC model are well summarised in the following assessment.

### BENEFITS FROM CRCs IN STRENGTHENING THE NATIONAL INNOVATION SYSTEM

<table>
<thead>
<tr>
<th>More effective research</th>
</tr>
</thead>
<tbody>
<tr>
<td>• critical mass, a diversity of skills and learning to work in multidisciplinary teams;</td>
</tr>
<tr>
<td>• focussing in areas of high priority;</td>
</tr>
<tr>
<td>• reduction in duplication;</td>
</tr>
<tr>
<td>• cooperation and exchange of staff raises trust understanding;</td>
</tr>
<tr>
<td>• better identification of user needs leading to improved and faster transfer and adoption;</td>
</tr>
<tr>
<td>• better communication among researchers;</td>
</tr>
<tr>
<td>• building trust between partners;</td>
</tr>
<tr>
<td>• Australian research networks and improved access to researchers and facilities, leading to synergies and more efficient use of resources;</td>
</tr>
<tr>
<td>• CRCs provide a focus for communication with other Australian organisations, extending networks;</td>
</tr>
<tr>
<td>• developing skills in identifying, protecting and marketing intellectual property;</td>
</tr>
<tr>
<td>• a capacity to take research further toward commercialisation and hence be in a stronger bargaining position with potential licensees;</td>
</tr>
<tr>
<td>• critical mass of researchers attracts overseas interest creating new opportunities for interaction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Universities and government research organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Many parts of a university can interact with a CRC;</td>
</tr>
<tr>
<td>• greater acceptance of applied research within a university;</td>
</tr>
<tr>
<td>• new knowledge and understanding more quickly introduced into courses;</td>
</tr>
<tr>
<td>• greater credibility in the eyes of local and overseas industry;</td>
</tr>
<tr>
<td>• strengthens the focus on areas of national importance rather than international research fashions;</td>
</tr>
<tr>
<td>• attracts high quality post-graduates and enhances opportunities for post-graduate students;</td>
</tr>
<tr>
<td>• access to national research programs;</td>
</tr>
<tr>
<td>• enables a long term and coherent relationship with industry, not chasing small contracts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>• with a better awareness of user needs;</td>
</tr>
<tr>
<td>• experienced in user-oriented research;</td>
</tr>
<tr>
<td>• enhanced career prospects;</td>
</tr>
<tr>
<td>• focussed post-graduate training in areas of priority for industry.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• more ‘user friendly’ access to university and government facilities and background IP;</td>
</tr>
<tr>
<td>• assists the awareness and evaluation of alternative ideas and techniques and potential technologies;</td>
</tr>
<tr>
<td>• leverages the company R&amp;D effort and improves its quality, which is important for companies competing in global markets;</td>
</tr>
<tr>
<td>• risk sharing based on the leveraging of overall CRC funds provides co-investment in pre-competitive research;</td>
</tr>
<tr>
<td>• stimulates increased corporate funding of long term R&amp;D;</td>
</tr>
<tr>
<td>• can develop collaboration and relationships along and across the value chain;</td>
</tr>
<tr>
<td>• Industry priorities are more important to the CRC than to a large research provider.</td>
</tr>
</tbody>
</table>

*Source: Mercer and Stocker, 1998, p.28*

As a ‘linkage-based’ programme, the CRC programme is only as strong as its link points. Problem areas which have been identified include:

- effective mechanisms for the participation of small and medium sized enterprises (SMEs). SMEs find it difficult to commit to long-term alliances, and often lack the skills and experience for working with large partners;

- gaps in the national innovation system, either in terms of research capabilities, or because of the lack of strong local industry players in a sector;

- industry participants have not been in the driving seat, in most cases, in shaping what were intended to be ‘user-driven’ consortia; and

- the difficulty of establishing and leveraging international linkages.

Programme benefits
There are significant lead times involved between the establishment of a CRC and the delivery of measurable economic impacts. These lead times may be between five to ten years:

*The majority of benefits from past investment is still to be delivered*.¹⁰⁴

This is a salutary reminder that innovation and structural change is a long-run exercise, at odds with the demands of short-run political cycles. This creates a policy dilemma: to maintain effort and momentum over the long-term requires a level of programme institutionalisation that protects programmes from the short-term vagaries of political cycles; on the other hand too great a degree of quarantining from scrutiny will render programmes resistant to healthy feed-back mechanisms. In the case of the CRC programme, the monitoring and review processes for individual CRCs provide a robust framework for ensuring a CRC remains ‘on track’ for the delivery of outcomes. It is more difficult to form judgements at the overall programme level: for example, should the overall investment be twice as big, or half the size?

The most recent study of the economic benefits of the CRC programme examined the various channels by which investment returns could be secured¹⁰⁵. These were identified as:

1. **The application of CRC generated knowledge/intellectual property.**
   This includes specific benefit channels such as:
   - benefits through commercialisation of new or improved products or processes based on CRC R&D via spin-off companies or licensing of IP to existing companies; and
   - economic, environmental, health and social benefits through the application by industry or public sector end users (including capital and operating cost savings delivered in the public sector) of new or improved products or processes enabled by CRC generated IP.

2. **Access to international knowledge networks.**
   This includes specific benefit channels such as:
   - international researchers coming to work in Australia on CRC research projects, bringing with them valuable skills, where the cost of the skills development has been borne overseas;
   - participation by CRCs in international technical standards setting bodies that results in technical standards suited to Australian market needs;

¹⁰⁴ Network Insight, *op cit.*, p. 1
• Australia in effect ‘buying’ access to the total value of the research being conducted within international research partnerships in which CRC researchers participate; and
• international industry partnerships or trade relationships that have been facilitated by CRC researchers participating in international projects or conferences.

3. **Enhanced skills formation.**

This includes specific benefits such as:

• benefits through the development of highly skilled post-graduates that build a critical mass of skills in a region that either attracts multinational companies to invest in the location or helps retain existing business activity levels;
• benefits through the development of highly skilled post-graduates who then work in industry and allow industry to be smart adopters and adapters of internationally generated technology/knowledge; and
• benefits through industry and academic researchers interacting and increasing their skills, and hence their future productivity, via this interaction. Collaboration across sectors and disciplines encourages researchers to develop understanding of both research provider and end user perspectives, maintaining focus on the active planning for and management of pathways to application.

It is recognised that not all these possible areas of impact can be assessed and quantified as clearly as might be liked. In addition, and most importantly, the ‘impact profile’ can be expected to vary significantly across the different categories of CRC. The long-run impacts in terms of competitiveness and trade are even more difficult to assess except at the micro level of individual CRCs and their host industry sectors. There has been, therefore, a tendency to focus on individual case studies, but these are hard to aggregate into broad generalisations in any meaningful terms.

Nonetheless the 2006 Network Insight study pursued some macroeconomic modelling which claims to show significant net economic benefits from the CRC programme. Whilst any such modelling is fraught with methodological challenges, the work does appear to suggest economic ‘additionality’ from the programme\(^{106}\).

**Challenges and lessons**

This CRC case study reinforces the desirability of maintaining clarity around programme rationales over time. The CRC programme also highlights the need for appropriate timeframes for the assessment of outcomes. Results from such a programme are long term. This, however, raises an issue with adaptability to changes in the background environment: to industry changes and to changes in other areas of the national innovation system and how the CRC programme sits alongside other programmes for industry development. For example, since the establishment of the CRC programme there have been major changes in the operation of agencies like CSIRO, and the role of its mission oriented national ‘flagship’ programmes in shaping new collaborations with industry. In addition the complementary ARC Linkage grant programme offers a more flexible and dynamic alternative to CRCs. Unlike the ARC scheme, the CRC model has high entry and exit barriers for participants and this makes it difficult for SMEs to participate effectively. Few SMEs can confidently make long term, seven year, funding commitments and most SMEs are unskilled in complex governance arrangements.

One of the strengths of the CRC programme over time has been its diversity in supporting a broad portfolio of activity. There has, however, been a countervailing tendency to the imposition of a uniform framework for the scheme, at odds with the different circumstances and industry structures in the various sectors of the economy. It is important to recognise

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\(^{106}\) Op.cit
that there is no ‘one size fits all model’ and that it may be desirable to differentiate between distinct types of CRC, along the lines of the taxonomy suggested by the Mercer and Stocker Review.

An early review noted that:

*Commonwealth core funding encourages collaboration in a CRC and forms the glue that unites the participants*107.

This however raises the question of how the new partnerships and alliances might migrate to a more self-sustained partnership model, less dependent on recurrent funding. The trend towards repeated re-funding of established CRCs suggests that some of these CRCs might best be viewed as permanent industrial research institutes, and funded and managed on a different basis.

There is also a challenge about striking the right balance between research, training and commercialisation. The funding model for CRCs leaves little available for the early stage commercialisation of programme outcomes. This means that large corporate partners can appropriate disproportionate benefit because they often represent the only path to market. Where there is not a strong industry base in Australia, CRCs frequently end up alienating intellectual property at a very early stage for want of commercialisation funds. The lack of a robust framework for commercialisation limits the ability of CRCs to become self-sustaining. If, however, the policy focus of the CRC scheme emphasises the building of research and industry capability, then the issue of commercialisation becomes less important. This tension highlights the importance of policy clarity about objectives, and the danger of institutionalising internal conflicts within the operation of a programme.

Finally, there may be fatal flaws in the core assumptions underpinning the scheme. The basic rationale of the programme is that CRCs strengthen public and private sector linkages through the encouragement of ‘user-led’ consortia. This implies that industrial problem-sets will motivate the marshalling of relevant university and public sector research capabilities. This is a classic ‘contract research’ model of user-driven research. In practice, however, few CRCs have arisen from private sector champions. In most cases universities – seeing the scope for additional flows of government funds – second-guess industrial problems that might attract private sector partners, and then actively market CRC ‘bid propositions’ to potential partners. To the extent that this occurs, the core objectives of the programme may be compromised, and it might be argued that these objectives could be realised better and more appropriately through other mechanisms.

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107 Mercer and Stocker, *op cit.*, p. vii
Annex: CRC selection criteria for 2006 round

<table>
<thead>
<tr>
<th>Selection criteria 1 — Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Scale (quantity and value) of the outcomes’ contribution to Australia’s industrial, commercial and economic growth including, but not limited to:</td>
</tr>
<tr>
<td>– additional economic activity either nationally or for a region(s) within Australia</td>
</tr>
<tr>
<td>– improved competitiveness or productivity of business, eg through improvements in product and service quality, cost savings, reductions in inputs or increased outputs</td>
</tr>
<tr>
<td>– new and improved goods and services and technologies</td>
</tr>
<tr>
<td>– creation of new jobs</td>
</tr>
<tr>
<td>– increased exports or development of import replacements</td>
</tr>
<tr>
<td>– creating new or assisting emerging industries</td>
</tr>
<tr>
<td>– improved capability (including education and skills development) in firms/industry sectors to identify, adopt and adapt technologies.</td>
</tr>
<tr>
<td>• Robustness of the estimation of the scale of the outcomes.</td>
</tr>
<tr>
<td>• Extent of the contribution of outcomes to relevant NRP Goals. Applications that can demonstrate a substantial contribution will be ranked more highly than those that demonstrate little or no contribution.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selection criteria 2 — Path to adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Robustness of the assessment of market or other end-use opportunities.</td>
</tr>
<tr>
<td>• Quality of planning and resourcing (including use of external expertise) for commercialisation and/or utilisation (including technology transfer) strategies and communication activities.</td>
</tr>
<tr>
<td>• Adequacy of the intellectual property management arrangements.</td>
</tr>
<tr>
<td>• Strength of commitments by end-users (including through international collaborations).</td>
</tr>
<tr>
<td>• Strategies to engage additional end-users during the life of the CRC.</td>
</tr>
<tr>
<td>• Strategies to reinvest some of the returns from commercialisation of IP in CRC’s activities.</td>
</tr>
<tr>
<td>• Approach for engaging small to medium sized enterprises (SME) end-users in the CRC.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selection criteria 3 — Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
</tr>
<tr>
<td>• Innovativeness and achievability of the research.</td>
</tr>
<tr>
<td>• Coherence of research programme including balance between the longer- and shorter-term projects.</td>
</tr>
<tr>
<td>• Strength and integration of international linkages.</td>
</tr>
<tr>
<td>• Time commitment and quality of the key individual researchers.</td>
</tr>
<tr>
<td>Adoption</td>
</tr>
<tr>
<td>• Quality of staff and industry participants involved in the commercialisation/utilisation of CRC outputs.</td>
</tr>
<tr>
<td>Governance</td>
</tr>
<tr>
<td>• Effectiveness of the collaborative arrangements and the structure and effectiveness of management and governance arrangements. Applicants are expected to become incorporated entities unless a compelling case can be made for alternative structures.</td>
</tr>
<tr>
<td>Education and Training (Skills development)</td>
</tr>
<tr>
<td>• Extent and quality of end-user focus in education and training, including industry PhD supervision.</td>
</tr>
<tr>
<td>Benefits of Collaboration</td>
</tr>
<tr>
<td>• Strategies to maintain the benefits of a CRC collaboration and for the closure or continuation of the CRC after Commonwealth funding has ended.</td>
</tr>
</tbody>
</table>

For ‘new from existing’ applicants track record including assessment of the economic impact of outcomes; key commercialisation or utilisation outcomes; key achievements of research and education programs; effectiveness of the collaboration (including in maintaining or enhancing participant involvement and contributions); and effectiveness of governance and management arrangements.

<table>
<thead>
<tr>
<th>Selection criteria 4 — Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Return on the investment through increases in Australia’s industrial, commercial and economic growth, including the value of the proposed outcomes relative to the costs.</td>
</tr>
<tr>
<td>• Appropriateness of the budget and the resource allocations.</td>
</tr>
<tr>
<td>• Any strategies for obtaining additional contributions over the funding period.</td>
</tr>
</tbody>
</table>

Source: Department of Education, Science and Training, 2006
Annex: CRCs operating in 2005-06

Manufacturing technology
• CRC for Advanced Composite Structures
• CRC for Bioproducts
• CAST CRC
• CRC for Advanced Automotive Technology
• CRC for Construction Innovation
• CRC for Functional Communication Surfaces
• CRC for Wood Innovations
• CRC for Intelligent Manufacturing Systems and Technologies
• CRC for MicroTechnology
• CRC for Polymers
• CRC for Railway Engineering and Technologies
• CRC for Welded Structures

Information and communication technology
• Australian Photonics CRC
• Australian Telecommunications CRC
• CRC for Enterprise Distributed Systems Technology
• CRC for Satellite Systems
• CRC for Sensor Signal and Information Processing
• CRC for Smart Internet Technology
• CRC for Spatial Information
• Capital Markets CRC
• Australasian CRC for Interaction Design
• CRC for Integrated Engineering Asset Management

Mining and energy
• Parker CRC for Integrated Hydrometallurgy Solutions
• CRC for Clean Power from Lignite
• CRC for Coal in Sustainable Development
• CRC for Landscape Environments and Mineral Exploration
• CRC for Predictive Mineral Discovery
• CRC for Sustainable Resource Processing
• CRC for Greenhouse Gas Technologies
• CRC Mining

Medical science and technology
• CRC for Aboriginal Health
• CRC for Asthma and Airways

Agriculture and rural-based manufacturing
• Cotton Catchment Communities CRC
• Australian Sheep Industry CRC
• CRC for Beef Genetic Technologies
• CRC for Innovative Dairy Products
• Molecular Plant Breeding CRC
• CRC for Sustainable Aquaculture of Finfish
• CRC for Forestry
• CRC for National Plant Biosecurity
• CRC for Tropical Plant Protection
• CRC for Value Added Wheat
• CRC for Viticulture
• Australian Biosecurity CRC for Emerging Infectious Disease
• CRC for Australian Poultry Industries
• CRC for Innovative Grain Food Products
• CRC for Sugar Industry Innovation through Biotechnology
• CRC for an Internationally Competitive Pork Industry

Environment
• CRC for Australian Weed Management
• Invasive Animals CRC
• CRC for Catchment Hydrology
• CRC for Coastal Zone, Estuary and Waterway Management
• CRC for Water Quality and Treatment
• CRC for The Great Barrier Reef World Heritage Area
• CRC for Greenhouse Accounting
• CRC for Plant-based Management of Dryland Salinity
• CRC for Sustainable Tourism
• CRC for Tropical Rainforest Ecology and Management
- CRC for Tropical Savannas Management
- Environmental Biotechnology CRC
- eWater CRC
- Desert Knowledge CRC
- Bushfire CRC
- CRC for Irrigation Futures
- CRC for Antarctic Climate & Ecosystems
- CRC for Contamination Assessment and Remediation of the Environment
- CRC for Chronic Inflammatory Diseases
- CRC for Cochlear Implant and Hearing Aid Innovation
- CRC for Diagnostics
- The Vision CRC
- CRC for Vaccine Technology
- CRC for Oral Health Science
- CRC for Biomedical Imaging Development

Source: Department of Education, Science and Training, 2006
4.6 The R&D Tax Concession

The R&D Tax Concession is an iconic programme in Australia, and it is a classic example of a generic, entitlement model of industry assistance scheme. It is the largest single innovation outlay by the government.

The Australian tax concession is a volume-based scheme where firms can claim all eligible R&D expenditure. Canada and the UK have similar schemes. Alternative models in the US and Ireland provide a concession above a nominated base threshold.

The overall rationale for a concessional scheme has been described recently in the following terms:

In a functioning free market, firms invest in less research and development (R&D) than is optimal for the economy. Firms only invest in R&D to assist their bottom line, not to benefit others. However, many firms can use the same knowledge that spills over from other’s R&D without reducing its value. As a result, many nations provide incentives, including tax concessions or credits, to encourage firms to invest closer to optimum levels of R&D.

Australia’s concessional scheme has been through numerous perturbations over the years. It is instructive to chart this history. The interface between the private and public sectors under this scheme has been characterised by:

- legal and probity barriers to close engagement between the parties;
- a lack of demonstrable linkages between R&D inputs and economic outputs such as exports; and
- a strong and self-interested role by third parties and agents.

As such it provides an instructive case study of how institutional parameters can both shape and constrain programmes for industry development.

The initial policy dynamics and policy evolution.

In the mid 1980s the then Labor Government was increasingly concerned with the low level of business expenditure on R&D (BERD) compared with other OECD countries. This threw into question the likely competitiveness of the manufacturing sector in the wake of the floating of the Australian dollar, and GATT commitments to the progressive reduction of tariffs barriers. Australia, at that time, largely remained a domestically focused economy.

In 1985, therefore, the government announced the introduction of a five year 150% tax concession for industry R&D. The legislation introduced the following year established a new statutory agency to administer the tax concession, and related programmes, the Industry Research and Development Board. The second reading speech in Parliament noted that:

“The specific objectives of the proposed tax concession are:

- to provide an incentive for greater levels of R&D in Australia;
- to concentrate new R&D efforts in industry by greater business investment in, and responsibility for, R&D;
- to provide positive support for R&D activities in industry, on the basis that significant benefits accrue both to industry and to the wider community through enhanced competitiveness of industry;”

Disclosure: the author was Chairman of the IR&D Board from 1996 to 1998.


Industry Research and Development Act, 1986. The IR&D Board has just been restyled as the Innovation Australia Board.
• to provide mechanisms for encouraging effective use of Australia’s existing R&D expertise; and
• to encourage a capacity in industry to be aware of, and exploit, technological developments occurring in other countries.

These objectives are part of a broader set of objectives which seek to encourage, through the Government’s industry and technology policies, the development in Australia of internationally competitive, export oriented, innovative industries.¹¹¹

Some of these stated objectives do not bear close scrutiny. For example, many factors influence competitiveness, most notably the application of the R&D as innovation within a marketplace. The last two objectives raise the very important issue of the absorptive capacity of firms; there is no doubt that in-house, technology-literate human resources are a key prerequisite for a firm’s ability to deploy technological advances. However, there are wider obstacles to technology absorption by Australian firms which in-house R&D alone cannot fix. A further and more systemic challenge is the ability of firms to respond to technology developments outside the firm’s current development trajectory or core expertise.

The Act established novelty and technical risk as the defining tests for eligibility.

Research and development activities are defined as activities of a systematic, investigative or experimental nature, involving innovation or technical risk undertaken for the purpose of acquiring new knowledge or for creating new or improved materials, products, processes or services.¹¹²

Activities related to marketing, quality control or prototyping are explicitly excluded.

The Act, by specifically excluding activities related to the commercialisation of eligible R&D, has instituted a fundamental bottleneck point for early stage firms and SMEs. This has continued to plague R&D focussed incentive schemes (including Co-operative Research Centres). People talk about the one in ten rule: you need to spend $10 on business development and marketing for every $1 of R&D. For smaller firms in particular, the standalone policy focus on R&D creates a structural disconnect between R&D, commercialisation and export development.

The current statement of objectives for the R&D Tax Concession is prefaced with the statement that sets a high bar for evaluating the programme. The IR&D Board currently states:

Through the R&D Tax Concession, the Australian Government aims to achieve its broader objective of developing internationally competitive, export oriented and innovative industries in Australia by:

• encouraging the development by eligible companies of innovative products, processes and services;
• increasing the R&D intensity of Australian companies;
• promoting strategic R&D planning for technological advancement through a focus on innovation and high technical risk in defined R&D activities;
• creating an environment conducive to increased commercialisation of new product and process technologies developed by eligible companies; and

¹¹² House of Representatives, Second Reading Speech
• supporting innovative small companies in tax loss by enabling them to obtain immediate benefit through the Tax Concession\textsuperscript{113}.

Within a business context, this statement still reinforces the technology-push view of innovation, focuses on technology driven innovation, and leaves R&D plans uncoupled from a firm’s strategic business plan. It leaves unaddressed the chasm between R&D inputs and their exploitation off the back of business development capability and export development plans. There is no longer reference to R&D assistance being promoted within the context of a suite of complementary and mutually reinforcing programmes to ensure firm and industry competitiveness within a global economy.

The underlying risk with the language around the Tax Concession and related generic support programmes is that it reifies the assumption that R&D is a good thing for firms in its own right, and the more we have the better - or at least we need to have as much as other OECD countries. Thus much of the debate around the Tax Concession has been tightly linked to the challenge to raise business expenditure on R&D (the famous BERD index of business expenditure as a percentage of GDP) to at least average OECD levels.

In 1989 the 150\% tax concession scheme was expanded to allow Syndication. In essence this scheme was to “encourage investment in R&D projects which were too big or too risky to be advanced solely by those with ability to directly use the results”\textsuperscript{114}. It made eligible projects that were carried out by a group of companies. Concerns about possible abuses of syndication lead to the scheme being dropped in 1996, with the full support of the IR&D Board of the time. Some key programme design lessons from the Syndication scheme are examined in a separate, short case study.

In 1996 an incoming government reduced the Tax Concession from 150\% to 125\%, at the same time as progressive lowering of the corporate taxation rate was steadily reducing the incentive value of the Concession. This was a highly unpopular move. Subsequently, in 2001, the government re-jigged the scheme in what continues to be its current form.

\textsuperscript{113} Annual Report, 2005-06, p. 23
\textsuperscript{114} Australian Taxation Office, Research and Development (R&D) syndication arrangements, Canberra, 6 September 2004
Structure and scope
There are currently three components to what AusIndustry describes as ‘the product’:

(i) a 125% concessional deduction on eligible R&D expenditure.
(ii) a 175% Premium concession for incremental activity; and
(iii) a R&D Tax offset for eligible SMEs.

The inter-relationship between the different components is illustrated in the following schematic.

THE COMPONENTS OF THE TAX CONCESSION

The R&D Tax concession is administered jointly by the IR&D Board in the Department of Industry, and the Australian Taxation Office.

The programme is available to companies for R&D carried out within Australia. Companies must register with AusIndustry, and lodge their claims within ten months of the assessable tax year. Since 2002, as part of Registration, companies must lodge an R&D Plan consistent with Guidelines issued by the Department. Companies must effectively control the R&D activities, and own the results. Annual R&D expenditure must exceed $20,000 (originally $50,000) unless work has been contracted to a Registered Research Agency. Claims are lodged as part of the self assessment process for income tax lodgement, but may be subject to audit by the IR&D Board in respect of eligible activities or by the Tax Office in respect of eligible expenditure.

Eligible activities must pass the ‘SIE’ test of being ‘systematic, investigative and experimental’, involving novelty and high levels of risk. Market, research, prototyping, and patent administration are all part of a growing list of explicit exclusions. Computer software development – a vexed eligibility issue over many years – must be intended for ‘multiple’ external sales. Any grants or government benefits related to the research activities must be carved out.

There is a strong emphasis on the ‘Australianess’ of the research activity in the Guidelines – with a requirement for research labour to be Australian citizens and research plant to be sourced locally, unless local resources can be shown to be not available.

The 175% Premium concession
This programme aims to promote additional, incremental investment in R&D. The additional incentive is focussed on labour-related expenditure (not plant related expenditure). To be eligible, companies need to have been registering for and receiving the 125% concession for three years, or have been receiving grants for R&D projects. The base level of R&D is
established as the average level of expenditure over the previous three years. Eligible expenditure above this base entitles the firm to the additional concession.

The R&D Tax offset.
This scheme targets small companies with a group turnover of less than $5 million, and a tax credit of up to $1 million may be claimed. Unlike the concessional schemes, companies gain the offset off total expenditure up to the cap, rather than just the incremental 25% or 75% over general deductibility.

This scheme is especially targeted at early stage firms that have not yet achieved profitability. Firms may offset the concession against other tax liabilities, or ‘cash it out’ as a tax rebate. The tax offset, therefore, directly flows through to the working capital of the firm. The take up of the new Tax Offset scheme has been greater than predicted in 2001. The IR&D Board notes that the number of Tax Offset registrants has been almost double the initial forecasts\textsuperscript{115}. Tax offset claimants now represent two-fifths of all R&D Tax Concession beneficiaries.

There is a direct disincentive for firms to exceed the expenditure cap, as additional expenditure cannot be brought to account as future tax losses. The behavioural impact is illustrated dramatically in the following exhibit. Additional R&D expenditure cuts off precisely at the $1 million cap.

EFFECT OF TAX OFFSET ON SME R&D EXPENDITURE

Operations
The complex listing of eligible activities shows that, for most firms and especially large firms, the costing and accounting of eligible activity is going to involve the exercise of considerable judgement in allocations and cost apportionments. In other regimes that involve regulatory reliance on company charts of accounts, such as telecommunications regulation, there has been a widespread view that these have failed in their intent of producing pricing and costing transparency. There is, in my view, clearly scope for ‘accounting based’ research claims with schemes of this type. There has, of course, also been a growth industry in business services firms supplying specialist R&D administrative advice and support services.

A further issue is the cost of compliance and administration to the company. The cost to produce an annual R&D plan, and to maintain separate charts of accounts for eligible R&D

\textsuperscript{115} Productivity Commission Submission number 77, 17 August 2006
activity, will need to be weighed against the benefit. In the case of the 125% concession, many firms with relatively low R&D intensity may and do question the net benefit.

It needs to be reiterated that the current eligibility rules support a very narrow base of technology activities, and explicitly exclude activities key to the successful commercialisation of innovation. These include market and customer research, international collaborations, prototyping and trials and, importantly, design skills (which has become a key input in industries such as automotive). Many of these functions have become integral parts of research processes. An open question, therefore, is whether these exclusions limit or distort the underlying research capability, or whether these capabilities are addressed under other programmes.

In 2004/05 5830 firms registered for the Concession at a cost to government – through tax revenue foregone or tax rebates – of around $535m. The overall R&D expenditure of these businesses is estimated to be around $7.8b. As at June 2006, almost 6000 firms were registered (5,961, to be precise). Much of the growth since 2001 in the number of firms registering is accounted for by SMEs registering to gain access to the tax offset. If these are netted out, the underlying numbers are fairly static.

The Tax Concession represents about 73% of IR&D Board outlays. For financial year 2004/05 it involved 5830 firms, compared to 914 companies who are the beneficiaries of other IR&D programmes – mainly grant schemes.

**Governance**

The R&D Tax Concession is administered by a Tax Committee of the IR&D Board. Whilst formally a Committee of the Board, it is constituted by the direct appointment of the Committee members by the government.

Whilst the Tax Concession is at the heart of the IR&D Board’s role and charter, there is remarkably little on the public record about its operation. Litigation, the privacy blanket over taxation affairs, and controversies over the scheme’s operations have all combined to limit the transparency of the scheme. The public relies on the IR&D Board, and its Tax Concession Committee, for assurance about the integrity of the programme. It is arguable, however, that there could be much greater disclosure in the public interest.

Many of the policy changes introduced from time to time by government are implemented through subsidiary regulatory instruments formulated by the Board. Decisions of the Board and the Tax Committee are subject to review by tribunals or the courts.

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116 Note that some discrepancies may arise between amounts recorded in the registration details provided to the IR&D Board, and the separate claims lodged with the Australian Taxation Office.

117 IR&D Board, *Annual Report 2005-06*
Consultative processes and the promotion of the scheme need to be conducted at a generic level because of the probity issues around firm specific interfaces arising from the legal parameters around a tax-based regime. This, and the complexity of compliance has encouraged the growth of third party intermediaries – accounting houses and specialist consultants with a financial stake in the maintenance of the scheme, and its complexity. In terms of public and private sector relationships around industry development, this type of tax based scheme leads to accounting interfaces rather than any strategic business interfaces.

Programme evaluation and impact

Many countries operate similar tax concession schemes. Comparisons with these overseas schemes, however, have rarely been highlighted in the debates over the tax concession in Australia. Quantitative comparative assessments are difficult in the absence of public data.\(^\text{118}\)

Two basic questions arise in examining the impact and value of a generic taxation based incentive scheme. The first is the difficulty of establishing a clear causal relationship between firm R&D inputs subsidised through the scheme, and economic outcomes in terms of competitiveness and exports. The second is in assessing the extent of additional R&D activity induced by the incentives.

What does appear unarguable is that there does appear to be a close correlation between the Tax Concession, and variations to it, and the level of BERD in Australia. Since the scheme was introduced business investment in R&D has increased from around 0.3% in 1985 to 0.95% twenty years later in 2004/5.

PROGRAMME IMPACT ON BERD

The first caution is to note that BERD had begun to rise modestly before the Tax Concession was introduced. The question therefore is how much of the subsequent growth was driven by the internationalisation of the Australian economy in the 1980s, or induced by the tax incentive. There does, however, appear to be a direct correlation between the end of Syndication, and a reduction in the Tax Concession in 1996, and the rapid drop in BERD that followed. This does not, of course, imply causation. An alternative explanation is that the

\(^{118}\) A recent review of taxation provides a useful summary; see R. Warburton and P. Hendy, *International Comparison of Australia’s Taxes*, Commonwealth of Australia, 3 April 2006
‘internet revolution’ of the second half of the 1990s and the lead up to the Y2K challenge shifted business investment towards ICT platforms and greater services innovation.

A related point of evidence supporting the contrast between pre 1996 and post 1996 trend lines lies in the changing value of the concession to firms. Any tax concession cannot be examined independently of the overall regime for corporate taxation. Falls in the rate of corporate tax over the period since 1985 have reduced the effective value of the R&D concession by a factor of 3. As the following table shows, the concession would need to be raised to over 175% to regain its original direct incentive value. Treasury, however, would argue that this line of argument ignores the direct benefit to firm profitability from reduced taxation and argue that it is a matter for firms to determine how best to use these funds.

### IMPACT OF CORPORATE TAX RATE ON VALUE OF INCENTIVE

<table>
<thead>
<tr>
<th>Financial Year(s)</th>
<th>Tax rate (%)</th>
<th>Incentive Rate (%)</th>
<th>After Tax Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>87/88</td>
<td>49</td>
<td>150 %</td>
<td>24.5</td>
</tr>
<tr>
<td>88/89 to 92/93</td>
<td>39</td>
<td>150 %</td>
<td>19.5</td>
</tr>
<tr>
<td>93/94 to 94/95</td>
<td>33</td>
<td>150 %</td>
<td>16.5</td>
</tr>
<tr>
<td>95/96 to Aug 96</td>
<td>36</td>
<td>150 %</td>
<td>18.0</td>
</tr>
<tr>
<td>96/97 to July 2001</td>
<td>36</td>
<td>125 %</td>
<td>9.0</td>
</tr>
<tr>
<td>Current</td>
<td>30</td>
<td>125 %</td>
<td>7.5</td>
</tr>
<tr>
<td>Possible Future</td>
<td>30</td>
<td>175%</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Source: Victorian Innovation Economy Advisory Board, 2006

The use of terminology around a 125%, 150% or 175% concession is actually misleading – we should more properly talk about a 25%, 50% or 75% special concession because all firms can claim a full write off of all R&D expenditure. It is only around the additional concession that special rules apply about eligibility.

A tax concession is only effective if firms are operating profitably. Many R&D intensive early stage firms do not. This is the rationale for tax rebate schemes for SMEs. Unlike the tax concession, the rebate scheme rewards the firm with the full offset for all R&D expenditure, not just the increment above the 100% deductible amount. In registering for the scheme, the firm foregoes the benefit of future tax losses for immediate working capital. However, as all tax schemes are retrospective – that is, they are based on activity already carried out – the firm needs to be able to fund the R&D in the first place. This has been the rationale for complementary grant or loan schemes for SMEs.

The impact of a concession scheme is significantly shaped by the definition of eligible activities. Eligibility rules potentially run into several problems. First, in the attempt to limit the scope for abuse and the re-badging of miscellaneous activity as R&D, tightly defined R&D may introduce an artificial hurdle to downstream activities necessary to exploit the core technology R&D and its marketing. This abstracts the R&D from the overall innovation system of the firm, and its export development.

Concessional schemes expose governments to a potentially uncapped liability in revenue foregone. This causes particular hazards in costing variations to a scheme. Forward estimates can be informed by history and experience, and can be made somewhat more predictable by the programme elements that can be controlled, that is:

- eligibility rules, both covering the type of firm that many participate – local, grouped, or foreign – or the eligible activities;
• threshold tests and caps. Threshold test may relate to size of firm, turnover, or the level of R&D intensity; or
• “controls on double dipping”, and limitations on the ability of a firm to leverage other government assistance to maximise concessional benefits.

What is less controllable is the impact of global industry trends and the economic climate on patterns of firm investment in R&D. It has been widely observed that R&D expenditure levels are highly volatile across years. In addition, the nature of innovation activity, market and trade conditions, and industry structure varies hugely across industry sectors. Eligibility rules will tend to skew the attractiveness of the concession differentially across the economy. Finally, the availability and attractiveness of complementary and industry specific assistance schemes will affect the take up of the generic tax concession.

In recent years there have been several official reviews of the R&D Tax Concession.

In the case of a 2003 review, the commissioned assessment is not in the public domain. Instead, there is a three paragraph summary on the AusIndustry website which notes, inter alia, that:

• about 30% of firms which responded to the survey indicated that their R&D built on R&D developments in other industries, and about a third of firms obtained access to R&D by buying the IP; and
• on average, firms expect that a typical year’s R&D will contribute substantially to sales and profits five years after it is conducted.

AusIndustry reports that 93% of Tax Concession recipients were satisfied with the operation of the scheme, and the 2003 review did not recommend any changes to the programme.

In 2007 the government released a further review of the changes to the Concession introduced in 2001\textsuperscript{119}. This evaluation, also, was mainly based on qualitative consultations with scheme beneficiaries, including “accountants, consultants and industry associations”. The evaluation\textsuperscript{120} did not examine:

• the additional value generated for the rest of the economy from spill overs of the knowledge generated by R&D undertaken through the new elements
• the value of the R&D to the firms concerned
• any additional behavioural benefits attributable to the program
• the R&D activities claimed by firms.

Nonetheless, the evaluation concluded that Australia appears to be pursuing best practice in:

• evaluations (frequency, methodologies and identification of spill overs)
• use of a registration process and risk assessment models
• availability and analysis of data, including numbers of firms using the Concession and investment in R&D by those claiming the Concession
• ongoing assessment of performance against policy objectives.

All this is in contrast to the findings of the recent Productivity Commission review. The draft findings in November 2006 recommended that:

The R&D tax concession could be improved by:

• Shifting the orientation of the concession towards its 175 per cent incremental component;

\textsuperscript{120} ibid., p.8
• Relaxing the beneficial ownership requirement and the expenditure and turnover thresholds for the tax offset for the incremental scheme alone;
• Changing the base on which the incremental subsidy is paid to a firm’s ratio of R&D to sales at a given, fixed date; and
• Allowing access to the incremental scheme to start-up firms121.

Despite vigorous counterclaims, the Commission has stood its ground and in its final report included the following findings:

FINDING 10.2
The extent to which the basic R&D tax concession stimulates additional R&D is low, particularly for large firms.
FINDING 10.7
The base on which the incremental subsidy is paid should be changed to a firm’s ratio of R&D-to-sales at a given, fixed date.
FINDING 10.1
The definition of R&D … should be reviewed and, if practicable, amended to focus on activity that is more likely to involve high levels of spillovers. That definition alone should be uniformly applied to meet all corporate reporting requirements to reduce the complexity associated with current arrangements.
FINDING 10.4
The design of current expenditure and turnover limits for eligibility to the tax offset create perverse incentives against undertaking R&D above a certain amount. The design of the threshold arrangements should be amended.

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121 Productivity Commission, Draft Report, November 2006, p. xxxvii
Issue: BERD and R&D Targets

Almost all OECD countries have adopted high level targets for science and innovation policy, and figures for business expenditure on R&D (BERD) are zealously monitored. The European Union has set an R&D intensity target of 3% of GDP by 2010, comprising a 1% public R&D spending target and a 2% BERD spending target. In 2004-05 Australia’s BERD was 0.95%, considerably below the OECD average of around 1.5%. Australia’s government expenditure on R&D is higher, at 1.65% of GDP but this is still below the OECD average of 2.2%.

BERD: OECD COUNTRIES

European OECD countries, driven by the European Union’s approach to common policy frameworks within the Union, have set aspirational targets. To match these levels Australia would have to at least double its current performance. There are several possible challenges to this way of thinking. First, as Professor Alan Hughes from Cambridge pointed out in a landmark speech in Melbourne in December 2006, only Australia and the world’s largest R&D players - the US and Japan- have not set R&D targets, and he argues this is a good thing. Second, the emerging innovation challenge is not coming from OECD countries: it is coming from countries like China, India, and Brazil. To benchmark against OECD countries, therefore, is to look the wrong way. Third, percentage targets based on cross-country comparisons ignore the question of scale and the tyranny of absolute numbers. Many, myself included, would argue that strategies designed to leverage sustainable sources of competitive Australian R&D into downstream market outcomes might be a better overall policy strategy and ambition. The test question is whether Australia could gain more impact from putting additional funds into providing incentives for business R&D, or into under-funded areas of the innovation system like technology diffusion and take up, and turning areas of clear R&D leadership into export market outcomes. Single point OECD comparators ignore the interdependencies and path dependencies within individual national innovation systems.

122 Common comparisons of Australia with smaller European countries ignore this distinctive EU context shaping the articulation of policy frameworks.


124 The Productivity Commission’s recent Inquiry contains some perverse comment on the relationship of technology supply and demand within the context of domestic industry structure: “In the Commission’s view the structure of the Australian economy should be seen as an important factor shaping the demand-side of the commercialisation ledger rather than a constraint per se. While there may not always be strong local demand for the knowledge and technology generated by research organisations, the community can still benefit from the sale and licensing of intellectual property to overseas buyers”. Draft Report, November 2006, p. 6.17
**Issue: Incentives and ‘additionality’**.

The question of additionality goes to the heart of the debate over tax concessions. That is, does the incentive encourage new levels of activity, and reward incremental effort, or simply subsidise activity which would have occurred anyway?

An alternative view is that, within a context where financial markets monitor and reward short term performance, government assistance to private R&D is subsidising firm growth through counterbalancing the effects of short-termism. In this view what we are dealing with is a market distortion within investment markets that does not reward or encourage long term investment in future growth. Commentators have noted that this is particularly perverse in the case of pension funds which should be natural vehicles for long run investments\(^{125}\).

The debate over additionality has fuelled a huge industry around econometric modelling, the complexity and arcane nature of which would make medieval theologians green with envy. What it has not promoted is an active discussion about sustainable firm business models, and the role of technology and innovation in building and sustaining competitiveness and an export orientation.

An alternative approach to avoiding subsiding investment that would be made anyway, and to increase the likelihood of net social benefit, is to use a volume threshold or some measure of the relative weighting given to R&D in the company’s overall operations. This is most frequently expressed as the ratio of R&D expenditure to turnover. The theory is that a very low R&D intensity can either represent an accounting artefact or is not likely to represent significant additional investment induced by a concessional incentive.

Proposals for establishing threshold tests for access to the Tax Concession based on R&D intensity, as measured by the ratio of R&D to turnover, have been around for a long time. In fact these were part of the measures proposed by the current Government in 2001, but withdrawn after industry resistance.

The opposition from firms is not surprising, as firms with an ‘accounting’ benefit will naturally object to losing any free ride. The bulk of the firms which would be affected by an intensity threshold are larger firms, including multinationals. However the demographic data on firms discussed earlier shows that that the largest investors in R&D by volume tend to maintain significant R&D intensity ratios over time. For firms with low intensity, or for the large cadre of firms which do not currently benefit from the concession, it is arguable that these firms might take a different attitude to programme changes ‘if reforms to the Tax Concession were seen as part of a larger innovation policy in which new offsetting and innovation related benefits were made available to the firms.

What underlies proposals around a R&D intensity metric is a growth theory of firms. The underlying assumption is the sales performance of a firm, and particularly its sustainability and growth over time, depends on reinvestment in factors such as R&D to maintain competitiveness, especially in global markets. As we have noted, in this context R&D stands as a narrow surrogate for firm investment in innovation more generally, and in an ideal world we would work on developing an ‘innovation intensity’ index. The Productivity Commission recently noted that:

> **Rebalancing the scheme toward the incremental component has the potential to significantly reduce the revenue forgone under current arrangements. This would provide scope to generally increase the concession rate for the premium component or perhaps introduce a tiered system with progressively higher subsidy rates depending on the extent of the increase in a firm’s R&D activity**\(^{126}\).

\(^{125}\) See Alan Kohler, in Cutler & Dodgson, *op cit*.
\(^{126}\) p.9, 21
The same arguments apply to proposals around R&D intensity thresholds.

Surprisingly, little of the debate about additionality starts out with a good look at why firms do R&D and consider innovation in the first place. A survey by AusIndustry in 2000 showed that, even allowing for the inherent bias of a survey about government assistance, the basic drivers of R&D – and innovation – will always be market driven. And the more firms are trade exposed, the more this will be the case.

**INFLUENCES ON R&D EXPENDITURE**

If we start with the hard realities of the firm, and not R&D of itself, what induces firms to innovate? What we find is that not only is innovation driven by the competitive struggle in the marketplace, but also that this marketplace – the arena of customers, suppliers, and competitors – is where the ideas and knowledge for innovation comes from. Numerous studies in Europe and the US match findings from Australia. In the case of Australia, remote from global customers and supply chains, the firm behaviours that need to be encouraged are to be outward looking and engaged with global industry networks. It is not a coincidence that the largest investors in R&D and innovation, by volume and intensity, are export oriented.

**KEY SOURCES OF IDEAS OR INFORMATION FOR INNOVATION IN AUSTRALIAN INNOVATING BUSINESS 2001-2003 (% COMPANIES)**

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128 See Alan Hughes, in Cutler and Dodgson, *op.cit.*
4.6.1 R&D Tax Syndication

The R&D Tax Syndication programme is a sorry case study of a deeply flawed scheme.

In 1989 the 150% tax concession scheme was expanded to allow Syndication. In essence this scheme was intended to “encourage investment in R&D projects which were too big or too risky to be advanced solely by those with ability to directly use the results”\(^\text{129}\). In itself, this was a worthy objective, in an area where there continues to be systemic market failure. The scheme made projects carried out by a group of companies eligible for the tax concession. To qualify for syndication status, projects had to exceed $500,000. In practice R&D Syndication often revolved around third party funding models for research, and risk shifting. It encouraged innovative financial engineering schemes, not dissimilar to the schemes which have developed around the special tax concessions for the film industry. The mechanics of the syndication arrangements were hugely complicated.

Concerns about possible abuses of syndication led to the scheme being dropped in 1996, with the full support of the IR&D Board of the day. This is also an example of how a change of government can act as a circuit breaker. (The previous government, which had introduced the scheme, would have found it much harder to change course. It also helped that there had earlier been an almost complete turnover and strengthening of IR&D Board membership, including the appointment of a very shrewd former Commissioner of Taxation to head the Board’s Tax Committee. Ironically, the new Chairman of the IR&D Board soon had to step aside because of what became a long running inquiry into a Syndicate he headed). By 1996 more than 235 syndicates had been formed. It is clear, in retrospect, that syndication was a major driver for the take up of the 150% concession. It is estimated that Syndication represented at least 30% of the outlays by 1995\(^\text{130}\). Government had little scope to undo existing syndicates, creating more than a ten year fiscal overhang before the established syndicates matured and were wound up.

The scheme also fuelled the growth of third party agents – banks, accounting firms and new specialist R&D consultants – with a direct stake in the operation and continuance of government schemes. These agents have become some of the loudest voices in debates over R&D policy.

There are important lessons to be learned from the flawed Syndication scheme. Few of these lessons are in the public domain because of the privacy rules around taxation affairs, and because of the litigation, and threats of litigation, which hovered around the scheme\(^\text{131}\). The inevitable outcome is a lack of transparency and diminished public accountability. This same issue arises with the growing use of ‘Public Private Partnerships’ for the ‘off balance sheet’ funding of state infrastructure projects.

The scheme’s objectives were not adequately defined. With hindsight, there was insufficient clarity about the nature of the problem to be solved for that intent to be translated into sustainable industry arrangements. Loose guidelines and a lack of expertise within the bureaucracy to understand the complex financing and corporate structures being proposed meant that the IR&D Board was forced into a reactive mode, trying to deal with problems after the event.

The incentives of participants were not well aligned. For firms the scheme provided access to patient capital to underpin longer term, high risk R&D investment. For public and not-for-profit R&D agencies, it was an opportunity to trade stranded tax benefits to third parties in exchange for access to new funding streams. For investors, the scheme provided an

\(^{129}\) Australian Taxation Office, *Research and Development (R&D) syndication arrangements*, Canberra, 6 September 2004

\(^{130}\) Productivity Commission, 2006, p. 9.18

\(^{131}\) The serving of writs on the Board members of a government agency is certainly calculated to test their mettle and commitment!
opportunity to access virtually risk-free returns. The investors had no incentive to support the commercialisation of any R&D outcomes, thus setting up the possibility that potentially useful intellectual property would be stranded.

The basic problem was that the driving forces behind the scheme shifted from firms and R&D agencies as the principals, to the financiers as the agents in the marketing of schemes. Over time the financial institutions became the main interface between the scheme and the government administrators.

In retrospect, it is clear that inadequate thought went into the initial design and implementation of the scheme. There was little attention to the ex ante examination of possible sources of abuse or of unintended consequences in the development of the scheme. This led to the promulgation of very inadequate administrative guidelines, and these later limited the legal powers of the IR&D Board to take remedial action. Inadequate response times to emerging problems with the scheme meant that registrations were rushed through by promoters in advance of amended guidelines.

The history of R&D Tax Syndication provides a sober reminder of the dangers of flawed policy making processes, and of the moral hazards which may arise when the interests of public and private sector actors are not aligned and mutually reinforcing.
4.7 Peak research funding agencies

The Australian Research Council and the National Health and Medical Research Council (NHMRC) are the peak government funding bodies for basic research in Australia. This places them, by and large, upstream from extensive industry interfaces. In the case of the NHMRC it is deeply embedded within Australia’s public health system and clinical practice. Linkages with the private sector, however, are not well developed except in niche areas around medical equipment. While the medical and health research institutes which are primarily funded by the NHMRC often participate in CRCs, there appears to be little focus on leveraging the embeddedness within the public health system into a strong focus on health services innovation. In the medical research domain the role of philanthropic funding alliances emerges as an interesting area for attention.

The National Health and Medical Research Council (NHMRC)

The National Health and Medical Research Council (NHMRC) was formally constituted in 1937, growing out of a precursor body, the Federal Health Council, established in 1926. The NHMRC combines responsibilities for public health, advice to government on health matters, and an expanding role as the main funding body for medical research. It sits alongside the Australian Research Council as one of the two peak funding bodies for the selective distribution and oversight of research funding streams and programmes.

Mandate

The National Health and Medical Research Council Act 1992 gives the Council the charter to:

- raise the standard of individual and public health throughout Australia;
- foster the development of consistent health standards between the various States and Territories;
- foster medical research and training and public health research and training throughout Australia; and
- foster consideration of ethical issues relating to health.

The resulting quadrilateral of biotechnology and medical research, clinical practice and trials, population health surveys, and health standards and policy combines to form a mutually reinforcing framework for evidence based public policy and provides direct paths for technology transfer to the health system.

One of Council’s distinctive features and strengths is that:

it brings together and draws upon the resources of all components of the health system, including governments, medical practitioners, nurses and allied health professionals, researchers, teaching and research institutions, public and private program managers, service administrators, community health organisations, social health researchers and consumers\(^\text{132}\).

Research and health services innovation is, therefore, firmly grounded in the practice of the sector. The Council’s policy and advisory functions support a strategic, forward-looking perspective that informs the focus and administration of its funding programmes, and vice versa. There are possibly two weaknesses arising from this level of embeddedness within the national health system. The first is the relatively undeveloped nature of international collaborations at an institutional level. The second is the development of cross-sectoral alliances to exploit technology convergence.

\(^{132}\) www.nhmrc.gov.au
The increasing cross-sectoral research drivers--whether animal genomics, nanotechnology or the ‘bio-economy’--pose the challenge of how best to develop new mechanisms for cross-sectoral collaborations and technology transfer. Another area of cross-sectoral challenge is the deployment of innovative solutions based on general purpose technologies like ICT within the sector. Advances in e-health have been slow and tortuous. Medical research and health systems provide a classic case study of the challenges within the emerging ‘open innovation’ environment.

**Structure and scope**

Sine 2006 the NHMRC has operated as an executive agency reporting directly to the Minister of Health and Aging. There is a well-established framework of expert committees, drawn from medical research institutes and the health sector. A new CEO was appointed in 2006, as part of a move to re-energise the Council which had become widely criticised as “arthritically conservative”.

**THE ORGANISATIONAL STRUCTURE OF THE NHMRC**

![Diagram of organisational structure]

All State and Territory health officers are represented on the Council, giving it a federal coordinating framework.

As at 2007-08, the NHMRC has 226 staff, not counting the numerous part-time external members of peer committees. Its budget appropriation in 2007-08 is $564 million. The significant increases in the NHMRC budget over the past decade reflect both increased government support for medical research (in part driven by an aging population), and the increased channelling of funds through the NHMRC as an agency for the administration of competitive grants (in lieu of the historical dominance of block funding to public institutions).

<table>
<thead>
<tr>
<th>Year</th>
<th>Appropriation $Million</th>
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<tr>
<td>1995-96</td>
<td>131.2</td>
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<tr>
<td>1996-97</td>
<td>139.1</td>
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<tr>
<td>2003-04</td>
<td>412.8</td>
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<tr>
<td>2004-05</td>
<td>414.6</td>
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</tbody>
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*Source: Department of Health and Ageing, Annual Reports*

In 2005-06, research funding was distributed as follows:\textsuperscript{134}:

- Basic research – 49%
- Clinical medicine and science – 28%
- Public health – 13%
- Preventative medicine – 5%

\textbf{Operations}

The NHMRC provides funding under three main categories – researcher support (24%), infrastructure support (11%) and research project support (65\%).\textsuperscript{135}

There is currently a strong focus on making the Council more ‘strategic’ in its operations. This has lead to priorities and initiatives such as:

- increasing the number of highly skilled professional staff across a range of disciplines (and thus reducing the dependence on part-time Council and committee members from the sector);  
- introducing an intern system for practitioners from the field to be seconded to the organisation; and  
- allocating ‘seed funding’ for strategic initiatives and new programmes outside the established funding programmes\textsuperscript{136}.

The NHMRC explicitly looks to the models of the US National Institutes of Health (NIH) and the Canadian Institute of Health Research, particularly with respect to initiating mission oriented research programmes addressing major national or global challenges. This involves capturing community and industry input into defining the target and scope of new areas of research.

Traditionally the NHMRC funds have been allocated on the basis of competitive bids assessed by panels of sector peers. The CEO acknowledges that the merits of peer review mechanisms are often open to question:

\begin{quote}
Not everyone agrees that the systems are optimal, with some accusing the NHMRC of using the GOBSAT method (Good Old Boys Sat Around a Table method) …. Others have complained that whole areas have been excluded from support (especially new disciplines); transparency has been lacking (eg, in 2006, for a number of funding schemes, including project grants, applications were reviewed without giving applicants the opportunity to see and respond to reviewers’ comments); and, more generally, there has been a focus on process rather than outcome.
\end{quote}

Dr Warwick Anderson notes that none of Australia’s most recent Nobel winners in medicine have been funded by the NHMRC. Peer review funding processes are used in many sectors, including the IR&D Board, the Australian Research Council, and the Australia Council for the Arts. There has, however, been little cross-talk between them about lessons learned, or the development of ‘best practice’ with this mechanism for engaging industry communities of interest. In my direct experience, I have found industry peer assessment panels to be highly resistant to review and the consideration of process improvement.

The Council has traditionally seen itself as in the business of ‘public good’ research, but has recently begun to ask whether there is a role for it be more active in research commercialisation and sector innovation. This raises the vexed issue for public research and

\textsuperscript{134} NHMRC Submission (no 80) to Productivity Commission, 2006  
\textsuperscript{135} NHMRC, Annual Report 2005, Canberra.  
\textsuperscript{136} Warwick Anderson, “Working to build a healthy Australia: A new era for the NHMRC”, Medical Journal of Australia, Volume 185, December 2006, p. 623 ff. This short article is the best recent strategic overview of the challenges and priorities of the NHMRC.
funding bodies of how best to determine the optimal paths for maximising impact and national benefit. It is early days for the NHMRC in this debate.

**Governance**

The NHMRC is an example of a delegated policy framework, where a specialist agency is delegated the responsibility to make decisions about the best distribution of government funds. The challenge in such a model is achieving alignment between higher-level government and community priorities.

Reporting directing to the Minister, and having a mandate for formal policy and standard setting, makes for a tight linkage between policy thinking and research programme portfolio management. Bodies like NHMRC provide an institutional channel for the implementation and oversight of special government initiatives – such as the government’s funding of the Australian Stem Cell Centre as a special centre of excellence.

**Alliances**

Private sector involvement in the policies for and the programmes of the NHMRC is neither extensive nor influential. There are two reasons for this.

The first reason is the long-standing dominance of the public sector in health service delivery and medical research in Australia. This creates a culture where some private health practitioners with an interest in medical research in their particular fields of practice report finding it difficult to engage with traditional institutions and funding bodies. This disengagement with industry is reinforced by the research emphasis on basic, longer-term research.

The second reason is that areas dominated by the private sector – such as pharmaceuticals and medical devices and instruments – are often in an adversarial negotiating position with government and public health providers over the commercial supply of goods.

To help overcome some of these cultural barriers, the NHMRC has implemented research internship programmes, placing researchers within industry settings.

*Industry Fellowships are designed to support development work undertaken in a human health related field, for example, diagnostics, medical devices, pharmaceutical product development, biotechnology, bioinformatics, biomaterials, biostatistics, disease management systems, organic synthesis, fermentation technologies, manufacturing technologies, clinical trials, toxicology, etc.*

The most formal private public alliances occur outside the ambit of the NHMRC, in other programmes like the CRC programme and through general R&D funding, such as for medical device technology and instrumentation companies, or the special funding of biotechnology initiatives. There is increasing cross-over between sector specific and generic research schemes.

One feature which distinguishes the medical research sector is the alliance with philanthropy. Medical research in Australia receives more philanthropic funding than any other sector in Australia, and this is an important source of leverage to government base funding. Philanthropic funding does not always operate as an efficient market for matching new monies to the most promising projects, and the NHMRC CEO has recently floated the suggestion that bodies like the NHMRC could provide informed brokerage services for the

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137 This observation is based on personal interviews.
138 NHMRC, Industry Fellowships Funding Policy, 2007
best and most productive allocation of extra-mural funds\textsuperscript{139}. It is likely that such a suggestion would be fiercely resisted by individual institutions who jealously guard lines of privileged access to such funding.

Several major medical and biotechnology projects in Australia have recently been underwritten by overseas philanthropic foundations. In some cases philanthropic grants have been made conditional on matching funds from government. There are circumstances where this could create moral hazards for government.

Globally, the impact of bodies like the Gates Foundation will increasingly, it would seem, raise issues about alliances and relationships akin to discussions about the role of international agencies in aid and development funding.

**Challenges and Learnings**
Periodic reviews and performance assessments have not typically been built into the NHMRC’s internal processes, so that change has usually been externally imposed – which raises risks about sustained institutional performance. This is in contrast to the CSIRO’s new performance evaluation processes, or the CRC mid-term review and re-bid processes.

With the NHMRC there is the potential for conflicts between its multiple roles in standards setting and regulation, and in funding research projects.

Other lessons from the NHMRC or the nature of its operations include:

- the ambiguities around peer review processes, and the overheads involved;
- the challenge of intermediation across institutional and sectoral boundaries;
- the constraints on the exploitation of ‘horizontal’, general purpose technologies within the sector;
- maintaining the skills of internal staff; and
- the importance of strategic funding pools to advance into new fields and areas.

The regulatory and standards role played by the NHMRC could potentially be linked to the use of these levers in industry development such as, for example, establishing Australia as an attractive domicile for clinical trials, or credentialing the export of health services. By and large the potential to use regulatory levers for industry development has been neglected in Australia.

Notably, the health sector highlights the role of philanthropic partnerships. Philanthropic alliances raise different challenges and issues than those usually associated with industry partnerships.

\textsuperscript{139} An alternative, less controversial approach would be the use of independent intermediaries, such as IXC.
4.8 CSIRO and institutional roles

CSIRO is a unique institution within the Australian innovation system, as a broadly based, mission-oriented industrial research agency. It is the largest single research agency in Australia, and one of the oldest. As the rest of the country’s innovation system has developed and changed, CSIRO has regularly had to re-think what is distinctive about its role and, increasingly, to move to closer collaboration with both other public agencies and with the private sector.

CSIRO provides a useful case study in the context of this survey for a number of reasons. First, CSIRO demonstrates the value of a large scale, largely autonomous institution in providing a stable underpinning to the capabilities of the national innovation system. Secondly, CSIRO has had to keep reinventing itself, and this has lead to its development of high quality strategic management frameworks. These provide role models which can be adapted by other organisations and are relevant to public administration more generally. Third, CSIRO’s charter means it has to be highly focused on the use and impact of its industrial research, and hence maintains a strong focus on paths to market. Finally, CSIRO has explored a wide range of collaboration models and partnerships.

Institutional evolution and development

The discourse that took place around the establishment of CSIRO has a remarkably timeless feeling and one that resonates strongly today.

The Council for Scientific and Industrial Research was established in 1926 (the name of the organisation changed to its current form in 1949). The organisation was ten years in the gestation, following the establishment of an Advisory Council of Science and Industry in 1916. There were two specific catalysts for action in 1916. First, the year before the UK has established a similar body (but one which did not have the lifespan of its antipodean clone). Secondly, behind both the UK and Australian initiatives was the “impact of Germany’s technological strength on Anglo science policy”141. Germany had caught up with Britain in the technology arms race. (Today, the challengers are China and India). Behind both factors, however, was a powerful belief in the power of knowledge to drive industrial innovation. The then Prime Minister, Billy Hughes said that

> science should act as a beacon to industry and guide its feet through mazes of experiments. It would cure the diseases of the body economic and be its striking and producing power.142

He then went on to anticipate the abiding mission of CSIRO as:

> a really effective instrument for the promotion of greater efficiency in Australia, and to ensure the investigation of some of those great problems which we must overcome if we are not to be handicapped in our national development.

Equally prophetically, he noted that this enterprise would necessarily be pursued through collaborations and partnerships. And Australia needed to be able to access and capture the best technology from around the world for the benefit of Australian industry.

Sixty years later, a commission of inquiry into CSIRO noted that:

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140 Disclosure: the author has been a Director of CSIRO since 2002.


The principal role of CSIRO, as we see it, is to fill a gap in national research with what we call strategic mission-oriented work, which would otherwise remain unfilled. This is the kind of rather long-term work for the community benefit which cannot be, and is not being, carried out by industry or other organisations.\(^{143}\)

The initial industrial focus of CSIRO was on support for primary industries, not only because of their dominance within the Australian economy of the day but also because Britain, and its Empire Marketing Board\(^ {144}\) which funded much of the early research, saw that as the natural specialisation of production in Dominion countries like Australia. A ‘general scheme for research’ put forward in 1921 gave priority to the following areas of work:\(^ {145}\)

- Agricultural and Pastoral.
- Forestry
- Mining and Metallurgy
- Standardisation work
- Bureau of Information

Some sub-text noted work relating to the “elimination of scientific and technical difficulties encountered by manufacturers”, but CSIRO’s real entry into manufacturing research only occurred around the industrial mobilisation for the Second World War and the strong investment in industrialisation which followed. CSIRO has had little involvement in medical research, although its strong role in plant and animal biotechnology has built relevant capabilities from which medical research has benefited. CSIRO’s long-held insistence on the autonomy of its science meant that successive governments drew a line around CSIRO becoming too close to research involving national security\(^ {146}\), which lead to the parallel development of the Defence Science and Technology Organisation (which burgeoned in South Australia following a joint weapons research and nuclear testing agreement with the UK in 1945), and the establishment of a separate nuclear research agency, the Australian Nuclear Science and Technology Organisation, in 1948.

Today, outside these carve-outs, CSIRO is a broadly based research institution, and plays a national interest role as the main custodian for Australia’s investments in astronomy, houses a range of significant national research collections, and operates a significant scientific publishing house.

The 1977 inquiry into CSIRO highlighted its role in knowledge transfer, a role that continues to be somewhat under-developed.

Because of the capabilities in information storage and retrieval, conferred by the primary role, and because of the ability of its scientists to act as interpreters, we recommend that CSIRO should develop further a role concerned with transfer of science and technology from the world scene to Australia and Australian industry.\(^ {147}\)

Today there is renewed attention to how CSIRO might establish global reach and better integration within global research networks.


\(^{145}\) George Currie and John Graham, The Origins Of CSIRO, p. 157


\(^{147}\) A. Birch, op cit., p.xxvii
Towards the end of the Twentieth Century CSIRO had somewhat ossified around a series of divisional fiefdoms. This balkanisation of its research capability mitigated against CSIRO’s ability to exploit its distinctive role of major mission-oriented, cross-disciplinary scientific research undertakings. There was a real risk that CSIRO would be broken up, as had happened to its smaller counterpart in New Zealand. Since 2001 CSIRO has gone through a major change process to reassert its distinctive role of being able to mobilise broadly based capability against major national challenges, both industrial and social. At the heart of this cultural change has been a strong strategic focus on a limited number of large-scale, cross-divisional ‘flagship’ projects to address significant national priorities.

**Mandate**

CSIRO operates under its own legislative charter, which sets out the broad objectives of the organisation. The Science and Industry Research Act 1949 establishes two primary functions for CSIRO:

(1) The functions of the Organisation are:

(a) to carry out scientific research for any of the following purposes:

(i) assisting Australian industry;

(ii) furthering the interests of the Australian community;

(iii) contributing to the achievement of Australian national objectives or the performance of the national and international responsibilities of the Commonwealth; and

(iv) any other purpose determined by the Minister;

(b) to encourage or facilitate the application or utilisation of the results of such research

Secondary functions are to:

(ba) to encourage or facilitate the application or utilisation of the results of any other scientific research;

(bb) to carry out services, and make available facilities, in relation to science;

(c) to act as a means of liaison between Australia and other countries in matters connected with scientific research;

(d) to train, and to assist in the training of, research workers in the field of science and to co-operate with tertiary-education institutions in relation to education in that field;

(e) to establish and award fellowships and studentships for research, and to make grants in aid of research, for a purpose referred to in paragraph (a);

(f) to recognize associations of persons engaged in industry for the purpose of carrying out industrial scientific research and to co-operate with, and make grants to, such associations;

(h) to collect, interpret and disseminate information relating to scientific and technical matters; and

(j) to publish scientific and technical reports, periodicals and papers.

CSIRO spells out its pursuit of these functions in a five year Strategic Plan, and the Government now directs an annual Statement of Expectations to the Board of the organisation. Under its quadrennial funding cycle, the organisation effectively enters into a contract with the Government over the broad deployment of its appropriation.
CSIRO’s current strategic plan for 2007 through to 2011 emphasises three elements:\footnote{CSIRO, Strategic Plan for 2007-2011, June 2007}:

- **National Challenges** – by addressing national challenges and opportunities faster and better, by accelerating and expanding our Flagships and by focusing on partnerships nationally and internationally, we will find new solutions to big problems in water, energy, climate, health, industry, and the environment.
- **Discovery and Delivery** – by focusing and strengthening our core science capability we will enhance the quality and the transformational potential of our science, while also improving the sustainability of our national facilities and collections. By improving our delivery of science through better business practices, accelerated adoption process and enhancing communication, we will also increase our impact in Australian society.
- **One-CSIRO Foundations** – by strengthening our enterprise and enhancing operational excellence, we will: foster an innovative, collaborative, and performance-based environment; develop and adopt common systems, structures and processes that support our matrix enterprise; and renew our focus on occupational health and safety.

Detailed operational plans, with detailed performance metrics, sit under the longer term strategic plan.

**Structure and scope**

CSIRO activities are distributed around the country, at 48 different sites. There are two small overseas sites, in France and Mexico.

Many of CSIRO’s sites are co-located with universities or State government facilities, and there has been a strong move to strengthen such ‘science hubs’ which promote collaboration and co-investment. CSIRO has entered into substantive joint ventures in forestry (with New Zealand), food processing (with the Victorian State Government), the Bureau of Meteorology, as well as participating in 49 current Cooperative Research Centres.

As at 2007, CSIRO had 6331 staff, and an annual operating budget of $956 million. Approximately one-third of this budget comes from co-investments or contract research. CSIRO’s basic business units of science capability are a wide range of science Divisions spanning:

- Agribusiness
- Energy and Transport
- Health
- Information, Communication and Services
- Manufacturing
- Mineral Resources
- Environment and Natural Resources.

Above the Division sit nine ‘National Research Flagships’ – cross-divisional and multi-disciplinary long-term major projects addressing:

- Energy transformed
- Food futures
- Light metals
- Climate adaptation
- Niche manufacturing
- Preventative health
- Water for a healthy country
- Wealth from oceans
- Minerals down under
The Divisions and Flagships combine within a rather complex matrix structure in which the glue becomes an increasingly sophisticated strategic management framework.

**CSIRO’s strategic management framework**

CSIRO has developed an explicit portfolio model of its roles and functions against which it maintains a rolling science investment process for resource allocation and priority setting. Quality control is maintained through a cycle of rigorous external science reviews of Divisional and Flagship performance and delivery.

CSIRO represents a microcosm of the different roles within a national innovation system. Its innovation *portfolio* encompasses the spectrum of activity from breakthrough science through to incremental innovation, all underpinned by crucial national facilities and capability building.

CSIRO’s ‘role house’ provides a clear framework for national investment and decision-making (and for aligning the objectives and incentives of partners).
CSIRO provided the following breakdown of its resource allocations to the recent Productivity Commission inquiry.

**CSIRO’S EXPENDITURE, 2005-06**

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>$ million</th>
<th>Share of total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core roles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advancing frontiers of science</td>
<td>91</td>
<td>9.2</td>
</tr>
<tr>
<td>Creating new or significantly transforming industries</td>
<td>147</td>
<td>14.9</td>
</tr>
<tr>
<td>Solving major national challenges</td>
<td>129</td>
<td>13.0</td>
</tr>
<tr>
<td>Delivering incremental innovation for existing industries</td>
<td>157</td>
<td>16.0</td>
</tr>
<tr>
<td>Science-based solutions for the community</td>
<td>60</td>
<td>6.1</td>
</tr>
<tr>
<td><strong>Satellite roles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite roles</td>
<td>120</td>
<td>13.0</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research support services</td>
<td>242</td>
<td>24.5</td>
</tr>
<tr>
<td>Enterprise strategy and governance</td>
<td>33</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Total expenditure</strong></td>
<td>585</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*According to CSIRO, this element is directed at improving capabilities in other areas of CSIRO’s research rather than being purely curiosity driven research.*

*Satellite roles include providing technical services, supporting post-graduate and post-doctoral development, outreach and education, managing national collections, managing national facilities and scientific publishing services.*

*Source: Productivity Commission, Final Report, 2007, p. 468*

CSIRO’s planning cycle begins with a foresighting process that sets an environmental context against which to consider relative priorities. This foresighting process establishes the broad directions for the organisation’s industrial research. It is informed by external sectoral advisory committees comprising industry leaders. Possible research themes are then assessed against a detailed and exhaustive set of criteria, as follows:
CRITERIA USED IN CSIRO’S SCIENCE INVESTMENT PROCESS

Relevance

Value from R&D

The intent is to assess how much value the successful completion, adoption and use of R&D might create, taking into account the full range of potential economic, social and environmental benefits. Assessment does not confine itself to Australia or to CSIRO’s traditional research activities. It compares what would happen with successful completion, adoption and use of R&D with what would happen with no additional investment in research. Indicators/data include:

- Industry Community Area (ICA) size (industry/market size, growth, employment, exports)
- Addressable benefit to Australia
- Trends in distribution of CSIRO investment (appropriation and external funding by ICA)
- Distribution of CSIRO ICA spend compared with Australian public and private R&D spend
- Contribution of ICA to the economy, looking at both GDP and environmental risks
- Key environmental challenges relating to each ICA
- Projected GDP growth and historic OECD change in ICA contribution to GDP
- Contribution of ICA to employment and changes in this measure over recent years
- World trade trend
- Resource use by ICA (water and greenhouse gas emissions)
- Trends in greenhouse gas emissions

Whether CSIRO should be engaged and the role it should play

Even if research has the potential to make a major contribution to the development of the ICA, it is still necessary to consider whether there is a role for CSIRO. Assessment considers:

- CSIRO’s mandate
  - Whether CSIRO has any specific responsibilities or restrictions relating to the ICA.
  - Whether government policies or obligations bear upon level or kind of effort in CSIRO.
- Australia’s National Research Priorities
- CSIRO’s role compared with that of other members of the national innovation system
  - Whether the nature of the users or potential users of CSIRO’s research results has any implications for the role of public sector R&D generally and CSIRO’s role in particular. Possible data include:
    - Australia’s total R&D spend for each ICA
    - Ratio of public/private expenditure for each ICA
    - R&D spend ratio between CSIRO, other PSRAs, higher education, states/territories
    - CSIRO spend relative to economic contribution of ICA (eg, value added and employees)
    - CSIRO spend compared with each ICA’s contribution to GDP
    - Australian challenges and opportunities
    - Trends in the balance of trade for each ICA

Relevance of R&D

Assesses relative importance of R&D in creating value for each ICA and whether science and technology are key to the development of the area. Assessment considers relevance of R&D to the problems and opportunities presented by the ICA. Possible indicators/data include:

- An industry sector’s own investment in R&D.
- Global business expenditure on R&D (BERD) intensity for major countries for each ICA
- Australian BERD trend for each ICA
- Aust R&D intensity: Total $ spent on R&D per $m of value generated
- Aust R&D intensity: Industry $ spent on R&D (BERD) per $m of value generated
- OECD intensity in Business R&D Expenditures as a % of Industry Value Added
- USA R&D Intensity: R&D Expenditures as a % of Industry sales
- Industry innovation focus: Industry action agendas
- Business innovation

Impact and likelihood of adoption

Assesses likelihood research users will adopt successful research, develop it if necessary, and put it to use. Requires analysis of state of ‘receptor’ system for CSIRO’s research. Considers:

- Willingness of partners/receivers (eg firms, resource agencies) to adopt or use results.

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149 This overview follows a CSIRO submission to the Productivity Commission in 2006
• Ability of likely partners/receivers to convert successful R&D into commercial or other value.
• Identification of what will be necessary to realise the benefits from successful R&D. (e.g., capital investment; distribution networks; marketing skills; changed enterprise processes)
• Identification of what factors would drive adoption of the research results.
• Whether these driving forces are short-term or long-term?
• Whether factors (e.g., community acceptance) are likely to promote or impede uptake.

Possible data include:
- Proportion of external revenue to total expenditure by CSIRO for each ICA
- European Industry Innovation: New products (last two years) % of total sales

**R&D productivity/potential**

Intent is to assess how much technical progress would result from R&D investment. Purpose is to identify: areas of science and technology that are most productive in enabling new applications or advances in applications; number of highly productive areas for an ICA; and breadth and size of impact across the ICA. Assessment evaluates R&D productivity/potential as global measure independent of particular research group or organisation. Takes account of:

- Scope for technical progress (or technically-based improvement in performance). The larger the scope the higher the R&D productivity/potential for the area.
- Likely cost of achieving this progress.
  - The higher the cost, the lower the R&D productivity/potential for the area.
  - Whether technical progress is likely to be quick or slow (as a proxy for cost)
- Technical progress measured in terms of parameters important for use of R&D in the ICA.
- Assessment considers uniformity and rate of technical progress in core areas of science and technology. It is important as if there is a significant mismatch between progress in one area and in those complementary areas needed to deliver value to end-users then overall rate of technical progress will be viewed by the users of research results as relatively low.

Indicators/data include:
- Global science and technology ‘hot spots’
- CSIRO research competitiveness (now and future networks)
- CSIRO’s ability to make scientific or technical progress in a timely and competitive way

**CSIRO research competitiveness**

The intent here is to assess CSIRO’s ability to make scientific or technical progress in a timely and competitive way. In conducting this assessment, CSIRO takes into account its existing and potential research collaborators. Factors taken into account include:

- Skills and experience needed and how CSIRO’s capability compares with elsewhere.
- CSIRO’s track record.
- Whether CSIRO can assemble internationally or nationally competitive research teams.
- Whether necessary infrastructure (equipment, other facilities) is or can be put in place.

Measures of CSIRO’s research competitiveness include
- CSIRO citations per paper compared with selected Australian institutions
- Ranking of CSIRO research in areas that are ranked in the Global Top 1%
- CSIRO divisional ‘quality’ as measured by customer value surveys
- CSIRO divisional Intellectual Property positions

CSIRO’s operating plans match planned science outputs to organisational capabilities. Detailed performance indicators are set and monitored. A proportion of senior management remuneration is tied to the achievement of these performance goals.

**Governance**

CSIRO operates as an arms-length agency, governed by a Board of Directors with roles and responsibilities similar to those under private sector corporations law. The Board members are appointed on the basis of relevant skills. The Board has established three Committees:

- Audit
- Remuneration
- Commercial (oversighting external commercialisation transactions)
At CSIRO’s establishment in 1926 the leadership group enunciated a set of governance principles which, apart from their gender bias, provide an unusually clear and timeless statement of the role of governance functions in research management:\textsuperscript{150}

1. Not to act as scientific directors and judges of research;
2. To determine, on the best available advice, what problems should be attacked;
3. To find the best man to put in charge of the investigation of such problems;
4. To provide full opportunity to such men to solve their problems: if necessary severely curtailing the list of problems in order that those chosen may be concentrated upon and not made to suffer from lack of funds or attention.

The 1977 inquiry into CSIRO reiterated the challenge of research management:

\begin{quote}
Research is basically an investment in the future. There is always an element of a gamble in the unknown, but the odds are improved if problems are appropriately chosen, if properly selected people are given the right jobs to do, and if the technical organisation supports them.\textsuperscript{151}
\end{quote}

\textbf{Alliances and partnerships}

In recent years CSIRO has placed a strong focus on partnerships and collaborations. Industry advisory committees play an important role in ensuring CSIRO’s strategic directions are aligned with industry trends and challenges. An increasing proportion of CSIRO’s effort is undertaken through formal co-investment partnerships and joint ventures. These provide a healthy external discipline over the enterprise, and help keep CSIRO focused on its performance in delivering real outcomes for industry and the community. The flipside is the increased governance complexity, and possible constraints on CSIRO’s degrees of freedom in adjusting its activity portfolio over time in response to changing priorities.

Involvement in CRCs and with industry facing groups like the RRDCs help provide CSIRO with paths to market. Establishing effective linkages with SMEs has proved a much greater challenge.

\textbf{Challenges and Lessons}

The scale and scope of CSIRO’s operations provides important institutional stability to Australia’s innovation system. Its autonomy and public status – as a highly trusted and respected public institution – has underpinned long term investment in science capability and facilities to support industry.

A decade ago, however, CSIRO was in danger of losing support for its role. It had lost touch with its core constituencies. CSIRO subsequent renewal has been based on four key factors:

- a fresh articulation of its founding mission in addressing large and complex industry and national challenges;
- the strengthening of governance frameworks;
- the adoption of robust strategic management frameworks, notably a portfolio management model; and
- a strong focus on research and industry partnerships and collaborations.

Remaining challenges include:

- Paths to market and technology diffusion outside those sectors with large players and well established sectoral organisation;

\textsuperscript{150} Schedvin, \textit{op.cit.}, p. 37
\textsuperscript{151} A. Birch, \textit{op.cit.}, p. xxvi
• The probable desirability for CSIRO to play a stronger role in the hosting of national facilities and infrastructure, available on a wider basis to industry; and
• The development of stronger international linkages and relationships.
4.9 Telecommunications: a case study of the unintended consequences of deregulation in Australia

What is often forgotten or overlooked in country surveys are the gaps in industry capability, or lost capabilities. The historical overview in this study reminds us of the key role that state owned enterprises played in Australia’s economic development. This brief case study is a salutary reminder about the downstream unintended consequences of micro-economic reform in the 1980s.

At the end of the nineteenth century Australia and New Zealand attracted international attention for their ‘state experiments’ in nation building through social legislation and state owned enterprises. Given a huge and remote continent, sparsely populated, government needed to step in to play a major role in building infrastructure. The legacy was that, for most of the twentieth century, government enterprises owned and operated most utilities in Australia, from telecommunications and transport to water and energy. These utilities developed considerable R&D and innovation capabilities around the distinctive challenges of the Australian environment, whether low density communications or the exploitation of brown coal for electricity in Victoria. Because most of these utilities were state owned monopolies, their sectoral research capabilities were largely independent of, and carved out from, the capabilities that developed as part of Australia’s general innovation system.

From the 1980s government ownership quickly fell out of fashion, and an era of utility deregulation and privatisation became the new orthodoxy in OECD economies. Relatively little attention was paid to the possible unintended consequences of such policies in the hollowing out of industrial capabilities. Telecommunications is just one case amongst many.

From 1901 to 1989 telecommunications in Australia was a government monopoly, first as a Department of State, and after 1975 as a corporatised Government Business Enterprise. From the beginning it had a ‘nation building’ mandate. It maintained the country’s core capabilities in telecommunications research, as a smaller version of the renowned Bell Laboratories operated by the then AT&T private monopoly in the US. The Telecom Research Laboratories established a global reputation for innovation in rural communications and solar powered facilities. As a monopoly operator, Telecom Australia’s procurement policies required local manufacturing and local R&D investment as offsets for major contracts to multinational vendors. The world’s major equipment manufacturers – Ericsson, NEC, Alcatel, Nortel and Fujitsu and others – all established major manufacturing facilities and research laboratories in Australia.

As the national carrier, Telecom Australia was the government’s delegate at the International Telecommunications Union, and played a disproportionately influential role in international standards setting processes. This meant that the telecommunications sector in Australia was well integrated within global technology networks. For example, in 1975, and well before virtually anybody else, Telecom Australia determined that digital packet switching – the platform for the Internet – would be the dominant network of the future.

From 1988 to 1990 there was furious debate over the liberalisation of the telecommunication market in Australia, heated by the crucial role of communications in rural Australia and a

152 The classic study is Pember Reeves’ State Experiments in Australia and New Zealand, first published in 1902. The focus of Reeve’s book is on social legislation, but he well captures the spirit of innovative nation building that extended to bold state interventions in infrastructure building. See also Ann Moyal, Clear across Australia: A history of telecommunications, Nelson, 1984

153 Telecom Australia, Telecom 2000, Melbourne, 1976

154 Disclosure: the author was Executive Director Corporate Strategy for Telecom Australia at the time, and led the lobbying that was more concerned with favourable corporate outcomes than good public policy.
crusade around the preservation of ‘universal service’. Telecom Australia successfully
lobbied on four fronts for:

- a staged approach, gradual introduction of market competition with a regulated
duopoly regime from 1991 to 1997 to enable the erstwhile government monopoly to
adjust to a new environment;
- the maintenance of a strong, ‘national flagship’ carrier role to take on the global
competition (the so-called ‘megacom’ imperative which led to Telecom and the
Overseas Telecommunications Commission being merged and re-branded as Telstra);
- special treatment on the basis of its purportedly unique role in the delivery of
community service obligations for ‘universal service’ (the very notion of which was
not invented before the prospect of competition loomed155); and
- carve out from the National Competition Policy and the principles of structural
separation and no vertical integration of infrastructure provision and retail marketing
which were applied in all other utility areas156.

Part of Telstra’s lobbying strategy was to lumber new entrants with as much ‘national
interest’ responsibility as possible. In 1991, therefore, the licensing process for a new carrier
entrant and new mobile licences was constituted as a ‘beauty contest’ weighted to the
industry development commitments of contestants. There was a formal requirement for
‘industry development plans’, the implementation of which were to be monitored by a newly
constituted Telecommunications Industry Development Authority (TIDA). The policy
presumption was that this and other measures to level the competitive playing field would
perpetuate legacy levels of investment in industry development in the national interest.

Following the part privatisation of Telstra in 1996, and the full liberalisation of the market in
1997, telecommunications industry development quietly went off the agenda. TIDA quietly
cesed to exist157. Telstra’s own procurement and R&D policies were wound back. Since the
end of the 1990s most of the MNC manufacturing and R&D in Australia has ceased. Over the
period from 1991 to 2001 Telstra’s own investment in R&D as a share of turnover shrank from
2% to a miniscule 0.2%.158. Together, this represented a major loss of national capability. This
occurred precisely at the same time as convergence and the digital information revolution
were transforming the economy, and ICT became an essential part of a national information
infrastructure. There was growing public debate about the prospect that Australia would fall
further and further behind in the technology stakes and in the new global information
economy. Numerous studies pointed to the growing trade deficit in IT equipment and
intellectual property.

In 2001 the government acknowledged the worldwide emphasis being given to ICT and
biotechnology and, as part of a pre-election innovation statement, decided to establish new
research centres of excellence in both areas. This lead to the establishment of National ICT
Australia (NICTA) as:

> a landmark research institute whose activities will build Australia’s ICT capability through
> its research and training programmes. NICTA will help transform Australia’s ICT sector
> and strengthen the competitiveness of our traditionally strong sectors such as financial
> services, primary industries, resources, education, entertainment and health159.

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155 See T. Cutler, “The necessity of universal service”, in M. Armstrong (ed), Telecommunications Law:
Australian perspectives, Melbourne, 1990

156 Australia differs from the US and EU in not having ex post anti-trust law.

157 A similar cycle occurred in the implementation of government IT outsourcing, where the local
industry development requirements for contractors which were introduced to allay ‘hollowing out’
concerns quietly faded from the agenda over time.

158 Calculated by the author, from annual reports.

It is noteworthy that this initiative was part of a research policy package, not an industry or economic development initiative. It is also noteworthy that the establishment of such a new, standalone centre was motivated and portrayed as a ‘slap in the face’ to CSIRO for having failed to develop serious ICT research capabilities, rather than a belated recognition of some of the negative impacts of micro-economic reform in the ICT sector. It was envisaged that NICTA would break the mould of traditional research funding in Australia, and be based on a single node with critical mass, and focus on building industrial research capability. Seven years later NICTA has nodes right around the country, and is increasingly focused on research commercialisation.

A privatised Telstra remains the dominant force in Australian telecommunications, but shareholder returns have displaced nation-building as a driving force. Because of its ‘bottleneck’ control of the local network infrastructure, it has had little incentive to invest strategically in next generation network platforms for high-speed broadband. This is eerily reminiscent of its slowness in the 1980s, as a government-owned monopoly, to introduce mobile telephony. That changed in the early 1990s with the introduction of vigorous mobile competition, but the same has not been true of fixed broadband. Australia now lags the developed world in broadband bandwidth availability and pricing. Arguably this is a direct consequence of the framework for competition policy adopted in the early 1990s.

Finally, in 1997 with the introduction of open competition in telecommunications, the mantra of the day became ‘industry self-regulation’. Forums constituted directly from industry would be responsible for agreeing standards and codes of industry practice. At the same time the US was lobbying hard around the world for governments to take a hands-off role to the regulation of the US-driven Internet. As a result of this naïve belief in the efficacy of industry self-regulation, Australia’s former national standing in global technical forums has diminished, and arguably the representation of the interests of smaller country economies in global business regulation has been marginalised. A global economy is demonstrably not a level playing field. Nor is a local oligopoly.

A final lesson from a review of the efficacy of the micro-economic restructuring of telecommunications in Australia is that structural adjustment ‘safety nets’ are seldom sustained or sustainable. The primary policy drivers will always predominate in the long run. This implies that any core ‘national interest’ objectives should be built into the core policy framework and not as ameliorating add-ons.

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160 Based on personal communications with Ministers of the day.
Chapter 5: Instruments and incentives

The cases studies examined in this paper, as well as a broader canvassing of the Australian experience, highlight the wide range of instruments and mechanisms which may be deployed to pursue public objectives and to provide incentives for the alignment of public and private interests. The section attempts to develop a working taxonomy of such instruments, albeit recognising that it is likely to be incomplete. In addition, there are likely to be areas where mechanisms are either undeveloped or under-developed. Possible examples of areas where there would be benefit in considering new mechanisms or instruments include:

- mechanisms and incentives to promote inter-disciplinary collaborations, especially in the areas of R&D and mission-directed problem-solving;
- funding and incentive mechanisms to promote individual talent development through personal careers;
- new or refined mechanisms to promote information flows and to support system linkages within an environment of open innovation; and
- novel instruments such as income contingent loan schemes and innovation voucher schemes.

Whilst many of these mechanisms outlined below will be mutually exclusive, others may be best deployed in various combinations.

**Instrument**

<table>
<thead>
<tr>
<th>Block funding</th>
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<tbody>
<tr>
<td><strong>Tied</strong></td>
</tr>
<tr>
<td><strong>Untied</strong></td>
</tr>
</tbody>
</table>

**Deployment, issues and experiences**

Block funding is typically associated with the recurrent funding of institutions with continuing functions, such as universities, research institutes and agencies, and national facilities. Block funded may be ‘untied’ – that is, decision making about the use of funds is delegated to the institution - or it may be ‘tied’ and conditional to a greater or lesser extent.

Block funding is usually reserved for institutions whose activities involve long time frames (such as basic research) or assumed continuity (such as national collections or facilities). It is best thought of as public ‘investment’ rather than as ‘expenditure’. In general block funding should relate to big scale activity.

Public block funding implies a high level of public accountability around institutional performance (including external ‘peer’ reviews of the levels of excellence being achieved). It is desirable for the timeframe of recurrent funding cycles to be not aligned with electoral cycles. In the case of CSIRO, for example, the funding cycle has recently moved from triennial agreements to quadrennial funding agreements between the organisation and the government.

Over recent years in Australia the pendulum has swung from block funding as the norm towards a greater use of competitive funding models. This is because competitive funding models provide government with more leverage to introduce competitiveness and contestability into the non-market sector of the innovation system, and to use funding models to induce a greater focus, for example, on the commercialisation of public sector research. How to strike the right balance between block and discretionary funding requires the wisdom of a Solomon, but the implications of where the balance is struck are far-reaching. This
challenge is addressed in more detail below, in the discussion of competitive grants.

“Bully pulpit”

This refers to the ‘soft infrastructure’ of strategic leadership and agenda setting through speechmaking and public discourse. The power of this mechanism to influence behaviour or to promote consensus around goals and strategies is often highly underestimated.

Co-investment

This is where two or more parties jointly or severally invest in a project, venture or programme. This often involves the government matching private sector funds. The leverage thus gained by the private sector is offset by the different behaviours or additional activity ‘induced’ by the incentive.

Examples in the Australian environment are commercialisation (matched) grants, the Innovation Investment Fund scheme, and the Rural R&D Corporations.

The design attractiveness of co-investment models is that they involve demonstrable mutuality of commitment or ‘skin in the game’. Nonetheless, care is needed in design to prevent such undesired consequences as unintended ‘double-dipping’ (where fund from one source or programme are used to leverage participation in or benefits from other programmes). Another issue is what the UK calls the ‘burden of matched funding’, referring to the loss of flexibility where monies are tied up in detailed and pre-determined project budgets. Co-investment schedules may also lead to cross-subsidisation and underinvestment if the true costs of related infrastructure and overheads are not brought to account; this can be a particular problem where there is asymmetry in the capital structures of the collaborating parties.

Co-location

The co-location of activities by different parties can promote critical mass, informal networks and facility access and sharing. It is often associated with co-investment in buildings, plant and equipment. A good example of the latter is the Synchrotron in the Monash science precinct in Victoria. In Australia it is frequently associated with tri-partite arrangements between state governments, universities and CSIRO or other research institutes. This scale of operation is not to be confused with ‘technology parks’ or incubators. There are limits to co-location and shared use, however. A good example is around highly secure establishments, such as those dealing with biomaterials, where there is a trade-off between shared access and security.

The co-location of major establishments and activities has increased in Australia over the past decade, and underpins the increased focus on collaboration and the fostering of stronger linkages within the innovation system.

Extension services

Extension services are concerned with the diffusion of technology, knowledge, and with skill building to increase the absorptive capacity of firms, especially smaller businesses. The objective is to increase the take up of and the capacity for innovation across the industry landscape. Extension services were pioneered in the
agricultural sector in Australia and the US in the 1930s, and have been major factors in the sustained rates of productivity growth in the sector.

The model began to be applied to other sectors from the 1980s, but fitfully. In its last days the Howard Government introduced Productivity Centres, the operations of which were often outsourced to industry associations or industry consultants. The incoming government is migrating these to a new network of Enterprise Centres.

A similar scheme has operated to assist small start-ups commercialising new technology – the Commercialising New Technology (COMET) programme. Typically field officers will work with individual firms on performance diagnostics and needs-based assistance.

Foreign aid programmes have been often tied to the involvement of firms or experts from the funding country. In the past the Australian agency AusAid worked in conjunction with Australian industry where appropriate. There is now, however, a trend for countries to adopt a policy of ‘open aid’.

This is clearly one mechanism to credential Australian capability in particular export markets, as well as providing a low risk learning curve for individual firms. It is also a mechanism to develop new linkages between companies across developed and developing economies.

A related mechanism has been where cross country collaboration have arisen from bilateral agreements or in the context of regional forums. A good Australian example is the Asia-Pacific Partnership on Clean Development and Climate (AP6) under which intergovernmental programme R&D projects have been funded between Australian institutes and companies and counterparts in Asia.

Government sponsored multilateral collaborations are likely to increase as a response to the need to increase the production of global public goods in an era of major challenges from climate change, food security, and population health.

This review has noted the role that government owned or linked enterprises and agencies played as instruments of industry and economic development for most of the twentieth century. In the 1980s and 1990s era of privatisation and micro-economic reform these roles, and the gaps that might have been left after structural adjustment, went largely unaddressed. (See the case study on telecommunications).

Nonetheless, governments at both federal and state levels continue to control significant infrastructure assets. In addition, awareness has grown of the value of previously undervalued assets like government information, and the role that more open access to government information assets might play in industry development. Certain state governments have probably been more active than the Commonwealth, to date, in considering ways to leverage government assets for economic development.
Government procurement
Offsets
Selective tendering
Preferential tendering
IP rights licensing
PPPs

In the past government procurement was a major instrument of industry assistance, and it still is in many countries, including the United States. In Australia, pre GATT and the WTO, there was a strong regime of local preference and offset programmes whereby multinationals gained local market access in exchange for investment in local R&D and manufacturing facilities. Over the past decade the pendulum has swung strongly against viewing government procurement as an active mechanism for industry policy.

Countries like the UK are now showing renewed interest in this area. The reasons for this include:

- the impact of the climate change debate on thinking about the impact and role of government procurement;
- growing awareness of well-established US programmes, especially those directed at small business support;
- growing awareness of the role of major projects and infrastructure investment in FDI and innovation flows; and
- the recognition, at least in some quarters, that some countries take a less ‘black letter’ approach than others to the implementation of WTO and WIPO treaties. A good example is the stance of Germany and Japan with respect to patent law (these countries require much higher thresholds for patent protection or enforcement).

The effective use of procurement as a development mechanism requires astute commissioning and contract management skills within government, and process design that mitigates against the risk of excessive red tape.

Grants
Competitive Entitlement Capped Uncapped Single party; Multi-party, collaborative

Grants are one of the more pervasive research and industry support mechanisms. This mechanism comes in many forms. It is usually some form of competitive application scheme.

Grants vary considerably in size. There is an inherent tendency, however, for administrators to try to make budgets go as far as possible, which often results in the size of grants becoming sub-optimally small (this is a case where the volume of activity substitutes for policy outcomes). Small grants are often worth less than the cost of their administration. Costs which are seldom measured are the cost of unsuccessful bids, the opportunity costs involved in writing up applications, the overheads associated with selection processes, and the compliance costs of monitoring and acquittal. In addition, because grants are usually determined around the direct costs of the activity being supported, overheads and supporting infrastructure can become significantly under funded. In the case of organisations heavily reliant on grant income this can have deleterious effects over time. There are also other potentially negative aspects to grant programmes (or their design). Some of the issues around selection processes and ‘peer review’ have been raised in the case studies, and need to be noted.
Sometimes the motivation behind grant schemes can become a little mixed. In the case of public sector research grants in Australia, competitive grants have been used to wind back block funding. An institution’s relative success in grant applications, therefore, becomes a de facto measure of its competitiveness and its research quality. Because this tends to skew activity towards shorter-term projects this can be at the expense of long term capability building. It can also be wasteful in encouraging institutions to divert far too much effort into the generation of grant applications. Not surprisingly, a market for consultancies has grown up around application development. Periodic external expert review is an alternative form of institutional performance assessment in the domain of monopsonist institutions or pre-competitive research and development. This also has the desirable characteristic of focusing benchmarking on global performance rather than domestic comparators.

Another fundamental design issue with grant programmes is the extent of subject matter targeting. Prioritisation around subject matter selection criteria can either occur on a bottom up basis – the norm – or on a top-down basis. Applicants themselves can propose the activity within a subject domain, or the call for applications could nominate with some precision the functional activity requirement. The later approach is the one deployed in the US SBIR scheme for small business contract research and in the UK Grand Challenge programme for breakthrough innovation. It is probably desirable that both ends of the spectrum are taken into account in considering how grant programmes might operate within a framework of national innovation and research priorities. If the balance between block and competitive funding is right, then the bias of a competitive grants scheme might be deemed to be properly at the strategic, ‘top-down’ end of the spectrum.

This discursive narrative about grants can usefully be taken one step further. In any bidding process, there are probity constraints on how far selection panels can go in suggesting modifications to the focus or structure of bids. This becomes a material issue in the case of multi-party bids. Consortium bids (as called for in the CRC and ARC Linkage programmes, for example) are normally brought together by one entrepreneurial lead participant, and that lead organisation will tend typically to shape the consortium around existing networks. In many cases this may not be the optimal solution from a national interest perspective. Programme design solutions around this problem need to be actively considered. The Australian experience provides little guidance.

Australian examples are the Australian Capability Network; the Australian Institute for Commercialisation (AIC), and the Innovation Xchange (for which see the case study).

Intermediaries and brokerage (qv Networks)

Within an era of open innovations new mechanisms are needed to support innovation flows and, in particular, to link distributed capabilities and ‘solution providers’ to market-facing business development challenges. These mechanisms are also important as enabling platforms for collaborations and dynamic industry networks.

Some of the emerging vehicles include:

- Trusted intermediary services (such as IXC, for which see the case study);
- Portal based services, which aggregate capability data about firms and firm clusters (such as the Industry Capability Network);
- Brokerage and business development support services for individual firms (such as the AIC’s TechFast programme); and
- Networking forums.

Commercial business services have been providing advisory services to firms for many years, but within the business model of retainers from the firm (so that the agent has a direct stake in the firm outcomes). Where matching services are involved, the question of the interest of the agent becomes central. For this reason the new Australian ventures in this field have all been established as ‘not-for-profit’ entities to enable them to play a disinterested role in the market. This also makes it easier for government to subsidise user access to such services.

As noted earlier (Chapter 4), it has become evident that innovation intermediation needs to be cross-border and international within a global economy in which cross-border innovation flows are increasingly important. The ability of these mechanisms effectively to support SMEs is a crucial consideration.

**Investment attraction incentives**

- **Outlays**
- **Exemptions**
- **Major project coordination**

Investment attraction incentives and FDI policies have received high levels of attention around the world, and national models and comparisons are widely documented. For this reason this section will not rehearse these details, but note some singular aspects of the Australian experience which might bear on thinking about these mechanisms. In policy terms many of the discussions around FDI incentives are often narrow, and do not reflect the broader context of the global competition around locational preference, whether it is for manufacturing plants or for global projects like the square kilometre array telescope in science.

First, however, it is useful to note the inherent complexity of these mechanisms, and their frequent lack of transparency. In general these incentives take three forms:

1. ‘outlay’ incentives such as tax concessions and other rebates;
2. exemptions from particular business requirements that would otherwise apply; and

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3. bi-lateral agreements (usually around major projects).

Some of the incentives are generic (such as the Tradex scheme for re-exporters of inputs), whilst others are sector specific (such as the complex package of arrangements around the automotive industry).

In general, specific incentives rarely substitute for the attractiveness or otherwise of the macro-economic settings of the country, the state of infrastructure, perceptions of business regulation and labour markets, and the liveability of cities.

In many ways FDI-related issues can be more broadly described as country strategies for engaging with multinationals. Often it is the retention of a MNC presence which is as important as new investment attraction. Thus issues of engagement with multinationals are now linked with the question of how best to internationalise a national innovation system. This includes the standing of MNCs in eligibility criteria for participation in general industry support programmes. There is currently an emerging consensus that it is the location of activity that matters, rather than a company’s flag of convenience. A neglected aspect of the FDI discussion is the extent to which investment attraction can be linked to targeted capability needs. Another neglected area is FDI outflows, particular the deployment of Australia’s massive Pension Funds. Little from these vast funds finds its way into Australian innovative activity, although such a long term investment perspective would appear to be aligned with the underlying rationale of these funds.

Finally, in material terms many of the biggest decisions arise from bi-lateral negotiations around special projects and ‘one-off’ investments, the terms of which are often shrouded behind ‘commercial-in-confidence’ provisions. These deals are often approved outside of conventional government processes. Any form of bi-lateral partnership is likely to give rise to concerns about transparency.

**Levies**

Industry levies are the foundation of industry collaborations in Australia’s primary industries and underpin the Rural R&D Corporations. (There is a detailed discussion of the scheme in the RDRC case study). What distinguishes this mechanism is its mandatory nature – although some voluntary levy schemes exist – and the transparent basis it provides for matching government funding. Where the levy arises from a legislative provision, or gives rise to matching funding, formal rules are created around the governance and deployment of levy funds. This provides for high levels of transparency and an ability for the government to negotiate priorities.

Curiously, levy instruments have not been widely considered nor deployed in other sectors in Australia. In Spain, for example, firms are levied for contributions to industry associations which, as a result, become highly focussed on investment in industry development.
Licensing

- Class licensing
- Generic
- Competitive
- Selective

The licensing of market activities or market participation is a mechanism that is sometimes explicitly linked to industry development objectives. The most high profile uses of licensing incentives in Australia have been during the de-regulation of the telecommunications sector and in the regulation of broadcasting.

As the telecommunications case study shows, during deregulation the requirement for ‘industry development plans’ was a mandatory requirement for new market entrants. The greatest leverage from licensing incentives arises when there is a bidding contest which gives rise to a ‘beauty parade’. The moral hazard for government arises from the scope to police or enforce undertakings after the event. The only enduring commitment in telecommunications arises from legislative requirements about the ‘community service obligations’ of nationwide carriers. A related mechanism arises from some government tendering processes. In the late 1990s, for example, ‘industry development’ proposals were required as part of a major government IT outsourcing programme. This requirement was introduced in response to public criticism of the outsourcing decision, and a detailed review of subsequent outcomes might question the efficacy and longevity of this ‘offset’ requirement.

Another version of licensing as an incentive mechanism comes from the broadcasting sector. Free-to-air broadcasting licenses in Australia have been restricted, creating a monopsonist market. In this context licensees are obliged to comply with strict local content production rules which have been a major underpinning of the local film and television industry. The emerging challenge is how local content objectives might be supported as the whole industry moves to an environment of diverse digital media. This is a good example of how global industry changes can strand and undermine long-established incentive mechanisms.

Loans

In Australia various loan schemes have been tried during the 1990s as an industry support mechanism for technology start up companies. The scheme was abandoned in 2001 following disappointing take up. There are probably two reasons why the scheme administered by the IR&D Board was unsuccessful. First, when companies have the option of pursuing a loan or a grant the latter will usually win out. Second, the greatest pressure on emerging SMEs is to build equity rather than debt on their balance sheets. By contrast, a parallel export loan scheme – the International Trade Enhancement Scheme (ITES) – has been deemed by industry participants to have been highly useful. The exporting companies were, of course, at a different stage of business development than the start ups under the other scheme. This scheme, however, has also been discontinued.

Some state government have introduced industry funding schemes where ‘awards’ are executed as long term repayable loans. In some instances the ‘non-recourse’ provisions in agreements imply little expectation of repayment and most beneficiaries treat the proceeds as grant funds. While this may shield government from perceptions of ‘public hand outs’, the fiction is probably not good public policy.
From time to time schemes have been proposed in Australia which involve some form of ‘claw back’ in the event of the downstream success of the firm. The latest example is CSIRO’s Australian Growth Partnership scheme which funds growth SMEs to acquire useful intellectual property or technology to fuel business development. Royalty payment or payback provisions are supposed to be triggered by specified financial performance milestones. This scheme is currently regarded as a trial. A more generic proposal is for the application of an income contingent loan scheme model to R&D and commercialisation. To date the only application within Australia of this model is with the Higher Education Contribution Scheme.

**National facilities and collections**

The scope for, or the terms of access to, certain national facilities or collections can represent an industry development instrument. The potential scope of this mechanism ranges from access to public research facilities, to the National Measurement Institute (NMI), high speed research networks (AARNet) or the provision of test facilities and pilot plant. The National Collaborative Research Infrastructure Strategy (NCRIS) and related funding programme has been a major recent example of this form of mechanism. Library and related information services provide another example. Other national collections represent an asset where the terms of access and use can influence industry development. A topical example involves biodiversity collections and their use in drug exploration. In some cases public gene libraries has been commercially licensed (rather than being made available on an open access basis).

Beyond some well-established areas, the wider use or potential role of this class of instrument has not received much discussion in Australia.

**Networks – Forums**

(Also qv intermediaries)

An instrument closely related to the brokerage role discussed earlier is the establishment and operation of industry networks and forums. These can play an important role in emerging industries or sectors going through rapid change, and where conventional industry associations do not exist or are too broadly based. Such forums have been promoted by both Commonwealth and state governments. Australian examples include AusBiotech, BioMelbourne, the Australian Nano Business Forum and many others.

The quality of network forums varies, usually as a function of structure and leadership. The most effective forums operate at arms length from government with leaders who have strong skills in social network management. The least effective forums are those with technocratic leaders and poor brokerage skills.

**Offsets**

(qv government procurement)

Apart from their use in government contracting, offsets may be deployed on a more ad hoc basis in the negotiation of any mutual obligations associated with public private agreements.

**PPPs**

Public Private Partnerships (PPPs) involve the use of private sector capital to fund an asset used to deliver government purposes, and are usually deployed around major infrastructure projects (such as
toll ways or major facilities). The Australian Government describes this instrument in the following terms\textsuperscript{165}.

“PPPs reconfigure the procurement process by placing emphasis on the service or capability that the public service requires rather than the asset(s) used to provide them. Typically the responsibility for delivery of the service or capability is shared between the public and private sectors”. In other words PPPs combine both financing strategies (as an alternative to government investment or debt) and service delivery models (a form of outsourcing of asset provision and service operation).

Because they involve commercial contracts and usually have extended terms, the structure and real cost of PPPs are not very transparent in terms of public accountability. There has been some debate about whether PPPs inflate the cost of capital for such projects\textsuperscript{166}, and about the extent of risk shifting which may be involved. There are several structural issues with PPPs. Because they shift assets and activities off government balance sheets, they can mask the true extent and footprint of public sector roles and responsibilities and, some would claim, diminish public accountability and reporting. Secondly, they embed a moral hazard for government if things go wrong, with the government left with the contingent liability and the responsibility for maintaining public services. Finally, they are theoretically open to abuse as a means to manipulate the macro budget surplus or deficit position of government.

Rebates

Rebates (including tax credits) are instruments used to offset normal taxes and business charges for specified activities or classes of business. Australian examples include the R&D tax credit for small business, or a range of excise rebates in different sectors. In some cases an alternative is an exemption, to avoid administrative burdens. The best example of this is the Tradex scheme where there is an exemption from duties for imported goods, such as components, intended for export.

Regulation and standards

Regulatory codes and industry standards can be a powerful incentive mechanism for R&D and new product development. In some circumstances they can also act as a powerful non-tariff barrier to trade. Codes can affect industry development either negatively or positively. In mature industries, the maintenance of old standards may act as a major barrier to innovation and the diffusion of alternative products and services.

In emerging markets, regulatory codes can catalyse and accelerate industry development. Very current examples include new standards for CO\textsubscript{2} emissions and energy efficiency codes. Also in emerging markets certified compliance with government standards can act as a major credentialing factor for firms in export markets.

During the 1990s there was a very strong movement in many industry sector away from government regulation to industry ‘self-regulation’. There has led to minimalist industry codes, or codes which lag market or community demand. Global warming,\textsuperscript{167} http://www.finance.gov.au/procurement/public_private_partnerships.html

\textsuperscript{166} Others would argue that the additional financing and margin costs are offset by the operational efficiencies of the private sector.
uncertain energy futures and increased environmental concerns are likely to restore more attention to the direct role of regulatory codes in the innovation system.

**Subsidies**  
*Recurrent*  
*Non-recurrent*  
Direct subsidies are becoming increasingly less common given WTO rules. This has lead in some quarters to considerable ingenuity in developing de facto ways to extend comparable benefits (such as, for example, the use of upfront or advanced payments, or the subsidisation of end users). Disguised cost shifting is probably not good public policy.

A related issue has been the matter of competitive neutrality in the delivery of contract services by government agencies. This has involved the setting of rules to ensure that the pricing of such services incorporates fully allocated costs so that there is no hidden cross-subsidisation within agencies.

**Tariffs**  
In Australia, like most advanced economies, tariff barriers are on a timetable to be eliminated. The final elimination of tariffs is still contested by some parties in vulnerable industries like automotive and textiles. The corollary to tariff reductions has been increased focus on structural adjustment instruments (and the unresolved issue of the timeframe over which it is appropriate to support special adjustment measures).

With the fall of tariff barriers there has been offsetting attention to non-trade barriers. In the case of non-tariff barriers it is more difficult to determine their efficacy and the appropriateness of purported rationales. In many cases, such as standards regulation, rules can provide both local public benefit as well as, potentially, local industry advantage.

**Tax concessions or credits**  
Tax concessions are a widely used mechanism both in Australia and worldwide, and the classic example in Australia has been the R&D Tax Concession (for which see the case study). It is an instrument in favour with Finance Ministers as being transparent and involving self-selection by beneficiaries. The robustness of these design features is probably somewhat illusionary as all concessional schemes become skewed by eligibility rules and country industry structures.

In theory there are all kinds of way to shape de facto concessionary schemes. For example Australia once had a compulsory training levy scheme –effectively a tax – against which firms could claim a rebate for eligible training activities.

Tax concessions only benefit firms operating profitably, and this factor leads to the establishment of tax credit schemes or rebates for emerging small businesses. In some jurisdictions (like the UK) the government also applies a lower tax rate for small business.

**Underwriting**  
Government can promote industry activity by underwriting the uncertainty around high risk projects. The clearest Australian example is the Export Finance Insurance scheme (for which see the case study).

In theory there are numerous areas where government...
underwriting could reduce risk and barriers to market growth. (One example might be a role for government in underwriting local patent assertions by small businesses in foreign jurisdictions).

**Vouchers**

Voucher schemes have not been deployed in Australia. In the Netherlands, however, vouchers are being used to induce SMEs to source technology inputs from public research institutions.
Chapter 6: Some challenges and issues

This section addresses some general challenges and issues which arise from a consideration of the Australian experience. The particular issues highlighted do not purport to be exhaustive, but explore specific challenges bearing on cross-sectoral linkages within an innovation system. Many of the following issues are interdependent:

- Strategic adaptation to a changing innovation environment
- Specific innovation challenges for smaller country economies
- The difficulties of collaboration and the limits to ‘partnerships’
- The role of formal versus informal networks
- The role of SMEs
- Complementary support strategies: skills
- ‘Soft’ versus ‘hard’ company formation
- The commercialisation of public sector research
- The challenge of evidence-based policy and evaluation

6.1. Strategic adaptation to a changing innovation environment

We have noted in this paper that many of Australia’s institutions and industry programmes have had a long history. This raises the challenge of policy and institutional obsolescence. To what extent do institutions have the ability to renew themselves in the face of gradually changing global circumstances? The Australian experience has shown that, too often, strategic re-assessment occurs only through external crises or at a break-point in electoral cycles.

This challenge may be dramaticised through recourse to two metaphors. One metaphor is that of the ‘boiling frog syndrome’ wherein gradual ambient change reduces one’s ability to identify the need to respond in a timely fashion. A good example of this in the Australian experience is the R&D Tax Concession, where its value as an incentive has been progressively eroded over time. A broader example is the implications of emerging ‘open innovation’ environments for programmes which continue to be based on firm level activity at a time when a lot of the action is shifting to inter-organisational networks and inter-firm innovation exchanges.

A second metaphor is Nasim Taleb’s ‘black swan’, and the challenge of dealing with the uncertainty of the improbable. He notes that:

*Before the discovery of Australia, people in the Old World were convinced that all swans were white, an unassailable belief as it seemed completely confirmed by empirical evidence.*

Taleb characterises a ‘black swan’ event in the following terms:

- it is an outlier;
- it carries an extreme impact; and
- it is explainable and predictable, after the event.

Disruptive innovation is a classic ‘black swan’ event.

Recent examples of ‘black swan’ events bearing on innovation systems have been the fall of the Berlin Wall (and the impact of the collapse of the Second World on globalisation and the structure of international labour markets), the attack on the World Trade Centre and the emergence of non-sovereign security threats, Avian Influenza and the threat of pandemics, and the sudden ‘tipping point’ of consciousness with respect to global warming.

The challenge for national policies is twofold. First, how best to develop the capabilities to respond to future demands on the innovation system? Second, how to institutionalise a strategic assessment capability within government and institutions that equips them with ‘the capability to destabilise’ and question existing understandings, to use Ian Marsh’s formulation. As we noted earlier in this paper, this role of government is about strategic leadership in promoting the capacity to reshape and refresh policy agendas and frameworks in the light of changing economic and social circumstances.

Australia and other countries have deployed a range of mechanisms for strategic assessment at various times. In Australia these have included:

- Standing science and technology councils (such as the Australian Science and Technology Council 1978–1998 and currently the issues-based Prime Minister’s Science, Engineering and Innovation Council [PMSEIC] – 1989 to date);
- Commissions of Inquiry (often proceeding along the UK lines of producing a Green and White Paper);
- National Summits and forums – such as the 1983 Economic Summit, or the National Innovation Summit in 2000; or
- Research reports from business councils and think tanks.

What is notable in Australia has been the decline of strategic institutional mechanisms, and the decline of forums for multi-party collaboration and consensus-building around emerging challenges. During the course of the Howard Government (1996–2007) numerous standing bodies were wound up and replaced by less transparent internal government review processes and ad hoc task forces.

Two key lessons emerge from a cursory review at this level:

1. many institutional mechanisms fail to renew themselves over time and, by ossifying, lose broad-based support; and
2. strategic public policy perspectives struggle against the short-term imperatives of electoral cycles (three years in Australia) and the short-term quarterly performance orientation of stock markets and analysts.

A short-term orientation in government and business biases thinking to an equilibrium construct of the world, which is anathema to innovation and competitive re-generation. Not surprisingly, a corollary has been the decline in attention to and investment in national infrastructure.

The Australian wine industry provides a sobering example of the dangers of policy obsolescence and, indeed, of new challenges arising from success. For years the wine industry has been held up as a classic example of successful cluster development and of industry collaboration in innovation. The performance metrics have supported this view: exports have boomed. What has been less commented upon is how the factors that had underpinned this success have changed fundamentally with the supply-side globalisation of the industry. The history of industrial collaboration was premised on an industry structure in which there were multiple players, many quite small, none of which individually had the
capacity to undertake the R&D or marketing which would make them collectively successful. None really competed within the small domestic market, and the main game was to capture global market share as an Australian brand. What has changed? Two things. First the industry structure has changed, with major consolidation through mergers and acquisitions to create multinational vehicles directly integrated into industry global supply chains (both in terms of supply and distribution). Second, the local distribution market has changed, becoming dominated and controlled by the oligopolistic supermarket players. The challenge for the wine industry cluster now is how might industry collaborations change and how does the industry as a whole maintain its competitiveness into the future.

So a major challenge for Australia is how to develop a strategic assessment capability near the centre of government. Unlike the models deployed in the UK, Finland or Ireland, this will need to be a capability that works within Australia’s federal structure. This new national capability needs to be forward-looking and provide a longer term framework within which agencies can pursue agreed national innovation priorities.

6.2. Specific innovation challenges for smaller country economies

No national innovation system is an island entire unto itself. The nature and extent of a country’s integration within the global economy is obviously a central issue of material significance in the determination of national innovation priorities and strategies.

Contrary to platitudes about how the new world order is a level playing field the reality is that there are winners and losers, and that optimal trade strategies for different countries will differ. This matters a great deal if you are an advanced but small economy like Australia. On virtually any economic measure Australia has at best a 2% global market share, and this is shrinking with the growth of the emerging BRIC economies. This is analogous to the plight of SMEs in highly competitive markets. In Australia’s case, this marginalisation is compounded by the realities of economic geography and its remoteness from the major markets and trading blocs of the world. Despite the communications revolution, the tyranny of distance persists for Australia. So size, scale, and location matter in a global world, advantaging some and creating special challenges for others.

We can identify at least five major challenges that present to a country like Australia:

1. How does a country like Australia best access the 98% of global knowledge and technology it does not itself produce, and actively participate in global knowledge networks? How does it minimise the potentially high transaction costs involved?

   There has recently been growing recognition to the need for Australia’s innovation system to be more integrated within the wider, global innovation system. As AusIndustry points out, “Australia’s relatively low presence in global supply chains limits access to the 98% of R&D undertaken outside Australia”.

2. How does a small country economy maximise the ability of its industries to put to innovative use the knowledge and ideas from elsewhere? This is the issue around ‘freedom to use’, and on what terms. This is where the operation of international intellectual property regimes will, ipso facto, not be designed to favour net importers of intellectual property.

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171 Productivity Commission Submission number DR191, 8 January 2007
3. Given the inexorable constraints of finite resources, how does the small economy best focus and prioritise its efforts? A non-discriminatory approach would imply significant waste on unsustainable activity.

4. In the situation of a small country ‘David’ facing the northern hemisphere triad ‘Goliaths’ of the US, North Asia and the EU, what is that country’s best approach to the rules of engagement?

5. Finally, in such a situation, which other countries are similarly placed and may be natural partners for collaboration? What would be the primary areas for focus in any such collaboration?

Good responses to these challenges are not self-evident, and call for strategic thinking of a high order. It is not clear, however, that the institutional structures for strategic assessment exist to progress such thinking.

The second crucial area is the impact of economic geography, the tyranny of distance and small domestic markets, and Australia’s resultant low trade intensity. Here I very strongly disagree with the Productivity Commission judgement that

“it is not clear how large these barriers are. In any case, these barriers do not generally constitute a strong basis for policy action172”.

To the contrary, I argue that three areas for action arise.

Australian firms need the in-house skills to be able to scan, identify, and access external sources of innovation and new technology. These are scarce ‘problem solving’ skills. As a remote, southern hemisphere country, Australian firms face huge obstacles to participating in global industry networks. AusIndustry makes the important observation that:

Australian SMEs have a poor record in the take-up of new technologies and knowledge. The DEST Mapping Australian Science and Innovation, reports on average only 34% of Australian SMEs take up external technologies compared to over 85% in Europe and the US173.

Second, with the growing internationalisation of R&D, Australia runs the risk of falling behind in international collaborations, both in public sector research and in industry R&D. Current guidelines for government assistance programmes reinforce national boundaries around innovation flows (although this issue is now receiving some attention).

Third, there has been a neglect of crucial advisory and intermediary services to firms, to educate them about general technologies which can be applied for increased competitiveness. AusIndustry notes that “extension services have been provided to SMEs in the agricultural sector for decades, but not in other industry sectors. Many Australian SMEs operate in sectors without collaborative infrastructure and networks”174. The recent Manufacturing Forum report strongly recommended measures to address advisory services to established firms. Overseas studies of productivity growth in service industries highlight the crucial function of the adaptation of general purpose technologies in this growth175.

172 Draft Report, 2006, p. 6.15
173 Productivity Commission Submission number DR185, 21 December 2006
174 ibid., p. 14
175 Alan Hughes, op. cit.
6.3 The difficulties of collaboration and the limits to ‘partnerships’.

Collaboration has become one of the buzz words in the innovation policy jargon in Australia – and underpins a number of funding programmes as well being an explicit objective of the National Research Priorities. Collaboration is a sine qua non of interdisciplinary inquiry or the pursuit of a shared objective by distributed parties. In an online, networked world the subject of collaboration has become a hot topic, but it remains one where the tools and methodologies to underpin it remain highly undeveloped. ‘Collaboration’ is a richer and more powerful concept than interaction. It focuses our attention – in research and in industrial service delivery – on the purposes and meaning of the social interactions involved. It is about the enabling and facilitation of purposeful interactions (whether within an industrial or community context). It is, therefore, closely linked to the concept of knowledge networks. It emerges as a particular challenge in the context of a small economy like Australia where a small population is distributed around the coastline of huge and remote country, creating issues of how to marshal critical mass more effectively locally and to engage meaningfully with international networks globally.

In the context of this ECLAC study it also raises some interesting semantic issues around the meaning of ‘alliances’. Alliances in the context of public and private sector engagements connote some compact around agreed terms of engagement. Even through the superordinate goals of the parties are different – one is about public good and the other about private benefit – an implicit or explicit understanding about the benefit to both parties of particular actions or behaviours can underpin some particular form of transactional relationship between the parties. What the terms of reference for this study do not address is the possible relationships between discrete parties in the non-market sector – such as government agencies, universities and research institutes, and other not-for-profit entities – and the extent to which the nature of these non-market relationships may or may not increase the benefits of engagement on the part of the private sector. In the case of CRCs, for example, the collaboration of multiple non-market organisations around a CRC structure provides significant leverage for private sector participants and reduces transaction costs significantly (or rather shifts these costs to other parties, including the Commonwealth as the funder).

Hence the nature of the interdependencies across non-market organisations is an important aspect of the function of a national innovation system. In the case of a small country like Australia, collaboration between universities and research institutes, and between them and public sector research agencies, can be an important solution to the challenges of scale and critical mass, as well as a means to maximise the benefits from supporting infrastructure, through shared access. However, this raises the issue of being clear about the core role of any one institution, and the costs of inter-organisational or market transactions versus intra-organisational co-ordination costs. (Nobel Laureate Ronald Coase famously identified transaction costs as fundamental to market organisation). This thinking can be beneficially applied to innovation markets, particularly in an era of ‘open innovation’ (where the imperative is to reduce the cost of market transactions around innovation).

CSIRO provides a good case study of the challenges around collaboration. It is involved in an increasing number of formal collaborations, from CRCs, formal joint ventures with State Government agencies and universities, and other unincorporated joint research projects. Whole industrial research domains therefore become ‘off balance sheet’, for example the Food Sciences Australia joint venture between CSIRO and the Victorian Government in food sciences. One of CSIRO’s current strategic principles is ‘partnership or perish’. There are clearly huge advantages from inter-agency collaboration.

There are, however, equally clear problems and challenges. The test question is at what point does the extent of collaborations lead to lack of clarity about the core role of an agency and give rise to problems of governance. In the case of CSIRO two issues arise.
1. The high level of transaction and coordination costs. To ensure sound governance and decision making around collaborations CSIRO has had to put in place an extensive, centralised administrative framework, including a Commercial Committee of the Board which has a significant workload. There is also a duplication of overhead and reporting costs.

2. Governance challenges. The carving out of whole areas of activity into joint ventures and other collaborations means that an increasing amount of CSIRO’s activity has gone ‘off balance sheet’. That is, these operations cease to be under the direct governance control of CSIRO’s main Board and in a number of cases are not brought to account in CSIRO’s financial reporting. This means that in terms of public accountability it becomes increasingly difficult to represent CSIRO’s actual activity ‘footprint’ (i.e., the true extent of its operations). This modus operandi might also reduce the organisation’s strategic control over its resources allocation and direction setting.

In the non-market sector, collaboration can become an alibi for addressing the tough questions of rationalisation or the adjustment of structural arrangements through mergers or amalgamations.

CRCs are another case of organisational collaboration with high transaction costs. In the case of CRCs there is an additional difficulty because the governing CRC entity does not directly control the ‘in kind’ resources contributed to the enterprise. In practice this means that management has to devote excessive effort to the task of coordinating resources and negotiating project agreements between the multiple parties. In practice the objective of participants is to get out more than they put in. (Some universities and CSIRO now set a leverage hurdle rate of return). This mitigates against the design principle of synergy where the objective is to realise the alchemy of 1+1=3. The test question is whether the benefits outweigh the costs and overheads, and whether there might be better ways to achieve the objectives of such a programme.

If multiple links are difficult to manage, there may be a trade off between intensive as against extensive networks of connections. The challenge here is finding the right balance between tight and loose networks. Bounded peer networks may become self-referential, and less open to renewal from lateral inputs. Less bounded networks may lack structure for continuity and purposeful interaction. This is an important and central question in the context of open innovation systems. At a forum in Australia in 2007 Professor Alan Hughes from the Centre for Business Research at Cambridge highlighted this challenge:

Now there is an important question behind this, which is how dense, how extensive and how widespread a system of inter-relationships can be for it to be successfully managed and to yield value? It may be that the UK has a very weak, dispersed set of relationships, and that is maybe why it does not, for example, value its university links as much as its US counterpart sector does. I emphasise that this is speculation on my part, but I think it is an interesting and important issue. This raises the question, in thinking through an innovation support policy, of what might be the optimal framework for collaboration. What combination of relationships is the most appropriate - given the technology, the market structure, and the appropriation conditions - to allow small firms to operate most successfully in their environment?176

Organisational collaboration is not to be confused with project collaboration. Task oriented or project collaboration is a core and essential capability in any innovation system.

Finally, it is important to recognise that there are limits to partnerships across sectors. Many of these limits arise when the core roles of the public and private sectors diverge. For government this will arise when there is a need to balance sectional against national interests or a need to avoid exposure to the moral hazard of capture, and the difficulty of disengagement or re-negotiation of the terms of engagement. Government will have more interest in transparent arrangements than the private sector. Sectoral tensions and conflicting interests may arise over ‘build or buy’ decisions by key public sector agencies (such as CSIRO or the Defence Science and Technology Organisation). The private sector, on the other hand, will have limited interest in building national capabilities for future responsiveness.

6.4. The role of formal versus informal networks

Government policy tends to focus on formal institutional arrangements and finds it hard to take account of informal interactions within an innovation system. This is analogous to the emphasis we put on codified, formal intellectual property in the form of patents or copyrights as distinct from the role of tacit intellectual capital and know-how. We massively underplay the importance of the latter. Business research in the UK and US shows that informal knowledge exchanges are highly valued by businesses 177, and play a key role in the social capital of industrial clusters.

The challenge is how we might nurture this social capital within national innovation systems. An increasingly important aspect of ‘open innovation’, little recognised as yet in government policy and in major businesses, is the proliferation of peer-to-peer business and research networks and collaborations 178. These are promoted by digital online environments, and the extension of ‘open source’ collaborations from software to wider areas of R&D and industrial problem solving.

Open collaboration models tend to be informal (and self-organising). High levels of tacit know-how accrue around the participants in these informal networks. Social networks need ‘public spaces’, both physical and virtual. They also need co-production platforms, and collaboration tools and technologies represent an important sub-set of innovation technologies, albeit still massively undeveloped.

The Australian experience highlights increased attention to three factors which promote purposeful networking. First, there has been an increased willingness by research organisations to cluster and co-locate. This is different from a more traditional science or technology park model because it is increasingly anchored in multi-party co-investment in new centres or facilities. There are numerous examples involving CSIRO, State governments and universities co-investing and co-locating.

Second, there has been increased awareness of the importance in reinvesting in research infrastructure, spearheaded by the National Collaborative Research Infrastructure Strategy (NCRIS) 179 programme and AARNet, the high speed broadband research network. This has mainly involved investment in shared facilities across public sector players. There is, however, a need to pay greater attention to the related ‘access’ principles for the use of national infrastructure and the scope for greater private sector access to public facilities. A related challenge is what role there might be for government in developing national industrial infrastructure facilities – perhaps particularly targeted at small growth businesses – and providing test facilities, prototyping plant, or pilot plant. Infrastructure can provide a useful platform for supporting cross-sectoral linkages and for underpinning both formal and informal networks.

177 Alan Hughes, 2006, op cit.
178 The exception is the field of eResearch, which is receiving increasing attention.
Third, there has been a focus on network building and forum development, particularly at a state and regional level.

A challenge is to find the right balance between formal and informal networks and linkages, and to make sure that one does not prejudice the other. Much of the policy focus over the last decade has been on promoting structured linkages between industry and research bodies (such as the CRC programme, CSIRO, and the whole focus on a linear model of commercialisation, of which more below). We have noted previously that this focus on formal (and thus privileged and proprietary) linkages is actually at odds with what industry, at least in the UK and US, values about linkages with universities, which is their role not only in providing problem solving graduates but also in providing ‘public spaces’ for informal information exchanges.

6.5. The role of SMEs

A great many Australian programmes focus on SMEs. The government support ranges across commercialisation funding, R&D Tax Credits, business advisory support schemes, subsided access to intermediary and brokerage programmes, and export facilitation grants. SMEs tend to represent a highly problematic challenge in innovation policy. This is also an area where there is a lack of good analytical data that would enable the evaluation of what works and what does not. Long run longitudinal data in the UK, for example, suggests that huge public investment in SME support programmes has not significantly altered the performance results for the small business sector\textsuperscript{180}. There is not a sufficient evidence base from which to draw any comparable conclusions in Australia.

Nonetheless, the Australian experience does indicate that SMEs struggle to participate effectively in programmes like CRCs because of the highly structured and long term financial commitments involved, and the cultural clashes with other institutional or large business participants. Many other SME programmes require the use of intermediaries to market and coordinate programme service delivery. This means that the quality of these intermediaries becomes a key issue in programme outcomes. It also means that there is a great number of third parties with a significant vested interest in the maintenance of particular types of programme.

The majority of start-up firms fail, but mostly not because of technology risk. An analysis of 148 spin out companies from CSIRO, for example, shows that the majority of those that failed did so for reasons other than technology.

\textsuperscript{180} Alan Hughes, 2007, \textit{op cit.}
This is a world-wide phenomenon. Radical innovation, also, will cause large established firms to fail and be displaced, as their product base is superseded by new technology or services. Too little attention, however, has been given to addressing the problem of why so many new start-up firms fail. Lack of management capability, including key business skills, is a major factor. This is an important public policy issue given the levels of government assistance they tend to attract, including through the tax offset scheme. This issue is discussed further below, in the discussion of skills.

Change of ownership, including to foreign control, often ensures technology survival in the absence of company survival\textsuperscript{181}. Mergers and acquisitions tend also to be a major factor in corporate growth paths in the technology sector. Many firms submitting to the Productivity Commission in 2007 commented that the ‘grouping’ or consolidation rules around the IR&D Board programmes do not make allowance for changes in structure brought about by legitimate corporate developments paths.

A core policy issue is whether there is a need to focus on programmes to strengthen the supporting infrastructure for SMEs, and their integration within supply chains. As Alan Hughes has commented in a discussion of SME policy:

\textit{I think we need to get a better grasp on the specific appropriation opportunities for different groupings of firms within sectors and product groups. There is no point in having a small firm policy which promotes the formation of new businesses if it is known that within three or four years they will be dependent on a key customer or a key supplier, or where access to a market depends on a specific asset they do not have, and the firm faces an unstable future. The overall lesson is that we need to place more weight on the innovation system as a whole, and to differentiate the support according to the given industrial circumstances}\textsuperscript{182}.

\section*{6.6 Complementary support strategies: skills}

In the previous section we noted that the dominant reason for firm failure is management: almost half the failures have been attributed to lack of management capabilities or under-capitalisation, and a further 30\% to inadequate marketing. These findings are consistent with a major survey of skills in technology companies commissioned by the Victorian Government in 2004\textsuperscript{183}. Some of the primary ‘markers’ identified from a literature review and reinforced by our industry consultations were as follows:

\begin{itemize}
  \item Both \textit{“hard”} and \textit{“soft”} skills need to be developed \textit{in tandem}. The most successful firms combine technology and process innovation.
  \item \textbf{Technology transfer is a two sided equation}: transfer from or technology “push”, and transfer to or firm and market “pull”. Generally there has been not much focus on how to increase industry’s receptor capacity.
  \item \textbf{Interdisciplinary and collaborative skills are becoming increasingly important.}
  \item \textbf{Skills and competencies must be internalised into the culture} of the firm or industry sector (that is, to a significant degree “know how” is not a tradable commodity).
  \item \textbf{Higher knowledge-intensive technologies industries are more uncoupled from local geography than medium technology industries}. This finding makes intuitive sense: the higher the technology, the more it will tend to be internationalised in terms of relevant networks and linkages.
  \item \textbf{Cross-cultural skills and aptitudes are important}, but have received relatively little treatment in the literature. The changing economic geography of global
\end{itemize}

\textsuperscript{181} ACIL Tasman, 2006.

\textsuperscript{182} Alan Hughes, 2007, \textit{op cit.}

\textsuperscript{183} Cutler & Company, \textit{Skills and capabilities for technology commercialisation and exporting}, A report for the Victorian Department of Innovation, Industry and Regional Development, February 2005
markets makes this an important challenge.

- **There is a growing focus on firms’ learning and adaptation skills.** This emphasis reflects a recognition of the growing complexity and interdependencies in both innovation systems and internationalised markets. Sophisticated ‘search’ skills are needed to access and capture relevant knowledge from industry networks.
- **A firm’s choice of development path will require matching skill sets and competencies.**
- **Particular skill and competency requirements are specific to the lifecycle stage of firm development.**

The study identified and examined fifteen areas of core or emerging skill and capability requirements which merit closer attention. These are as follows:

1. Science and technology skills formation.
2. Technology business management
3. IP strategies and asset management
4. Process IP and *know how* capabilities
5. Business development skills
6. M&A skills
7. Stakeholder management skills
8. Recruitment and human resource development
9. Negotiation skills
10. Project Management
11. Prototyping and trials
12. Systems and technology integration skills
13. Interdisciplinary & collaboration skills
14. Global marketing
15. Firm learning mechanisms

It should be noted that many of these capability areas are highly inter-dependent. A related skills issue raised at a recent innovation forum is the scarcity of people with advanced problem-solving skills and the corporate retreat from on-the job training and staff development\(^{184}\). This is a missing agenda item in the current debate over skill shortages.

What this discussion highlights is that the failure to make concomitant investment in capabilities to underpin innovation based on public support for industry development reduces the net public benefit flowing from business programme incentives. This raises the key policy issue of whether there is greater public benefit from increasing incentives for R&D and other industry support, or from addressing ways to better leverage and to increase the impact of current levels of investment.

A related challenge is having a sufficiently broad view of the different characteristics of the possible firm start-up strategies.

### 6.7 ‘Soft’ versus ‘hard’ company formation

In a previous study\(^{185}\) we identified two generic development paths for IP based firms, each of which implies a distinct business model and concomitant firm skills and competencies. In the case study of venture capital initiatives I noted that there has generally been an over-emphasis on speculative product development or what have been termed ‘hard start’ strategies, and a neglect of enterprises which emerge from customer-driven contract research and exploratory development. In the case of these ‘soft companies’ where industrial capability emerges from the process of engaging with the solving of customer problems,

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\(^{184}\) Leslie Butterfield, in Cutler and Dodgson (eds), *op. cit.*

\(^{185}\) Cutler & Company, *op.cit.*
customer funding plays a key role in the early ‘exploratory’ stages of developing and exploiting new technology.

The first company type is a technology spinout from a research environment where the objective is to commercialise the IP by building an enterprise and a business plan to take the technology to market. Typically further R&D is required before there is product to take to market – in the case of drugs this may be many years – and funding is an issue before cash flows are generated. In many cases this commercialisation model simply transfers the R&D activity from one sector to another, without producing a viable business model. In the case of some institutions, almost half the spin-outs become categorised under the ANZSIC code of “scientific advisory services” – that is, their main business is research, not market innovation. Some may be described as “IP firms or hatcheries” where the business outcome is protectable IP which can be on-sold to third party manufacturers and distributors, often overseas. (This is very different from a contract research business which has a clear revenue model). Because many of these companies remain unprofitable for long periods of time, this gives rise to claims for special concessions – such as Tax Credits – or other support mechanisms.

In the second case, an entrepreneur (or team) founds a company, usually with a specific market or customer in prospect, and looks to build or acquire technology to address the market and develop product or service differentiation. Not all these companies start from scratch; in many cases an existing company will migrate to a new strategic market focus or joint venture. Typically a new company of this type will use consulting or contract R&D as a springboard and as an initial revenue source. Some – like Vision Systems – will incorporate this contract R&D into an ongoing business model as a discovery platform for product development. Type I companies deal with proprietary technology and originating IP. These are what David Connell call ‘hard’ companies. Type II companies can be described as IP or technology receptor enterprises which will commonly bundle internally generated IP with IP brought in from outside. These are what David Connell has characterised as ‘soft’ companies. This typology is consistent with Chesbrough’s open innovation model, as indicated in the following exhibit.

THE KNOWLEDGE LANDSCAPE IN THE OPEN INNOVATION PARADIGM

This typology represents, of course, the ends of the spectrum from ‘technology push” through to “market pull”.

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In the case of the Type I company, incentives mainly relate to maintaining the research inputs; in the second case the return from public investment can be more directly linked to job creation, export development and business sustainability. The Type II model is also compatible with emerging ‘open innovation’ frameworks for inter-organisational knowledge flows, collaborative activity, and to the integration of internally and externally generated intellectual capital.

A number of proposals have been made to underpin how emerging growth companies might better access intellectual property and knowledge to grow their business. One of these is CSIRO’s recent Australian Growth Partnerships model.

The model, developed by CSIRO, and endorsed and widened by the House of Representatives Standing Committee on Science and Innovation (2006), aims to encourage demand driven collaborative arrangements between SMEs and PSRAs\(^\text{186}\).

In essence the proposal involves:

• providing funds to SMEs with a track record of commercialisation to acquire technologies and technical advice; and
• repayment of funds if the project is successful.

The same demand-side focus is behind the initiative of the Department of Industry and several state governments to underwrite SMEs access to intermediary services, and the discussion about the possible role of government procurement schemes like the US SBIR scheme.

### 6.8 The commercialisation of public sector research

Over the past decade public policy around government expenditure on R&D has put a premium on the commercialisation of publicly funded research, with a key metric for public institutions becoming the number of patents and spin-out companies they produce. It can be noted that this reflects a linear, technology-push model of innovation.

There are several inherent problems arising this policy focus.

First, this imperative will skew the focus of public sector research activity, and change the balance between ‘basic’, curiosity driven research and applied research with demonstrable and current market application.

Second, this policy focus may fall into the trap where ‘the tail wags the dog’. The experience of leading universities globally shows that few realise more than a very small percentage of their funding from commercial returns. This raises the question of what is the ‘core business’ of a university and public sector research agencies, and the nature of the industry linkages that would be congruent with this mission and most productive for all parties. For example, if at best only 3% of research output is transferred from the system as commercial transactions, then what is the effect on the remaining 97% of activity? The following schematic indicates how an emphasis on commercialisation effected through funding models may, in fact, reduce knowledge production and limit general access to new ideas.

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\(^\text{186}\) Productivity Commission, 2006, p. 6.31
The proliferation of commercialisation units within universities distracts attention from the question of the wider role of public research in knowledge diffusion and information flows. These have traditionally been associated with the complex and largely intangible processes around the production of valuable graduates, the cross-sectoral movement of faculty, faculty engaging in ‘problem solving’ consulting, publication, and the provision of forums for knowledge exchanges.

In other markets, and particularly the US, the public policy focus is now the opposite of commercialisation, and revolves around the mandating of ‘open access’ to publicly funded research. There is also the related discussion around eResearch based on ‘cyberinfrastructure’ and the role of a ‘science commons’ in the production process for the generation of new knowledge (and new information search and exchange technologies for collaborations).

### 6.9 The challenge of evidence-based policy and evaluation

Good public policy relies on relevant data and evidence. Good data sets need to be marshalled against a clear articulation of the problem a policy is intended to address. The information that will be needed to evaluate the effectiveness of a policy needs to identified and collected. Appropriate analytical methodologies need to be applied. All this is pretty obvious. What becomes more challenging is in looking for the diagnostic evidence which might inform a better understanding of the problems or challenges that we want to address, or in testing the assumptions we make about the nature of the linkages between policy interventions and desired outcomes. As Alan Hughes has aptly observed, “The closer you get to hard evidence, the more things change shape”.

Two particular challenges around evidence-based policy are worth highlighting.

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187 [Brisbane Innovation Leadership Forum, September 2007](#)
The challenge of input/output analysis of innovation systems

At the core of understanding productivity contributions to competitiveness is the alchemy involved in the transformation of inputs into outputs. Economists have sweated blood and tears trying to understand multi-factor productivity at a macro-economic level. The same challenge arises in our attempts to understand the functioning of an innovation system and the factors at work in the processes of change. For example, we often simply assert that R&D is good, but then fail to demonstrate how and why it might make a difference to productivity and competitiveness, or how an increase in levels of R&D will produce a commensurate change in trade or firm growth. Much more analytical effort is needed to understand how interventions actually make a difference.

In many cases this input/output analysis will require cross-agency data sharing and matching. A good example of the value of this, and the challenges of doing it, has been around the experience, for example, of Australian population health diagnostics. Public policy research and diagnostics would benefit from open taxonomies for public sector information that allow for the re-purposing of source data, and the identification and rectification of data gaps (such as survey data on firms).

An understanding of innovation linkages is complicated by the extent of intermediate use to final production within modern economies, making supply chains very complex systems. The mapping of cross-sectoral inputs and linkages therefore becomes a powerful tool for understanding sectoral interdependencies. A classic example in Australia has been the use of cross-sectoral mapping to illuminate the role of design and creative industries in manufacturing and other industries188. Its wider application is important to understanding the role of service industries.

The challenge of insufficient longitudinal analysis

Many of our case studies have highlighted, especially in terms of the adequacy of evaluation, the challenges associated with the lead times between programme interventions and market impact. In general there has been too much reliance on short-term case studies and insufficient attention to long-term longitudinal tracking. A few examples highlight the challenge:

- In the case of the Australian wine industry the development path to exports extended over twenty-five years;
- CSIRO’s development of polymer bank notes took twenty-five years from development to deployment; and
- CSIRO’s Wireless LAN patents involved space research transfer to telecommunications and the value only crystallised ten years after patenting.

In the case of CRCs various studies have noted that impact generally occurs over a ten year timeframe, whilst the funding cycle is seven years. These timeframes and the mismatches with funding cycles highlight the desirability of looking carefully for

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188 This refers to work being undertaken within the Centre for Creative Industries Innovation, Queensland University of Technology. The author is Chairman of the Advisory Board of this Centre.
leading indicators, rather than lag indicators, for programme monitoring. This is a major challenge.

The other reason longitudinal data is important is because it helps us better understand changes in industry composition and input/output patterns. Better information here is of value not only to public policy but also to business, especially in understanding structural changes affecting skill profiles and requirements. Again, the pioneering analysis associated with mapping the Creative Industries in Australia has highlighted the value of such research capability.

These challenges highlight the importance of establishing – and funding - robust innovation research capabilities within a country. Ideally these would be independent of government, and probably best hosted within a public institution.
Chapter 7: Design Principles and Criteria

It is useful to consider and apply certain basic policy and programme design principles, applying some of the lessons of the experience in Australia and other countries. Adherence to clear design principles is the best way to avoid flawed programmes and unintended consequences. Good policy design should reduce inefficiencies in the innovation system and the extent of ‘innovation regulatory red tape’ around support programmes. Approaches to design will frequently be influenced by the political mindset as to whether public innovation outlays represent ‘expenditure’ and costs to the community, or ‘investments’ for future benefit. Too often the former prevails over the latter.

Designing good policy essentially revolves around identifying the best solution to a problem. Gary Banks, the Chairman of the Productivity Commission, recently provided a succinct overview of the key steps in good policy development.189

Key steps in best practice policy development

Developing the best policy approach to a particular social, environmental or economic issue requires systematic processes to ensure that the ultimate decision is as well informed as possible and therefore unlikely to have adverse or unintended consequences. The key steps are:

• Understand the nature of the problem or issue and its causes.
• Determine why some form of policy intervention is called for and thus specify the policy objective.
• Outline the range of possible policy options (including non-regulatory approaches).
• Assess their relative efficacy in addressing the problem, and their impacts (costs and benefits) across different parts of the economy and sections of the community.
• Choose the option that maximises net social benefits, taking all impacts into account.
• Develop an effective implementation strategy to avoid undue transitional costs, and monitor the outcome.

In 1998 Australia’s Productivity Commission undertook a comprehensive survey of design principles for business programmes, the so-called Lattimore review. This provides an excellent reference point and resource, and continues to be a reference model in Productivity Commission reviews. The following checklist is adapted from this framework, and its further elaboration in the recent Commission report on public support for science and innovation.191

POLICY DESIGN CRITERIA

Criterion  Discussion and elaboration

Clarity about the problem to be solved  Is there a clear and unambiguous statement of objectives and rationale? Does the policy or programme target the problem

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effectively?

**Inducement effect**
(additionality or behavioural change)
Is it clear how policy or programme incentives will affect behaviour? Will it induce new or different activity? Is it likely to have acceptable take-up? Is the scale of the programme consistent with the desired outcomes?

**Contestability and transparency**
Should there be contestable funding arrangements? Deliberate choices should be involved in deciding between contestable or non-contestable arrangements. The Productivity Commission notes\(^\text{192}\) that such choices should be informed by:

- the ability to define appropriate objectives in terms of community benefits;
- the ability to evaluate the merits of competing proposals against those objectives;
- the administrative and compliance costs involved in the application and evaluation of funding proposals; and
- the potential for strategic behaviour by stakeholders to obtain preferential treatment.

A different insight might come from the tests for ‘policy market’ contestability. Are there low entry and exit barriers? This directs our attention to the appropriateness of any hurdles to accessing a programme, or to potential problems with ‘lock-in’, both for participants or programme providers.

In the case of non-contested funding arrangements (as in block funding or bi-lateral arrangements) how might monopsony market pricing disciplines be applied to public policy?

**Consistency**
What are the possible interactions with other policies? Where does this policy fit within the overall policy portfolio?

**Duration**
How long would the programme need to be in place to produce the desired outcomes, or to produce sustainable results? This also draws attention to the desirability of aligning carefully the cycles for funding, milestones, and evaluation. It is also worth considering whether there is scope or benefit in programme ‘tranches’, as in a venture capital model of migration through a development cycle. Finally, there is the question of planned programme exits, discussed further below.

In addition to programme duration, there is an ancillary question about the presumed lifecycles for participation by individual entities (this refers to expected or desired churn or turnover in participation).

**Calculated risk**
Lattimore et al tend to express risk criteria in terms of ‘the avoidance of risk’ and this can lead to a policy or industry culture of risk aversion. The more basic aspect to risk criteria is the understanding of the nature of risk. Research and entrepreneurship entail risk by definition. In science, for example, progress is made by the fallibility of the current state of knowledge, with as much learning arising from null hypotheses as from proofs. There is

\(^{192}\)ibid., p. 374
inevitably waste within a robust innovation system, but the key issue is how to capture the lessons from apparent failure. Most things involve risk. The appropriate test revolves around assumptions about the profile of risk and the potential return. ‘Is this worth the risk?’ Good public policy formulation will explore the appetite for risk and proceed on the basis of ‘calculated’ risk. Some assessments of high risk and high return might, for example, lead to policy models built around experimentation, or pilots. These are standard processes in leading edge industrial innovation, which often proceeds through a cycle from proof of concept (does it work in test conditions?) to pilot plants (can this be scaled to industrial strength?). Public policy discussions sometimes conflate these notions of experimentation and piloting, to the detriment of appropriate outcomes.

Nonetheless, there are special categories of risk which are usefully addressed by design principles.

**Risk management:**

(i) Adverse interactions with other programmes

This calls for attention to the possibility of conflicting signals arising from different programmes or policies. Pertinent examples might include:

- conflict between objectives about research excellence and productivity (i.e., output by quality versus volume, as in the value of patents versus the number), or
- the conflict in building knowledge capability between knowledge diffusion and commercialisation (or public knowledge *versus* privatised knowledge).

A different kind of negative interaction might involve the scope for ‘double dipping’ and ‘programme shopping’.

The flipside is to look for ways in which different programmes might be rendered more complementary and mutually reinforcing. This is particularly important where programme interventions occur at specific points in a value chain (such as R&D incentives). Both the potential positive and negative impacts on upstream or downstream activity or behaviours needs to examined. The risk of isolated interventions at a single point of the innovation system is that outcomes may become stranded or ‘orphaned’, with no path to impact.

(ii) Unforeseen liabilities for government and ‘moral hazard’.

The most basic example here is excessive risk to government revenue from uncapped or open-ended incentive programmes, especially those delivered through the tax system. The Australian experience has shown that the impact of variations to the R&D Tax Concession has proved notoriously difficult to predict.

The biggest pitfalls arise from inadequate attention to possible ‘contingent liabilities’ for government, or the ‘moral hazard’ of policies which might leave government captive to the claims of sectional interests. Moral hazard often surfaces when the termination of a programme is contemplated. This frequently results in inefficient or sub-optimal programmes being continued because the expenditure of political capital in closing them down is just too high. As with venture capital, there is merit in building ‘exit’ options into programme design. A very useful mechanism is
to have explicit sunset terms, linked to an appropriate funding cycle, and explicit, *ex ante* criteria for the renewal of a programme\textsuperscript{193}.

**Risk management:**

**(iii) Strategic behaviour by firms**

This is code language for the risk that firms and beneficiaries may be able to ‘game’ the system. Poor programme design may leave the way open for unexpected behaviours, some of which might undermine the integrity of a policy. A good example of this in Australia was the financial engineering around R&D Tax Concession Syndication. Another example is the way the new ventures backed by private equity might use the R&D grant schemes to leverage the value of their equity stake and to free up working capital for other purposes. No judgement is being made here as to whether or not this is inimical to the public interest. The real risk in public private interfaces around programmes arises from the often mutual incomprehension of the operating context and culture of the other. Where one party sees an opportunity to take advantage of ‘blind spots’ on the part the other, the risk is that this undermines the intended alignment of interests in certain outcomes. It can also breed suspicion and lack of trust.

The test in policy design is to keep asking how a self-interested, commercially savvy party would seek to optimise the private benefit from a public programme. There are several ways in which this can be done. The first design strategy is the ‘hacker challenge’ in computer software, where developers co-opt hackers to fireproof a system design. Where the stakes are high, this strategy can be used in public programme design\textsuperscript{194}. Retain the smartest commercial operators to tell you all the ways they could find to ‘rort the system’. More generally, one of the sources of value from private sector participation in public sector governance or evaluation processes is the ability for these participants to provide a critique of how programmes might operate in the ‘real world’. For example, anyone with a business background would quickly provide feedback that a small incremental tax benefit with high compliance costs is likely to have little industry impact. Another example is in the area of making judgements about the points at which ‘additionality’ might kick in as the threshold below which a firm or entity would be likely to undertake an activity anyway.

**Administrative and compliance efficiency**

While this is an obvious design principle, it is frequently ignored in practice. Problems arise when there is a mismatch between the inventive instrument or funding mechanism and the administrative framework. An example would be where a small grant programme involves complex application and assessment procedures. A proportionality principle should apply. Another source of inefficiency is where compliance regimes require special-purpose reporting which is different from related reports a firm may be required to produce for normal business compliance\textsuperscript{195}. This practice commonly creates significant additional overhead costs for an entity. Compliance and evaluation can be over-engineered. Often very simple mechanisms can substitute for massive red tape.

\textsuperscript{193} This approach is exemplified in the EFIC case study.

\textsuperscript{194} See the IIF case study for the use of this strategy.

\textsuperscript{195} The CRC programme, for example, requires detailed financial reports as a different chart of accounts to those which a CRC needs to prepare as its statutory corporate returns.
Accountability and transparency

The strongest mechanism to promote accountability and transparency is the timely and open reporting of activity. The default position should be full public disclosure unless there are sound reasons for the introduction of limitations (such as the privacy implications of fully disaggregated data). Where commercial sensitivities limit disclosure there should be robust independent audit processes to provide assurance about the integrity of programmes.

Cost effectiveness

The cost effectiveness of programmes is best secured by establishing a business case model as part of the design process. This has the benefit of:

- enabling a proposal to be evaluated against alternative programme solutions for a given objective;
- articulating the ex ante assumptions for review in evaluation processes.

Thinking about costs should not preclude attention to non-price factors and externalities. Externalities include examining whether an initiative might impose some significant costs on a particular group. Positive externalities should not be ignored.

Compliance with international obligations.

There has been increased focus on compliance with international treaty obligations in policy design. Unfortunately, there is often little expert knowledge brought to bear on such compliance, leading to unnecessarily barren policy frameworks. On occasion international trade rules will be used as an alibi for inaction.

As with all compliance regimes, there is often a great difference between the actual ‘black letter’ obligations and the purported intent or ‘spirit’ of an undertaking. It is arguable, for example, that obsessive concern with keeping to an expansive interpretation of an undertaking will penalise a country relative to others that operate on the basis of minimum compliance. Germany and Japan are good examples of the latter in the area of the application of WIPO rules to patent law.

Evaluation, monitoring and reporting.

The key principles here are:

- the development of the evaluation criteria and reporting requirements ex ante;
- a requirement for ex ante and ex post performance data;
- the independence of the review function as an ‘audit’ process; and
- proportionality.

In monitoring frameworks, there is scope for greater attention to be given to ‘lead’ as well as ‘lag’ indicators. The distinction between group or portfolio evaluation versus individual programme evaluation should be considered carefully.
Chapter 8: Lessons and general principles

A global assessment of Australia’s innovation system supports the conclusion that there appear to be five factors at play in those parts of the system which appear to work best.

1. There has been a long history of industry ‘self organisation’ (such as in mining, primary production and, more recently, computer games). Exemplar initiatives are the Rural R&D Corporations or AMIRA. These involve industries where Australia is fully integrated within global supply chains, the industry is overwhelmingly focused on export markets, and supporting industry arrangements span the whole value chain (from R&D to marketing). Arrangements around these industries have driven economic diversification into support industries, and continuous technology innovation (such as in mining and agriculture).

2. There is reciprocity and mutuality in partnerships around outcomes (‘skin in the game’). This principle of mutuality can be found in the Rural R&D Corporations and Cooperative Research Centres, the former Partnerships for Development scheme, the IIIF scheme, and some industry assistance schemes. Into the future this principle would be appropriate in shaping responses to climate change and environmentally based industries.

3. There are strong, semi-autonomous institutions with scale, within which the competing pressures for sustained capability building and of responsiveness to new challenges can be assessed and balanced. Australian examples include the CSIRO, Rural R&D Corporations, and medical research institutes.

4. The focus is on a distributed, federated model of innovation that promotes an inherently systemic, non-pogromatic framework for a national innovation system (emphasising the range of diverse and complementary roles across participants rather than being based on contests for hegemony).

5. National structural challenges, such as sparsity, fuel innovative solutions. (Australian examples are around logistics, the environment, systems integration and project management, and systems for distributed collaboration).

One the other hand there are parts of the Australian innovation system which appear to work less well and which represent major challenges.

1. Those areas where ‘innovation’ is unhappily or inappropriately coupled with structural adjustment and palliative interventions. The resultant blurring of policy clarity can create conflicting messages, and result in a lack of transparency.

2. Where industry sectors are not self-organising, or where there is no ‘natural’ market organiser (such as in areas of manufacturing and in some emerging markets, or in areas like ‘information markets’). This raises the issue about the particular role of government in market design and creation.

3. Sectors which are dominated by strong local oligopolies, and which are not greatly trade exposed. These include many parts of Australia’s services sector (particularly retail, banking, and telecommunications). This is in contrast to other service industries which have been have been highly successful and innovative (such as asset management, financial services, logistics, and education).

4. Those areas where industry support interventions or their incentive mechanisms are disconnected from upstream or downstream activities (and accompanying feedback mechanisms). This is the challenge with schemes like the R&D tax concession, EMDG, and Science and Technology commercialisation policies.
5. The recent lack of authoritative and continuing central agencies with a responsibility for strategic direction setting and consensus building around national priorities and interests.

There are a number of overall lessons which may be drawn about what aspects of national innovation policies might make the greatest difference. These include:

1. A focus on industries and initiatives with the broadest impact and benefit on the national polity.
2. The pursuit of evidence based policy and programme formulation, and review.
3. Recognition that government is the appropriate provider of basic infrastructure and the architect of national capabilities.
4. The role of government should be to complement market forces, to articulate the rationale for interventions in the public good and national interest, and to be a catalytic coordinator in areas where there is no private sector ‘natural owner’ of a problem or challenge. Only government can make broadly-based strategic assessments in the national interest. By definition – because otherwise there would be no call for regulation – public and private interests can only ever be partially joined.
5. National benefit is a function of the quality of outcomes and the extent of impact. Evaluation of possible outcomes and impact should feature strongly in the ex ante evaluation of policy proposals.

8.1 First Principles
This section steps back and attempts to essay some general first principles about innovation policy and for economic development strategies. Some principles seem to be of general application, whilst other may be more country specific.

FIRST PRINCIPLES – GENERIC

<table>
<thead>
<tr>
<th>Do</th>
<th>Don’t</th>
<th>Recognise</th>
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<tbody>
<tr>
<td>Align policies with (changing) global environment and realities</td>
<td>Entrench policy obsolescence</td>
<td>The need to maintain capability to respond to uncertainty and the unexpected.</td>
</tr>
<tr>
<td>Develop clear reference models for innovation and development</td>
<td>Apply ‘one size fits all’ models; entrench institutional “silos”; or lose clarity about policy focus over time.</td>
<td>The risk that parts will be stronger than the whole; risk of programme bureaucratisation over time.</td>
</tr>
<tr>
<td>Adopt a portfolio model for managing the components of the Innovation System.</td>
<td>Ignore interdependencies within portfolio, or confuse roles and accountabilities</td>
<td>Align programmes with portfolio role characteristics, including time horizons for outcomes.</td>
</tr>
<tr>
<td>Pursue evidence based policy, and embed ex ante evaluation criteria</td>
<td>Ignore data limitations</td>
<td>The challenge of developing meaningful data sets, and need for longitudinal analysis.</td>
</tr>
<tr>
<td>Actively manage a capability/outcome matrix</td>
<td>Under-invest in supporting infrastructure</td>
<td>Articulate and embed paths to impact, but allow for synergies and serendipity.</td>
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</table>
Develop open innovation market mechanisms

Over-externalise
The importance of feedback mechanisms and need to capture learning.

Strike a balance in collaborations and network linkages (loose versus tight)

Ignore the importance of informal linkages and networks
The need to navigate between rigidity and flexibility.

**FIRST PRINCIPLES - COUNTRY OR CONTEXT SPECIFIC**

<table>
<thead>
<tr>
<th>Do</th>
<th>Don’t</th>
<th>Recognise</th>
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<tbody>
<tr>
<td>Align policies with (changing) local environment and realities</td>
<td>Maintain policies or programmes beyond their half-life</td>
<td>Need to monitor for gaps in attention; review for continued policy and programme relevance</td>
</tr>
<tr>
<td>Recognise structural realities, such as: • impact of economic geography and demography; • role of natural endowments versus built competitiveness</td>
<td>Indiscriminately mimic other country models</td>
<td>The scope for policy dissonance</td>
</tr>
<tr>
<td>Recognise and work with path dependence</td>
<td>Ignore history</td>
<td>There is no ‘greenfield’ environment</td>
</tr>
<tr>
<td>Promote bi-partisan consensus around long-term directions</td>
<td>Allow policy capture by sectional interests</td>
<td>The constraints of rigid political paradigms, and the influence of the locus and focus of policy sponsorship.</td>
</tr>
<tr>
<td>Explore and develop ‘small country’ strategies and principles</td>
<td>Ignore imbalances of market power</td>
<td>The global economy is not a level playing field.</td>
</tr>
<tr>
<td>Adjust generic strategies for local industry structure and capabilities</td>
<td>Confuse or conflate structural adjustment and industry development</td>
<td>Scale affects the impact of global factors.</td>
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## Glossary:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACIS</td>
<td>Automotive Competitiveness and Investment Scheme</td>
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<tr>
<td>AMC</td>
<td>Australian Manufacturing Council; abolished 1996</td>
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<tr>
<td>AMIRA</td>
<td>The industry association which manages collaborative research for members in the global minerals industry</td>
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<tr>
<td>ANSTO</td>
<td>Australian Nuclear Science and Technology Organisation</td>
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<tr>
<td>ARC</td>
<td>Australian Research Council</td>
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<tr>
<td>AusIndustry</td>
<td>Australia’s domestically focussed agency for delivering general industry assistance programmes</td>
</tr>
<tr>
<td>Austrade</td>
<td>Australian Trade Commission: Australia’s trade facilitation agency</td>
</tr>
<tr>
<td>BRIC</td>
<td>The quartet of major emerging global economies: Brasil, Russia, India, China</td>
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<tr>
<td>CRCs</td>
<td>Co-operative Research Centres</td>
</tr>
<tr>
<td>CSIRO</td>
<td>The Commonwealth Scientific and Industrial Research Organisation, Australia’s principal industry facing public research institution.</td>
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<tr>
<td>EMDG</td>
<td>Export Market Development Grants, administered by Austrade</td>
</tr>
<tr>
<td>IIF</td>
<td>Innovation Investment Fund programme</td>
</tr>
<tr>
<td>IXC</td>
<td>The Innovation Xchange, a not-for-profit intermediary service for brokering relationship opportunities.</td>
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<tr>
<td>NIES</td>
<td>National Industry Extension Service; abolished 1996</td>
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<tr>
<td>NCC</td>
<td>National Competition Council</td>
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<tr>
<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
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<tr>
<td>PMSIEC</td>
<td>Prime Minister’s Science, Innovation and Engineering Council</td>
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<tr>
<td>P³</td>
<td>Pharmaceutical Partnerships Programme</td>
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<tr>
<td>PC</td>
<td>Productivity Commission</td>
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<tr>
<td>RR&amp;DCs</td>
<td>Rural R&amp;D Corporations</td>
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