



Society for Knowledge Economics

## Submission to the Review of Australia's National Innovation System

This submission has been prepared under the skilful guidance  
of our Advisory Committee on Innovation

Submitted: April 30, 2008

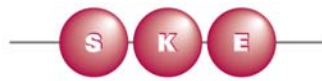
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Society for Knowledge Economics

## **About the Society for Knowledge Economics**

The Society for Knowledge Economics (SKE) is a not-for-profit organisation founded in June 2005. Our founding and other members include organisations such as Microsoft, Westpac Banking Corporation, CPA Australia, PricewaterhouseCoopers, the New South Wales Department of Lands, the Department of Finance and Deregulation, the University of New South Wales, Macquarie Graduate School of Management, Sydney University, and others.

The SKE believes that Australia needs a collaborative industry organisation, with high profile people (industry leaders, academics, policy makers and others), who work together to make Australia one of the world's leading knowledge economies.

To this end, the SKE conducts industry-based research projects and prepares policy submissions, research papers, thought leadership pieces and editorials to influence policy directions and management and leadership practices in the Australian economy. Visit [www.ske.org.au](http://www.ske.org.au) for more information.

## **Declaration of Interest**

The SKE and the members of this Advisory Committee have a vested interest in ensuring that government policy supports the development of Australia as a more prosperous and innovative society and economy.

We believe that innovation will be critical, as a national and organisational strategy and capability, to sustain economic prosperity and social wellbeing in Australia. We also believe that it is the shared responsibility of government, business, researchers, education providers and others to develop Australia's national innovation system.

Specifically, for government, there is a need to position innovation as a national priority supported by a whole-of-government approach.



## Acknowledgements

This submission builds on the 2006 policy paper, *New Pathways to Prosperity*, by the Business Council of Australia, in collaboration with the Society for Knowledge Economics (authored by Prof. Roy Green).

In developing this submission, the SKE has attached a high priority to obtaining the views of a wide cross-section of the community with an interest in Australia's innovation future.

Specifically, the SKE would like to acknowledge the generous work and expertise of the members of the special Advisory Committee that have helped create this submission, and also those that assisted with the 2006 policy paper.

The members of the 2008 Advisory Committee are:

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- Bill Withers, Managing Director, acQuire Technology Solutions, WA

The authoring of this submission has been led by Christina Boedker. Yet many more people have participated in preparing the submission. Specifically, Renu Agarwal's research assistance has been very valuable. Prof. Roy Green has provided skilful guidance on innovation policy and practices in Australia and overseas. Dr. Rowan Gilmore has led the writing of the two case studies which provide practical insights to some of the barriers and enablers of innovation in Australia. Steve Vamos, the Chair of the Advisory Committee, has shown his leadership and commitment to making Australia a more advanced knowledge society.

Prof. Mark Dodgson and Associate Prof. Don Scott-Kemmis have reviewed this submission and provided valuable comments and suggestions, for which we are thankful.

This paper is the result of workshops held with the Advisory Committee on April 4 and April 29, 2008. This paper was presented to Dr. Terry Cutler on April 29, 2008.



### **Executive Summary**

Those who have collaborated on this submission believe that we need to make Australia the most advanced nation in the world in which to foster innovation. This requires leadership, a strategic approach to policy formulation, collaboration and 'joined-up' thinking in government and across industry, policy, research and academia.

Innovation is critical to ensure continued economic prosperity and social wellbeing in Australia. Indeed, the future growth and prosperity of Australia will depend on our ability to innovate. Innovation offers many benefits. It enables us to respond more effectively to economic and social challenges, for example, climate change and skills shortages. It helps increase Australia's international competitiveness and create a sustainable economy. It also plays a vital role in the creation of social wellbeing and the maintenance of high living standards for Australians.

Innovation can be broadly defined as the application of knowledge to create additional value, wealth and wellbeing. Innovation is much more than invention, and occurs not just in laboratories and universities but across society and the workforce. Specifically, innovation requires that knowledge and ideas be transformed into new goods, services, or production processes to provide additional social and economic benefits.

Those who have collaborated to develop this submission consider that Australia needs a clearer framework of strategic support at government, business and community levels to lift innovation in Australia.

Currently, there are **areas of relative weakness** in Australia's national innovation system, which act as barriers to Australia reaching its full potential and lifting innovation performance. Some of these are summarised in Table 1 overleaf, which shows Australia's performance on 23 innovation indicators across six categories<sup>1</sup>. The areas where Australia is performing poorly include:

- Collaboration and value networks (notably between businesses and researchers)
- Research and development (R&D) (notably business investments into R&D, as well as availability of scientists and engineers and 'brain drain'<sup>2</sup>)
- Public expenditure on education
- Leadership, culture and management at the workplace level (specifically, the number of businesses that innovate, and their capacity for innovation)
- Broadband subscribers and technological readiness
- The business environment and regulation (specifically, burdens of business regulation and total tax rate).

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<sup>1</sup> Table 1 benchmarks Australia's performance across 23 indicators relative to other international nations. It draws on data from, among others, the World Bank, the OECD, and the World Economic Forum. The appendices section of the report provides a full summary of the indicators summarised in Table 1. Table 1 is by no means a perfect representation of Australia's innovation performance, but is merely intended as a starting point for further research and discussion. It could possibly serve as input into the creation of a National Innovation Scorecard for Australia. 😊 = top 10% of performers 😐 = 10%-20% 😞 = below 20%.

<sup>2</sup> It should be noted that 'brain drain' might not necessarily be a threat or a negative issue. Indeed, there can be potential benefits to Australia from people going to work overseas, including opportunities to tap into networks with expatriate Australians and gain access to global knowledge and innovation.



**Table 1: How Do We Fare? Barriers to Innovation in Australia**

Indicator	Rank (% , rank)	Performance
<b>1. Collaboration and Value Networks</b>		
All types of external collaboration by companies (with clients, suppliers, public research institutions, etc)	28%. Australia ranks 20 as compared to the EU27	
Collaboration with universities or other higher education institutes	2%. AU ranks 27 as compared to the EU27 nations. EU27 average is almost four times the AU measure.	
Regional collaboration & Int. collaboration outside region	Indicators not available for Australia	N/A
<b>2. Research and Development</b>		
Gross domestic expenditure on R&D - GERD (% of GDP)	1.76%. Australia ranks 17 out of 39 OECD nations	
Business expenditure on R&D	53.5%. Australia ranks 26 out of 39 OECD nations	
Research & development indicator (patents and scientific journals)	Australia ranks 19 out of 140 nations	
Availability of scientists & engineers	Australia ranks 34 out of 131 nations	
Quality of scientific research institutions	Australia ranks 15 out of 131 nations	
'Brain drain' (whether a country's talented people leave to pursue opportunities in other countries)	Australia ranks 36 out of 131 nations	
Availability of venture capital	Australia ranks 15 out of 129 nations	
<b>3. Education and Skills Development</b>		
Public expenditure on education (% of GDP)	4.28%. Australia ranks 25 out of 33 OECD nations	
Quality of the educational system	Australia ranks 8 out of 131 nations	
Education and human resources (secondary and tertiary enrollment)	Australia ranks 5 out of 137 nations	
<b>4. Culture, Leadership and Management</b>		
Capacity for innovation	Australia ranks 30 out of 131 nations	
% of AU companies that innovate	34%. Australia ranks 15 as compared to the EU27	
Sophistication of business strategy and operations	Australia ranks 24 out of 131 nations	
Production process sophistication	Australia ranks 23 out of 131 nations	
Willingness to delegate authority	Australia ranks 14 out of 131 nations	
National human capital survey	Indicators not available for Australia	N/A
<b>5. Technology Infrastructure</b>		
ICT coverage	Australia ranks 5 out of 131 nations	
Broadband subscribers per 100 inhabitants	Australia ranks 12 out of 30 nations	
Technological readiness	Australia ranks 17 out of 131 nations	
<b>6. Business Environment and Regulation</b>		
Economic incentive and institutional regime (tariff and non-tariff barriers, regulatory quality and rule of law)	Australia ranks 16 out of 137 nations	
Burden of government regulation	Australia ranks 68 out of 131 nations	
Total tax rate	Australia ranks 83 out of 131 nations	



This indicates that opportunities exist to improve Australia's innovation performance.

To this end, those who have collaborated to develop this submission suggest a number of **strategic actions from government**, starting with clear and aligned policy objectives, increased funding, strong leadership, and the strategic allocation of resources.

Maximising our innovation potential requires, first and foremost, that innovation be recognised as a critical national priority, with government's full commitment. This could include:

- Strengthening (or replacing) the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) with a body of governance and custodianship, possibly labeled the 'Innovation Council Australia'. Such a body would be chaired by the Prime Minister. It would lead the development of a new governance framework for Australia's innovation system and seek to overcome weaknesses in the current system. In particular, it would be responsible for aligning policy initiatives and programmes within and between governments.

Such a new body would also be tasked with establishing clear national innovation priorities. This could involve:

- Setting innovation policy as a new national reform priority for the Council of Australian Governments (COAG) to ensure coordination across the nation as a whole and eliminate duplication and fragmentation of programs across state and federal levels.
- Identifying critical national infrastructure and capability requirements, including delivery mechanisms to business, large and small.
- Ensuring that national challenges are turned into national opportunities (climate change being one example).
- Aligning incentives for all stakeholders involved.
- Embedding innovation into all areas of public service delivery.

Strategic action would also include setting medium- to long-term strategic objectives and targets for Australia's innovation system to enable forward thinking, track performance, and ensure accountability for all involved. This could include:

- A 'benchmarking exercise' of Australia's innovation performance internationally, focusing on national strengths and weaknesses, and leveraging the findings of this National Innovation Review to this end.
- A 'Knowledge Foresight 2025' exercise to further explore gaps in the national innovation system, and enable collaborative planning for the future.
- A National Innovation Scorecard to govern and monitor performance and progress.

The above strategic actions would require the support of a **series of operational measures**. Some of our recommendations and suggestions on these are summarised in Table 2, which is structured in accordance with the six pillars introduced in Table 1. These are discussed in detail in the main body of the report.

**Table 2: Some Recommendations for Lifting Australia's Innovation Potential**

**1. Collaboration and Value Networks**

*Strengthen linkages and collaboration between all elements of Australia's innovation system*

- Prioritise the development of closer collaboration between business and the research and education sectors, for example, via a National Centre for Collaboration, Industry Placement Programs, intermediaries and Collaborative 'Lighthouses', and a new model for developing course curricula (see main body for more details).
- Support innovation resource centres such as the *Enterprise Connect Network*.
- Increase international collaborations, for example, by creating more incentives for multinational enterprises to invest in Australia and form partnerships with Australian businesses, including SMEs.
- Consider establishing Australian Innovation Centres abroad, as done by some European countries.
- Develop regional 'centres of excellence' to maximise the utilisation and development of local endowments and specialised regional competencies.

**2. Research and Development**

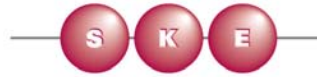
*Implement specific policy and investment measures to make Australia's research institutions world leaders*

- Develop a shared vision to transform Australian research institutions into world leading institutions, supported by strong leadership and measures, which aim to lift private and public sector investment into R&D.
- Implement measures to attract the best and brightest of our young people into research and academia. Future Fellowships is a welcomed initiative, but more is needed. This may include efforts at changing public perception and making research and academia attractive career paths for young people to pursue.
- Strengthen the commercialisation and development of new products and services, for example, via funding agencies similar to the Finish TEKES and 'proofs of concepts' to road-test commercial application and benefits.
- Inquire into alternative measurement systems for incentivising businesses investments into R&D and intangible resources.

**3. Education and Training**

*Enhance policy focus and strategic investment in education and training to improve the innovation capabilities of our people*

- Ensure education and training systems, including VETs, are equipping Australian children and adults with the skills and capabilities to become innovative, aimed at developing both 'soft' and 'hard' skills (see the main body for more details).
- Introduce measures to raise the percentage of people in business with tertiary qualifications in science and technology.
- Develop a greater tolerance for change and ambiguity in students and recognise 'change management' as a key area of expertise that requires skills development.
- Support teachers and, importantly, teaching methods that contribute to the development of innovation skills in primary, secondary and tertiary education.
- Introduce a national adult learning program to ensure Australians across all socio-economic and ethnic groups have the basic skills that underpin innovation, specifically basic language, literacy and numeracy skills.



**Table 2: Some Recommendations for Lifting Australia's Innovation Potential (continued)**

<p><b>4. Leadership, Culture and Management</b></p> <p><i>Improve the innovation management practice of public and private organisations</i></p>	<ul style="list-style-type: none"><li>• Strengthen innovation capabilities, leadership skills and management practices at the workplace level, for example, by creating a 'National Forum for the Workplace of the Future' or a 'Futures Centre', which is jointly governed and managed by industry, government, researchers and other stakeholders.</li></ul> <p>Such a centre would be charged with: 1) building learning networks; 2) running collaborative industry research projects; 3) analysing, researching and disseminating information about industry practices and needs; 4) communicating alternative leadership styles, management structures, organisational cultures, and people management practices that lift innovation activity; and 5) providing input to, and possibly coordinate, a national human capital survey.</p>
<p><b>5. Technology Infrastructure</b></p> <p><i>Improve the nation's technology infrastructure, recognising that ICT is an enabling source of innovation</i></p>	<ul style="list-style-type: none"><li>• Ensure Australia's information and communications infrastructure, specifically broadband, is 'leading edge' and globally competitive. The government's \$4.7 billion promise to establish a National Broadband Network is a welcome initiative, but more may need to be done to ensure future enhancement capacity.</li><li>• Align the governance of government information and communications technology (ICT) strategy (i.e. AGIMO) to the national innovation governance structure.</li><li>• Ensure government leads the acceleration and uptake of new ICT technologies in government service delivery.</li><li>• Actively encourage a supportive business climate and partnerships for and between SME ICT firms and global ICT players and develop a continued set of incentives to take local ICT innovations to the global market.</li></ul>
<p><b>6. Business Environment and Regulation</b></p> <p><i>Undertake continuing micro-economic reforms that improve and sustain a business environment for innovation</i></p>	<ul style="list-style-type: none"><li>• Reduce the burden of government regulation to ensure corporate governance systems do not inhibit entrepreneurial behaviour, and continue to support schemes that work well, such as export grants.</li><li>• Support SMEs, for example, by improving Government Procurement Policy to provide equal access for SMEs, the US SBIR being one example.</li><li>• Review and reform the taxation system (individual and corporate) to ensure it encourages higher levels of innovation, specifically for SMEs (pay roll tax being an example of an area for possible inquiry).</li></ul>



## 1. Introduction

The future growth and prosperity of Australia will depend on our ability to find new ways to innovate. Australia's aging population, growing inflationary pressure, skills shortages, and the emergence of strong global competition mean that innovation is increasingly important as a source of economic growth and sustainability, and as a determinate of international competitiveness. We also face great challenges such as climate change and the persistence of social inequality. Through innovation, Australia as a nation can make a contribution to addressing these challenges.

In a global and domestic economy where services and knowledge-based production is becoming increasingly important, the use, development and application of knowledge is now as important to economic growth as efficiencies in production. Since there are absolute limits to lifting productivity growth through increased labour-force participation and work intensification, Australia must find new ways to sustain high levels of economic growth. Whilst efficiencies in production became the primary determinate of economic prosperity in the 20<sup>th</sup> century, innovation in turn is becoming the main catalyst for economic growth in the 21<sup>st</sup> century. Indeed, with improvements to productivity, from the last two decades of microeconomic reform, beginning to fade, innovation will be critical to keeping productivity growth on par with accelerating inflation in the future.

This trend is being further amplified by the changing nature of global competition. Increasing competition, particularly from low-cost emerging economies, and the steadily increasing rate of technological change means that competing through efficiencies delivered by structural reform is no longer enough for developed economies such as Australia. In short, the changing nature of our economic circumstances is pushing to the fore the importance of innovation for future economic prosperity in Australia. That is why governments, together with the private sector, must make innovation a national economic priority. As in the 1980s when we began to recognise the importance of microeconomic reform to our future prosperity, we now need to recognise the critical role that a comprehensive and strategic innovation policy will have in our economic future.

This paper sets out what innovation is, why it is important, and why a more focused and strategic approach is needed by Australia to capture greater benefits in the form of increased productivity and higher value for the goods and services we produce. Specifically, the paper reviews and identifies, through a series of analyses and discussions, barriers to innovation in Australia, and outlines recommendations for how these can be overcome.

This paper argues that a National Innovation Framework is needed to identify and harness the benefits of Australia's innovation potential and allow us to take a lead role in global innovation. It provides a series of recommendations, across the six pillars of the National Innovation System, as critical 'pointers' to the creation of a comprehensive and strategic National Innovation Framework for Australia. The key theme throughout the submission and its recommendations is 'collaboration'. Each agent in the innovation process brings its own capabilities and strengths to this process. Broadly speaking, business brings the commercial know-how, capital and access to markets, educational institutions the intellectual capital and linkages, while the key inputs from government are policy leadership, strategic focus, and overarching vision that enable these other agents and their capabilities to be 'joined together' into a coherent whole.

The SKE and the Members of the Advisory Committee look forward to further developing the recommendations and initiatives outlined in the Framework with government, business, our education and university systems and the broader community over the next 12 months.



## 2. The Innovation Imperative

Put simply, innovation means ‘creating or doing new things or doing things in new or better ways’, drawing on knowledge, relationships, value networks<sup>3</sup> and other knowledge-based assets to add value to products and processes. While R&D activities make a vital contribution to innovation, it is essential that we recognise, define and promote innovation across a much broader range of sectors and activities than R&D, whether they are developed in Australia or overseas.

There is increasing recognition around the world that innovation is a key driver of the competitiveness of firms and organisations in the global economy, and the quality of both private and publicly provided services. Most successful societies of the new millennium, not to forget the emerging economies of China and India, have grasped the opportunities and challenges of innovation, made it their own vision of the future and translated the vision into reality through strategic focus and action. Australia must ensure that it is one of these societies.

The federal government has emphasised the importance of innovation to lifting Australia’s productivity and to supporting future growth and opportunities for the nation, reflected in the commissioning of the current review of our National Innovation System and the emphasis on a new approach to innovation. They state:

‘Innovation is a key driver of productivity and economic growth, particularly for advanced economies such as Australia. Innovation drives the creation of new businesses and sectors and revitalises existing industries ... Federal Labor will put the right policy framework in place, implementing a range of initiatives to: bridge the divide between industry and research; ensure that business has better access to new ideas and new technology; and increase innovation incentives across the economy.’<sup>4</sup>

This new approach to innovation needs to be embedded into the national culture – in government, economic policy, business strategy, workplaces and the community to bring direct benefits for the nation’s economic potential.

### 2.1. Creating Prosperity

Traditionally, wealth was thought to have its source in land, labour and capital as factors of production, but with the joining of information and technology the world changed forever. This new industrial revolution has forged greater understanding of the dynamic role of knowledge-based assets in creating value for organisations and, in doing so, has transformed the productive performance of whole economies. In the 21<sup>st</sup> century, economies are increasingly competing on the basis of unique value delivered through the development and application of knowledge and knowledge-based assets in the production of goods and services. Consider for example that Australia’s services sector now accounts for close to four-fifths of Australia’s economic activity,

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<sup>3</sup> A technology or new innovation seldom travels alone. Instead, it takes on ‘form’ and gains strength as it travels through networks. The value of an innovation is created by the network that a technology or innovation travels through. Verna Allee (2003) defines value networks as any web of relationships that generates both tangible and intangible value through complex dynamic exchanges between two or more individuals, groups or organisations. Similarly, Fjeldstad & Stabell (1998) point out that value networks is a configuration which emphasises that the value being created is *between* customers *when they interact* facilitated by the *value networks*. Clayton Christensen’s (1997, p. 296) definition is slightly different. He defines value network as: ‘the collection of upstream suppliers, downstream channels to market, and ancillary providers that support a common business model within an industry’. The main point is that value assigned to an innovation or technology is a network effect.

<sup>4</sup> See ‘An innovation future for Australian Industry’, by Senator Kim Carr, November 2007 (p. 1).



employs 85% of the workforce, and accounts for 23% of exports. Economic production in such sectors relies increasingly on the mediation of knowledge-intensive services and human capital.

Australia is currently experiencing an unprecedented boom in its primary commodity exports and a reversal in the decades-long deterioration of its terms of trade, as markets are reshaped by China's entry into the world economy. Yet Australia still lags behind many of its international competitors in terms of Gross Domestic Product (GDP) per capita. The International Monetary Fund, for example, ranks Australia number 15 in GDP per capita, at \$43,312, behind countries such as the USA, the Scandinavian countries, Germany, Ireland, The Netherlands and Switzerland. Opportunities exist to improve Australia's GDP performance, and innovation is a plausible strategy for doing so.

The significance of innovation to GDP performance has been shown by a number of leading innovative nations. Examples include, among others, Ireland, whose success is based on integrating global investors with local supply chains to build a presence in software, pharmaceuticals and medical devices; the 'Asian Tigers', including, for example, Taiwan, with its formidable and continuously improving manufacturing capability in electronics and semi-conductors; Singapore, which is reinventing itself as a trade, investment and financial services hub for the Asia-Pacific region; and Finland, now a world leader in mobile telephony and related technologies.

Other successful knowledge-based economies may be larger, but one of their key strategic advantages lies in geographically concentrated clusters of skills and technologies, which drive an increasing share of growth. Examples from the US have included Silicon Valley, the Carolinas 'Research Triangle', Minnesota's 'Twin Cities', Austin, Texas, and, following the exit of computer hardware, the remarkable emergence of a Massachusetts biotech region. From Europe, examples include biosciences clusters in Cambridge and Munich, digital media in South-east England and Flanders, and French 'competitiveness poles' such as Grenoble and Sophia Antipolis.

While these economies are diverse and complex, with distinctive systems of governance and public policy, there is arguably a common thread in their success – *investment in human capital and collaborative networks, besides R&D and technology infrastructure, as part of a broader innovation framework that provides a favourable business environment for innovation and enables knowledge diffusion*. It is this strategic policy focus, through a mix of government, business and education institutions, which creates innovation capacity at national and regional levels. This capacity in turn underpins the development of more specific innovation capabilities at the organisational level, where it counts for growth, employment and competitiveness.

Investment in human capital and value networks, besides R&D and technology infrastructure, as part of a broader innovation framework that provides a favourable business environment is essential to innovation success.

## **2.2. Expanding the Boundaries**

Innovation can only be understood in its totality as a combination of different but interrelated elements contributing to the development of new, commercially relevant products and processes, or the delivery of better, more cost effective services. It ranges from what Clayton Christensen calls 'sustaining' or incremental innovation, by improving the performance of organisations, to 'disruptive' innovation, which creates whole new markets. While the innovation pathway may proceed along a conventional 'linear' route from scientific discovery to exploitable invention, and then to market, this tends to be the exception rather than the rule.



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Innovation is both a more complex and much broader phenomenon than traditional views focused on R&D and paradigm-changing technologies, although these remain very important. Innovation transcends traditional functional boundaries both nationally and within organisations, and this 'dispersion' of innovation to reside in 'many places' poses new challenges to policy makers and managers alike. It means that innovation is more ambiguous and more complex to influence and manage, requiring new skills at both the government and organisational levels.

Essentially, innovation has at least three main elements – technological, organisational and network-based.

### Technological Innovation

Technological innovation is often identified with the formal, codified knowledge arising from basic research in science and technology and its application to product and process development. In this sense, it can be measured by the output of scientific papers and patents, and a strong correlation with public investment in research and education is suggested by the international data. However, such innovation may also reflect continuous improvement in technology, which results from an internal focus on quality, and externally from a broader process of networking and collaboration, including with customers and suppliers; such activity is more difficult to quantify.

### Organisational Innovation

Clearly, as can be seen in the case of technological innovation, not all knowledge is codified and measurable, and nor does innovation always embody R&D in new products and processes. The second element of innovation is *organisational innovation*, where knowledge and learning may be tacit as well as codified, and has the capacity to transform organisations through adaptation and absorption of new technologies, introduction of new operational processes and implementation of new workplace structures and practices.

Significantly, a recent ABS-DITR (2006) survey, *Patterns of Innovation in Australian Businesses*, found that non-R&D spending accounted for over two-thirds of total business expenditure on innovation. While most innovating firms reported changes which were 'new to the business' rather than 'new to the world', research suggests that organisational innovation can result in substantially improved performance through structural flexibility and agility, high performance workplaces and good practices associated with new product and service development, quality and supply chain management. The organisational challenge, identified in the innovation management literature, is how to do two things at once: how to be 'ambidextrous' – to explore and exploit, to be fluid and organic, and structured and systematic.

There is support for this approach in IBM's 2006 global CEO survey, *Expanding the Innovation Horizon*. While, according to the survey, CEOs continue to place more emphasis on technological innovation, they now focus 30% of their efforts on organisational innovation, particularly changes in their business models. Further, 'companies that have grown their operating margins faster than their competitors were putting *twice* as much emphasis on business model innovation as underperformers'. In this context, CEOs identified 'organisation structure changes' and 'major strategic partnerships' as key features of business model innovation.



### Network-based Innovation

Firms engaged in innovation clearly do not operate in isolation from the external business and broader economic and policy environments. This is why the external environment of innovating firms is, and must be, shaped by network innovation, the third element of innovation.

Innovating firms benefit from structured collaboration, technology spillovers, networking and knowledge diffusion, where the boundaries of the extended enterprise become less easy to draw. Recent research has highlighted the emergence of 'open systems' approaches to innovation, including increasing engagement with the innovative feedback loop generated by customer engagement. In Australia, DITR's (2006) analysis, *Collaboration and Other Factors Influencing Innovation Novelty in Australian Businesses*, found that firms which collaborated for innovation had a much greater chance of achieving a 'new to the world' degree of novelty, especially in technology-intensive sectors.

Internationally, a Frost & Sullivan (2006) research program, *Meetings Around the World: The Impact of Collaboration on Business Performance*, supported by Verizon Business and Microsoft, found that 'collaboration works in conjunction with strategic orientation and opportunities inherent in the market environment ... to improve business performance', and that collaboration was more than twice as significant for performance than these other factors.

PricewaterhouseCoopers, in their 11<sup>th</sup> Annual Global CEO survey (2007), conducted with 1150 CEOs across 50 nations, found that collaborative networks is a defining principle for business with 57% of CEOs stating that collaboration is a defining organisational principle. Managing collaborative networks, however, requires new skills and new business practices and the survey also found that most companies are still opportunistic in their approach to capitalising and maximising the value of collaborative networks and how these are managed.

Successful and emerging knowledge-based economies are typified by sets of institutions and intermediaries, which support not only the internal capabilities of firms and organisations but also the interrelationships which allow them to realise their full productive potential. International comparative studies by Michael Porter and others have demonstrated that 'national innovation capacity', including research, education and networking infrastructure, is as important as internal technological capabilities in driving competitiveness.

### **3. Australia's National Innovation System – We Can Do Better**

The federal government's call for a review of Australia's National Innovation System signifies the importance of innovation in Australia. Certainly, Australia's national innovation system has pockets of excellence, such as the CSIRO and its National Flagships Program, the various Cooperative Research Centres, and sector-specific R&D institutions such as the Australian Centre for Minerals Extension and Research (ACMER).

Yet there are also gaps in the national innovation system and areas where Australia can do better. The Australian Bureau of Statistics' Innovation survey (2005), for example, reports that only 34% of Australian businesses are 'active in innovation'. This places Australia in 15<sup>th</sup> place compared with the 27 European Union nations. Similarly, an international survey of manufacturing firms (Dodgson and Innes, 2006) finds that Australian companies lag behind their international counterparts in terms of pursuing innovation as a business strategy. The study concludes that 'while there is evidence of manufacturers engaging in some innovative business practices, especially towards achieving production efficiencies, they generally fail to appreciate and employ innovation as a

decisive competitive strategy'. This indicates that more needs to be done to increase innovation activity in business and across government organisations.

Figure 1 provides a graphic illustration of Australia's National Innovation System. It shows that innovation offers macro-economic benefits, such as increased labour force productivity, reduced inflationary pressure, improved competitiveness and a more robust and sustainable economy. It also illustrates that the nation's GDP per capita rates are linked to and influenced by six operational 'pillars' of innovation, each of which can act to enable and/or impede innovation activity. These six pillars are charged with: 1) enabling collaboration and strengthening linkages between all sectors of the economy and with international markets; 2) building world class research capabilities and institutions; 3) developing leading education and training systems that build the innovation capabilities and skills of people; 4) creating the workplace environments and cultures where innovation is enabled, allowed and encouraged to flourish, supported by the right leadership skills and management tools; 5) developing the nation's technology infrastructure, recognising that ICT is a key enabling source of innovation for all industry sectors; and 6) fostering a regulatory environment, which incentivises and rewards innovative activity.

**Figure 1: Australia's National Innovation System**

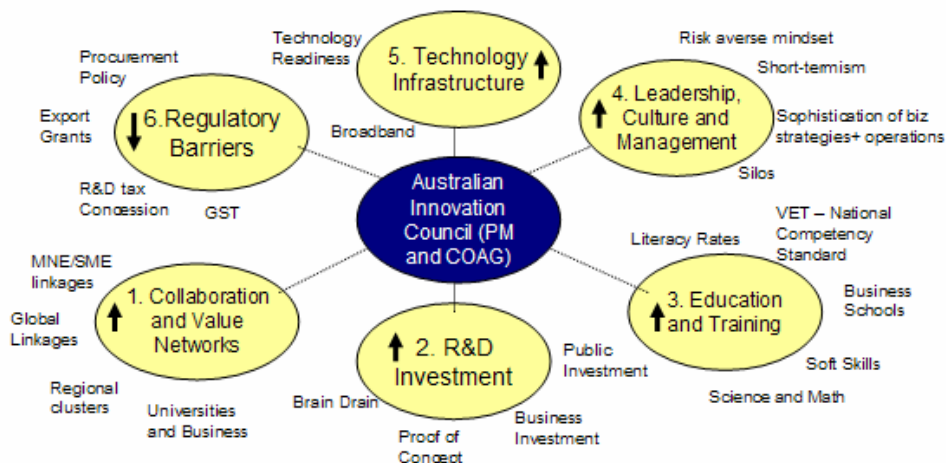
1. Anticipated Macro-Economic Effects of Innovation

↑ Labour force productivity = ↓ Inflationary pressure  
 ↑ Australia's International Competitiveness & Comparative Advantage  
 ↑ GDP growth → Full employment → Economic Robustness

2. Objective of the National Innovation System

Increase Australia's GDP per Capita	2010 Target	2012 Target
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3. How to achieve the Objective? The 6 Pillars of Innovation



The following sub-sections outline recommendations for 'strategic action' in government and for 'operational action' in each of the six pillars shown in Figure 1.



### 3.1. Strategic Action in Government

At the strategic level, there is an opportunity to identify the long-term advantages conferred by a comprehensive innovation system, which promotes both the generation and systematic application of knowledge within and across sectors. Thus far, there has been no strategic vision for Australia to pursue innovation as a national strategy. To this end, the people who have collaborated on this submission suggest that government must take a strategic approach to innovation, recognise it as a critical national priority, and align efforts across our national innovation system to this end.

As discussed in the Executive Summary, this would involve establishing a new governance framework for Australia's innovation system, which seeks to overcome weaknesses in the current system, in particular the need to improve focus and better align policies within and between governments. Currently, the effectiveness of this system is compromised by the lack of innovation policy focus and 'joined-up thinking' in government, public agencies, business and universities, as well as fragmentation and duplication of programs across state and federal levels<sup>5</sup>. Funding deficiencies is another impeding factor (see OECD's report on *Governance of Innovation*, 2005). Key leaders across state- and federal-level government must have a shared understanding of their role and interrelationships as well as a willingness to collaborate for the system to deliver results and to build innovation capabilities at the level of individual firms and organisations.

Strategic action (as discussed in the Executive Summary) could include strengthening (or replacing) PMSEIC with a body of custodianship and governance, possibly labelled the 'Australian Innovation Council', chaired by the Prime Minister and working with COAG. This would be charged with elevating and setting innovation as a new national reform priority for federal and state governments. It would provide whole-of-government policy coordination within and between governments, and between governments, business and the education and research sectors, and comprise business leaders, university leaders, researchers and other stakeholders in innovation policy. Such a body would also identify critical national infrastructure and capability requirements, including delivery mechanisms to business, large and small, and be responsible for the development and implementation of innovation policies.

A strategic approach will also involve establishing medium- to long-term strategic objectives and targets for Australia's innovation system to enable forward thinking, track performance, and ensure accountability for all involved (see again the Executive Summary for details).

This in turn will require an expansion of research data and measures to allow better insights into the performance and effects of Australia's national innovation system, and to strengthen innovation management practices at the organisational and national level.

Strategic action needs to be supported by the development and strengthening of the six operational pillars (see again Figure 1). Each of these six pillars is discussed in the following sub-sections. A summary of recommendations is provided in table format at the conclusion of each of the six sub-sections.

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<sup>5</sup> Senator the Hon Kim Carr mentioned on 22 Jan 2008, that 'At last count there were 169 programs in Australia, across all levels of government, aimed at supporting innovation.'. See <http://minister.industry.gov.au/SenatortheHonKimCarr/Pages/GOVERNMENTANNOUNCESREVIEWOFNATIONALINNOVATIONSYSTEM.aspx>



### 3.2. Collaboration and Value Networks

The level of effective collaboration between businesses and universities and research institutions and more broadly between the private and public sectors is of fundamental importance to innovation success.

There is now wide acceptance within business that the main sources of innovation are likely to come from outside the organisation. As noted by Howard (2005), 'access to new knowledge through networks is recognised as an important way of accessing and acquiring new ideas, insights and technologies for new products and services, for new approaches to business processes (both within and between businesses), and new ways of responding to consumer behaviour and wants'.

While Australia has benefited from examples of highly effective collaboration, there continues to be considerable scope to improve the level and quality in all sectors, in particular between industry and public sector research institutions and universities. The 2005 ABS Innovation Survey found that around 28% of innovating businesses in Australia engaged in some form of external collaboration or alliance. Particularly noteworthy are the low levels of collaboration between researchers and industry, with only 7% of innovating businesses having formed collaborative links with universities, governments or research institutions. This compares poorly to international performance, according to research by the Australian Business Foundation (2007) (see Table 3), which illustrates that collaboration between innovating businesses and universities is 2% in Australia, compared to 33% in, for example, Finland. Similarly, collaboration between innovating businesses and clients and customers is 12% in Australia versus 41% in Finland, and 28% in Sweden and Denmark (see Table 3).

**Table 3: External Collaboration by Innovating Firms  
EU (2002-04) versus Australia (2004-05)<sup>6</sup>**

	EU27	Den.	Ire.	Fin.	Neth.	Swed.	AU
<b>Innovating enterprises</b>	42%	52%	52%	43%	34%	50%	34%
<b>Collaboration with clients or customers</b>	14%	28%	25%	41%	22%	28%	12%
<b>Collaboration with suppliers</b>	17%	28%	23%	41%	30%	32%	11%
<b>Collaboration with universities or other higher education institutes</b>	9%	14%	10%	33%	12%	17%	2%
<b>Collaboration with public research institutes or government agencies</b>	6%	7%	6%	26%	9%	6%	3%
<b>All types of external collaboration</b>	26%	43%	32%	44%	39%	43%	28%

<sup>6</sup> Eurostat news release 27/2007 22 Feb 2007 and ABS Cat. 8158.0, presented by Dr Matthew Steen at the Victorian Government's National Innovation Agenda Forum, 31 October 2007. Table 3 has limitations in that it compares data from two different sources. It is, as such, not a perfect representation, but is rather intended to be a starting point for further discussion and more comparative research.



## Society for Knowledge Economics

Measures that aim at developing more effective collaboration between sectors of the economy, specifically research and industry, need to be viewed as a priority for strengthening the national innovation framework. The government's pre-election promise to create and fund an industry placement program is a welcome initiative to this end. This includes funding of \$10 million within Enterprise Connect to support the placement of researchers from universities or public research agencies into businesses where it is identified that such a placement would help to develop and implement a new idea with commercial potential. Under this initiative, the government will provide funding for up to 50% of salary costs – to a maximum of \$50,000 – for each 12 month placement<sup>7</sup>. Placing researchers in business is also intended to help break down the cultural divide between business and the research sector, whether the researcher is from a university or research agency.

A second measure to strengthen linkages between research and industry includes an assessment of the benefits of extending the requirement for researchers in universities and research organisations to have a partner or partners outside their organisation when making an application for various research funding mechanisms (possibly using ARC Linkage Grants as a model).

A third possibility is to undertake a more detailed assessment of the barriers to collaboration and provide recommendations on strategies to counter these. This may include a more in-depth assessment of the incentives that exist for collaboration between industry and universities, also taking into consideration perceptions and cultures that prevail in academia, business and elsewhere. Recommendations on 'what needs to change' and 'how this should be done' would be one outcome of such an assessment.

A fourth option relates to how courses are developed at universities and business schools, which traditionally has been done, by and large, by the teaching institutes themselves. Yet ideas for new courses often originate from business. Opportunities thus exist to develop a new model for the delivery and development of course curricula. Such a model would encourage and ensure the participation of industry managers and specialists in course design, and that course curricula are in line with demand and reflect the needs of industry. Universities can act as mediators between industry requirements and knowledge production in relevant fields and have procedures in place whereby new demand can be found, assessed and acted upon in a timely manner.

Australia could also explore, as a fifth option, the establishment of a National Institute or a National Centre for Collaboration. In the United States, the University of Nebraska is the home of a recently established Institute for Collaboration Science. Australia could explore the option of establishing such a centre here with the purpose of undertaking research into effective collaboration, including teaching collaboration concepts to undergraduates, graduates and organisational leaders.

Organisations such as the Society for Knowledge Economics (established with the support of Westpac, Microsoft, CPA Australia, PwC, UNSW, MGSM and others) that bring together thought leaders across public and private sectors also have a vital role to play in driving discussion, insight and collaborative recommendations across private, public and research sectors. Such organisations represent a new model of working in a highly collaborative, technology-enabled world for the common good of a knowledge-based economy. Government could play a more proactive role in encouraging stronger linkages between the important agents of innovation.

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<sup>7</sup> Source: Election 07 Fact Sheet , 'An innovation future for Australian industry New Leadership', Kim Carr, Nov. 2007.



### The Role of Intermediaries and Innovation Agencies

Collaboration also brings into perspective the importance of intermediaries in increasing collaboration and thus innovation activity. The case study by Rowan Gilmore in the appendices section illustrates the importance of intermediaries and value networks to innovation. It emphasises that Australia must do better to create the right environment and connecting mechanisms between SMEs, universities and others to transform and 'transport' new products and services into commercial offerings. New technologies seldom travel alone and their life span may be very short if not given appropriate vehicles for transportation and commercialisation. Organisations such as the Australian Institute for Commercialisation play an important role as mediator, connector, enabler and 'transporter' of innovation from theory into practice and from concept into action.

Yet at the operational level, innovation agencies in Australia may not have sufficient support, scale or funding linkages that would allow them to emulate the role of their counterparts in other countries such as the Fraunhofer Institutes in Germany, the Finnish Funding Agency for Technology and Innovation (Tekes) and the highly effective Enterprise Ireland. These agencies work with business and public research organisations to identify and evaluate opportunities and then to exploit them in a systematic way, from 'proof of concept' stage to commercial application, including opportunities for business and technology integration. In some cases, these agencies also support technology transfer and commercialisation to ensure research funding is used for public benefit, either individually or on a 'shared services' basis as in Switzerland, Israel, Midlands UK and the University of California systems (Cunningham and Harney, 2006), and to encourage universities to become 'innovation hubs' for business networks and clusters. Public agencies of this kind are part of the new emerging technology and innovation infrastructure of 'innovation intermediaries' (Dodgson et al., 2005). Australia does not currently have institutions such as these overseas organisations, and opportunities exist to evaluate the pros and cons of introducing similar vehicles in Australia.

The government's proposal to establish innovation resource centres such as the Enterprise Connect Network (ECN) may be one suitable measure to this end. Kim Carr announced on 26 March 2008, that the formation of the ECN is aimed at linking businesses to new ideas and new technologies. This includes the establishment of five new manufacturing centres in Sydney, Melbourne, Adelaide, Perth and Burnie, which will be joined by Queensland's QMI Solutions. It also includes five dedicated innovation centres operating under innovation councils – a Creative Industries Innovation Centre, a Clean Energy Centre, a Remote Enterprise Centre in Alice Springs, a Mining Technology Innovation Centre in Mackay, and an Innovative Regions Centre in Geelong. The ECN could help extend the range of support services available to small and medium-sized business, possibly under the guidance of sector-specific bodies, and in close cooperation with services provided by the States.

### International Collaboration – Building Linkages with Global Markets

It is also essential that Australian businesses, research organisations and education institutions engage in effective international collaboration. Collaboration is a major issue for the nation. It is compounded by our distance from global markets, as the Committee for the Economic Development of Australia (CEDA) highlighted in their research in 2007.

Stronger linkages with the global innovation system will be increasingly critical for Australia to lead the development of new products, technologies and services internationally. International collaboration needs to involve organisations working together in effective partnerships that add value through improvements in knowledge, network building and learning, resulting in new goods,



services and access to new markets. Given the fact that approximately 98% of all new knowledge is generated outside Australia, Australia has to prioritise providing more support and potentially incentives for effective international collaboration in research, and also in the utilisation and international commercialisation of new knowledge or ideas.

Doing so, however, requires the establishment of national priorities for global collaboration and investment in mechanisms that build links to global networks and innovation systems. Australia can and ought to be a 'global hub' in many more areas than it currently is. Australia leads with technological innovation in industry segments, such as water preservation and management. Yet innovative Australian technologies and services do not always see the light of global markets. Opportunities exist to develop the mechanisms to profile and position Australia as the global hub in many more industries and more consciously drive Australian practices and standards into the global sphere. Doing so may require new processes for assessing and analysing, in a more rigorous manner, the unique capabilities and technologies that currently exist in Australia and to develop appropriate mechanisms for transforming these into global products and practices. Furthermore, incentives for multinational enterprises to invest in Australia and form partnerships with Australian businesses, including SMEs, could be more closely assessed and encouraged. A closer examination of the potential for forming a coalition of smaller nations to work together more effectively in research and innovation – such as South Africa, Ireland, Chile and South Korea – is another plausible option<sup>8</sup>.

Another possible model is the joint initiative between the Danish Ministry of Science, Technology and Innovation (DMSTI) and the Danish Ministry of Foreign Affairs, who have established the 'Innovation Centers of Denmark'. Centers have been opened in Silicon Valley, California and Shanghai, China. In January 2008, a third centre was opened in Munich, Germany. The primary purpose of the centers is to strengthen research and innovation performed by Danish research institutions and companies by facilitating their access to foreign networks, knowledge, technology, capital and markets. To facilitate the contact between Danish and foreign research environments and business communities, the centers are located in dynamic regions where recognised universities and world leading companies collaborate in unique and innovative environments. Thus, the centers act as 'bridges' between Denmark and the countries in question. Furthermore, they promote the coordination of Danish research and innovation initiatives, thereby enhancing visibility and impact of Danish research and business communities abroad. Similar initiatives may be considered in Australia as means to strengthen ties with international communities/global markets and thus improve Australia's innovation capabilities and the transfer of knowledge to and from Australia.

While the Danish Innovation Centres are one potential model, another approach might be to take the most successful examples of Australia's Cooperative Research Centre program and pilot these overseas in partnership with foreign governments.

A last point to note is that currently there are limited measures available on the degree of collaboration between Australia and its regional neighbours, specifically the Asia Pacific region, or with countries outside the APAC region. The OECD compiles measures on EU collaborations within the region and with countries outside the region, but not on Australia (see the 'How Do We

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<sup>8</sup> Note here Senator Kim Carr's suggestion for the following measures to strengthen international linkages: 'Australia also needs to ensure that it leverages its position as an economy that produces roughly two per cent of the world's research and innovation. A Rudd Labor Government will examine the potential for forming a coalition of smaller nations – such as South Africa, Ireland, Chile and South Korea – to identify where they work together more effectively in research and innovation.' Source: An innovation future for Australian Industry, November 2007 (p. 9).



Fare?’ section in the appendices for more details). Future surveys on Australia’s innovation performance may consider incorporating such measures on Australia<sup>9</sup>.

### Constructing Regional Advantage – the Notion of ‘Regional Centres of Excellence’

Another opportunity for strengthening innovation activity in Australia is the notion of ‘regional hubs’ or ‘regional centres of excellence’. Overseas initiatives by regional and national governments have been successful in this regard; the Italian fashion industry being one example, the Danish Textile Footwear and Clothing industry another. An Earth Sciences and Technology Centre in Western Australia is one of many possibilities for creating regional centres of excellence in Australia.

State and federal governments could play a role in developing such initiatives by providing the mechanisms and support structures, regional or state-specific, for bringing together diverse stakeholders (SMEs and MNEs, public and private companies, universities and business) to jointly develop, strengthen and commercialise region-specific products and competencies.

The European Commission’s (2006) paper on *Constructing Regional Advantage* highlighted the need to devise new ways to valorise specific knowledge assets at regional level and to increase average investment in R&D. The working group devised a methodology as a flexible tool providing a variety of approaches for delivering guidance and workable approaches to regional policy makers. The assumption behind regional advantage is that firms rarely, on their own initiative, start cooperating with neighbouring firms or co-located knowledge creating and diffusing organisations. Thus, a key policy recommendation is for a more planned and systemic approach where the public sector holds a dynamic role in interacting with the private sector, in facilitating knowledge exchanges, creating linkages between stakeholders within the region, identifying and analysing local competencies and endowments, and providing appropriate mechanisms for increasing the development and exploitation of regional assets<sup>10</sup>.

The government’s pre-election promise to invest \$20 million to establish an Innovative Regions Centre in Geelong, as part of the Enterprise Connect network, is a welcome initiative to this end. The aim of the centre will be to boost local economies and create new jobs. It will provide direct support to small- and medium-sized businesses in targeted regions, helping them to develop their business skills and link into relevant innovation networks. It will also build on successful experiences in Australia and overseas by providing seed funding to support region-specific strategies, such as business clusters and networks that aim to boost the innovative capacity of local firms. In the longer term, an expansion of such initiatives to build regional advantage and maximise and strengthen the utilisation and development of local endowments and specialised regional knowledge and competencies could be considered. Specifically, such centres ought to focus on fostering collaborations between SMEs and MNEs, public and private companies, universities and business to strengthen local endowments and regional advantages.

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<sup>9</sup> See <http://miranda.sourceoecd.org/vl=1986996/cl=11/nw=1/rpsv/sti2007/q-7.htm>

<sup>10</sup> Specifically, the report recommends a flexible approach in which regions identify basic building blocks using four dimensions, including: (1) *related variety*; (2) *differentiated knowledge*; (3) *distributed knowledge networks*, which in turn enable the formulation of trans-sectoral (4) *platform policies* for potential applications across a wide range of industries. The three dimensions relate to: 1) initiatives which combine the strength of the specialisation of localisation economies and the diversity of urbanisation economies; 2) identifying local knowledge bases (‘analytical’, ‘synthetic’ and ‘symbolic’), and 3) shedding light on how knowledge bases of different sectors are changing as a consequence of globalisation.



## Summary Table: Recommendations on Collaboration and Value Networks

### 1. Collaboration and Value Networks

Objective:  
*Strengthen linkages and collaboration between all elements of Australia's innovation system*

- Support closer collaboration between business and the research and education sectors. This could include:
  1. Funding industry placement programs, as proposed by the government.
  2. Examining the benefits of extending the requirement for researchers in universities and research organisations to have a partner or partners outside their organisation when making an application for various research funding mechanisms (possibly using ARC Linkage Grants as a model).
  3. Undertaking an assessment of the barriers to collaboration and, specifically, providing recommendations on strategies to counter these (i.e. what incentives exist for collaboration between industry and universities; what perceptions, cultures and paradigms prevail in academia, business and elsewhere?; what needs to change and how?)
  4. Developing a new model for the delivery and development of course curricula, which encourages and ensures the participation of industry managers and specialists; and that course curricula reflect the needs and practices of industry.
  5. Consider establishing a National Centre for Collaboration to undertake research into effective collaboration, including teaching collaboration concepts to undergraduates, graduates and organisational leaders.
- Support collaborative 'lighthouse' organisations that connect thought leaders across industry, government, academia and research to find solutions for sustained prosperity in the knowledge economy, such as the SKE and the Australian Institute of Commercialisation.
- Support innovation resource centres such as the Enterprise Connect program, which will extend the range of support services available to small- and medium-sized businesses under the guidance of the sectoral Innovation Councils and in close cooperation with services provided by the States.
- Invest in developing stronger linkages between the Australian National Innovation System and the global economy. Build the mechanisms to, for example, develop profile and position Australia as the global hub in certain industry segments (water preservation and management being one example); increase incentives for multinational enterprises to invest in Australia and form partnerships with Australian businesses, including SMEs; and consider the feasibility of establishing Australian Innovation Centres abroad.
- Support the creation and development of regional or state-specific 'centres of excellence' to build regional advantage and maximise and strengthen the utilisation and development of local endowments and specialised regional knowledge and competencies. Diverse stakeholders (SMEs and MNEs, public and private companies, universities and business) would collaborate to produce and pilot new capabilities, new service and new products; the Italian fashion industry being one example, the Danish Textile Footwear and Clothing industry another. An Earth Sciences and Technology Centre in Western Australia is one of many possibilities in Australia.

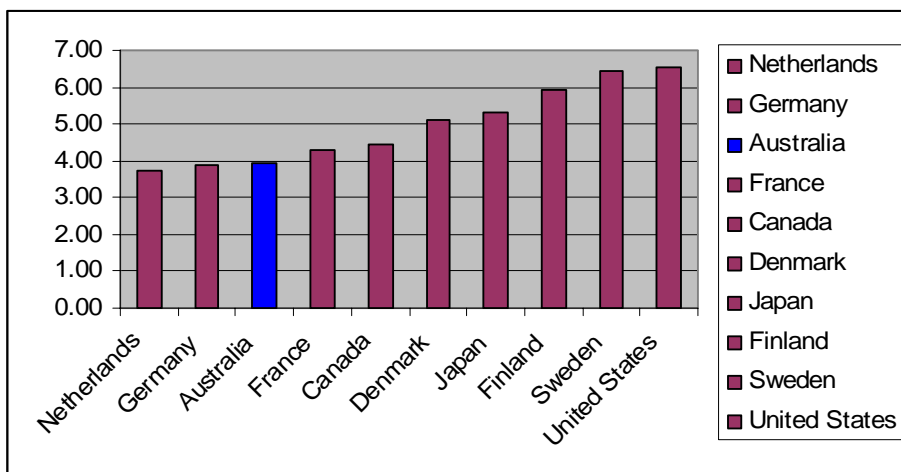
### 3.3. Research and Development

#### Investment in R&D

Australia has always compared well in scientific output, but a lower proportion of investment in research and education as a proportion of GDP when compared to other developed nations threatens this achievement. There are also serious gaps and weaknesses in Australia's R&D performance and in the transfer of knowledge to markets by industry and public research organisations. While technological innovation in Australia has been stepped up in the past decade, so has the performance of the rest of the world, and in many countries at a faster pace. According to OECD Science Technology and Industry Scoreboard (2007)<sup>11</sup>, Australia spent 1.76% of GDP on R&D in 2004-05, up from 1.51% in 2000-01, yet far short of leaders such as Sweden (3.98%), Finland (3.49%), Japan (3.31%), USA (2.74%), Denmark (2.58%), France (2.20%) and Canada (2.02%). While R&D many not be a comprehensive performance measure, it is an important indicator of levels of technological innovation.

ABS data points to a 25% increase in higher education expenditure on R&D to 0.48% of GDP in the two years to 2004. Whilst Australia is still behind leaders such as Sweden (0.88, 2003) and Canada (0.73), this is a clear improvement. On the other hand, the modest increase in business expenditure on R&D to 0.95% of GDP in 2005 compares much less favourably with the position of Sweden (2.95%), Finland (2.46%), Japan (2.36%) and Korea (2.01%). Aggregating expenditure on R&D, higher education and software into an index of 'investment in knowledge', OECD data shows Australia at 3.94% of GDP trailing comparable countries including France (4.31%), Canada (4.45%), Denmark (5.1%), Finland (5.92%), Sweden (6.44%) and the USA (6.56%) (see Figure 2).

**Figure 2: Investment in Knowledge (R&D, Higher Education and Software) % of GDP 2004**



The OECD data points to a 30% increase in R&D, higher education and software expenditure across the 1997-2003 period, yet Australia is still behind leaders such as Denmark (1.29%, 2004), Japan (0.98%, 2004), USA (0.91%, 2004), Sweden (0.86%, 2004) and Canada (0.54%, 2004) across the same period.

<sup>11</sup> See the OECD <http://masetto.sourceoecd.org/vl=1418233/cl=47/nw=1/rpsv/sti2007/index.htm>



The structure of Australian industry, with a large services sector, smaller scale manufacturing operators and significant resource base, may provide a potential explanation for Australia's low business R&D expenditure. However, R&D is important in the innovation process in the mining and agricultural sectors, and increasingly so in services industries. Therefore, the fact that Australia's business R&D intensity is substantially less than overseas competitors should be of concern.

Work by the OECD<sup>12</sup> and others highlight that existing measurement systems can be a barrier for business to increase investments in knowledge-based assets and intangibles. The current shareholder value model, the prevailing archetype of business reasoning, can dis-incentivise investments into intangible by treating these as expenses, not assets that can be amortised. Short-termism and a narrow focus on return-on-investment is not always conducive to innovation, and new archetypes of reasoning may be required to focus on long-term value creation and for companies and share markets to better recognise the value of intangible assets and associated investments.

A risk averse business environment can be another inhibitor to increasing business investment. The Knowledge Assessment Methodology (KAM) 2007 report by the World Bank<sup>13</sup> measures, across 130 nations a country's ability to generate, adopt and diffuse knowledge, taking into account whether the environment is conducive for knowledge to be used effectively for economic development. The index measures, among other things, the availability of venture capital, and finds that Sweden, Denmark, Norway, Finland, The Netherlands, USA and UK generally provide venture capital for risky projects more easily than Australia<sup>14</sup> (see Table 1, and also the 'How Do We Fare?' section in the appendices for more details). An attitude of risk avoidance in Australia may be an underlying impeding factor to increasing business investments.

To counter this, federal and state governments must take a leadership role and recognise and emphasise to the business community and others that investment in R&D is critical to the virtuous cycle of national economic performance. It is also the responsibility of government to continue to introduce incentives aimed at lifting public and private investment via tax and regulation (see section 6 for more discussion thereon).

To aid the commercialisation of new technologies and products, government may consider providing funding arrangements which finance innovative activities and 'intermediation services' where there are currently barriers to private sector investment. A feasibility study could start this process by investigating the reasons for private sector under-funding of certain innovation activities, and provide recommendations on arrangements to improve funding for innovative activities such as early stage venture development and activities that involve the creation or use of intangible assets. The Finnish Funding Agency for Technology and Innovation (Tekes) and other

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<sup>12</sup> See, for example, the OECD 'World Intellectual Capital Initiative', formed in Paris on 31 October 2007. The WICI brings together industry and policy experts from the European Commission, the Japanese Ministry of Trade and Industry, the US Enhanced Business Reporting Consortium, and Australia to collaborate on promoting the management and reporting of intellectual capital/assets at company level throughout the world and to develop business management and reporting frameworks to this end. See also the Australasian Capital Reporting on Knowledge Award for an example of an Australian initiative ([http://www.arawards.com.au/criteria\\_a.html](http://www.arawards.com.au/criteria_a.html)). See also the SKE submission to the US Securities Exchange Commission's Inquiry into Improvements to Financial Reporting <http://www.ske.org.au/reports.php>.

<sup>13</sup> The KEI measures four pillars related to the knowledge economy: economic incentive and institutional regime; education and human resources; the innovation system; and ICT. The KI index however only takes into account the last three pillars of the knowledge economy. See [http://info.worldbank.org/etools/kam2/KAM\\_page5.asp](http://info.worldbank.org/etools/kam2/KAM_page5.asp)

<sup>14</sup> This measure is based on a statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether entrepreneurs with innovative but risky projects can generally find venture in their country (1= not true, 7= true).



similar foreign initiatives might be useful as models for establishing an investment agency or vehicle in Australia. Other means of expanding financial incentives for investment in innovation through venture capital support, loan subsidies and income-contingent loans should also be considered.

Measures to improve the knowledge transfer and commercialisation activities of universities should also be assessed and improved upon. Universities are rich sources of knowledge that can solve business problems and create new products or services. However, because such knowledge or research is often either formative or implicit, it lacks expression in a tangible form. Measures to aid the transformation and commercialisation process could include, among other things, the creation of proof of concepts. Small amounts of funding, typically less than \$100,000 per project, are required to take research to a 'demonstrator' or 'proof of concept stage' that shows its potential use or benefit. Beyond the scope of research grants, such funds are difficult to obtain from private sources because the transaction costs of providing it are simply too high. Governments could, in this regard, consider making available to research organisations a pool of funds, awarded competitively, yet rapidly, to enable the creation of 'proofs of concept' from research, which in turn can be used to show the feasibility of use and provide assurance to further investment (for instance, by angel investors or pre-seed venture capitalists).

Measures to improve the knowledge transfer and commercialisation activities of universities may also involve the creation of 'Shared Services Centres' for groups of universities to support university commercialisation structures.

A third option would be to review the intellectual property regimes of universities to improve the arrangements for sharing and transferring intellectual property between universities, businesses and the research sector, and to establish frameworks that simplify the way intellectual property can be shared between jurisdictions.

#### Attracting People into R&D and Retaining Skilled People in Australia, Specifically Scientists and Engineers

Another impeding factor to increasing R&D activity relates to skills shortages. The take-up of research degrees by Australian students has, for example, stayed flat over the last decade. Furthermore, compared to other Western countries, Australia fares poorly on attracting people into R&D. For example, Australia only has eight PhDs per thousand in the workforce, compared with 11 in the US, 20 in Germany and 28 in Switzerland<sup>15</sup>. This is compounded by the general lack of availability of scientists and engineers in Australia. The Global Competitiveness Report 2007-08, for example, ranks Australia number 36 on 'availability of scientists and engineers' (see Table 1 and 'How Do We Fare?' in the appendices for more details).

Consideration should thus be given to lifting the profile and reputation of academic and research careers, in addition to salary levels, which on average tend to be lower than those in industry. This may include efforts at changing public perception of what research is, and public campaigns designed to re-position and re-profile careers in research and academia as attractive career paths for young people to pursue. The government's promise to double the number of Australian Postgraduate Awards for PhD and Masters by research students, and create 1000 new four-year Future Fellowships is a welcome initiative to address some of these challenges. It is also encouraging that Federal Labor has committed to halving HECS fees for maths and science

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<sup>15</sup> See the 2006 Audit of Science, Engineering and Technology Skills  
<http://minister.industry.gov.au/SenatortheHonKimCarr/Pages/SCIENCESERVINGSOCIETY.aspx>



students, and halving their repayments if they take up jobs in key fields, like teaching, to help address Australia's chronic shortage of qualified mathematicians and scientists. More such measures are needed.

Consideration could also be given to incentivising highly skilled people to stay in Australia. On the one hand 'knowledge flight' out of Australia threatens the nation's innovation capabilities and long-term prosperity. The World Economic Forum's Global Competitiveness Report 2007-08, which benchmarks nations on their competitiveness across 12 pillars<sup>16</sup>, for example, ranks Australia number 36 on their 'brain drain' measure, which indicates that Australia can do better at retaining highly skilled people. Yet, on the other hand, 'brain drain' may not necessarily be a threat or a negative issue since there can be potential benefits to Australia from people going to work overseas, including opportunities to tap into networks with expatriate Australians and through that access global knowledge and innovation. To counter knowledge flights, India and China have recently instituted incentives to bring expatriates back home. Incentives include, among other things, tax breaks, travel allowances to stay connected with activities overseas, and recognising medical degrees taken overseas. China is also implementing special funds, talent reserves and higher salaries to give expatriate families preferential treatment. In addition, people who wish to invest capital and set up hi-tech companies are enticed with loans and tax breaks and the opportunity for a place in the newly created entrepreneurial parks.

Australia may assess the feasibility of national strategies for people retention to secure the long-term prosperity of the nation. The government acknowledges this and some initiative has been taken to address this issue<sup>17</sup>. Simultaneously, the government may assess the benefits of strengthening ties with expatriate Australians and through that increase Australia's access to global knowledge and innovation.

### Summary Table: Recommendations on Research and Development

<p><b>3. Research and Development</b></p> <p><i>Objective: Implement specific policy and investment measures to make Australia's research institutions world leaders</i></p>	<ul style="list-style-type: none"><li>• Develop a shared vision to transform Australian research institutions into world leading institutions, supported by strong leadership and measures which aim to lift private and public sector investment into R&amp;D.</li><li>• Investigate the feasibility of federal and state government investment fund arrangements to finance innovative activities where there are currently barriers to private sector investment.<ul style="list-style-type: none"><li>○ The feasibility study could investigate the reasons for private sector under-funding of certain innovation activities, and possible arrangements to improve funding for innovative activities such as early stage venture development and activities that involve the creation or use of intangible assets.</li><li>○ Consideration should be given to whether the Finnish Funding Agency for Technology and Innovation (Tekes) and other similar foreign initiatives might be useful as models for establishing an investment agency or vehicle in Australia.</li><li>○ Other means of expanding financial incentives for investment into innovation</li></ul></li></ul>
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<sup>16</sup> These include: institutions; infrastructure; macro-economy; health and primary education; higher education and training; goods market efficiency; labour market efficiency; financial market sophistication; technological readiness; market size; business sophistication; and innovation.

<sup>17</sup> The 'An innovation future for Australian Industry', by Senator Kim Carr, November 2007 (p. 9) suggested the following measures to retain skilled staff in Australia: 'A Rudd Labor Government will invest in new Future Fellowships to keep Australia's best and brightest mid-career researchers in Australia. This program will offer four year Fellowships valued at \$140,000 a year to 1,000 of Australia's top researchers in the middle of their career. In addition, each researcher's institution will receive a \$50,000 grant to support the purchase of related infrastructure and equipment for their research project.'



through venture capital support, loan subsidies and income-contingent loans should also be considered.

- Inquire into alternative measurement and accounting systems for incentivising businesses investments into R&D and intangible resources.
- Improve the knowledge transfer and commercialisation activities of universities by:
  - Developing 'proofs of concepts' to illustrate commercial application, benefits and opportunities and indicate feasibility for further investment by the private sector.
  - Supporting university commercialisation structures, including 'Shared Services Centres' for groups of universities.
  - Reviewing the intellectual property regimes of universities to improve the arrangements for sharing and transferring intellectual property between universities, businesses and the research sector.
- Implement measures to attract the best and brightest of our young people into research and academia, and to retain high quality people in Australia. The government's suggestion to create 1000 new four-year Future Fellowships is a welcome initiative, but more is needed. This may include efforts at changing public perception of what research is, and campaigns, which would re-position and re-profile careers in research and academia as attractive careers paths for young people to pursue.

### **3.4. Education and Training**

A focus on collaboration and R&D, however, is not sufficient to equip businesses with innovation skills and capabilities and heighten innovation activity.

The development of world-class innovation capacity requires as its precondition a national commitment to invest in human capital and infrastructure, including schools and universities, vocational education and training and provision for life-long learning. Such an investment will ensure a skilled and adaptable workforce, ready to meet the challenge of innovation and change. Such an investment should also be directed at building more entrepreneurial cultures, developing leadership skills and managers in the workplace, who are willing to take risks in implementing new ideas.

The OECD (2005) has noted that Australia is the only country 'where the shift towards private expenditure at tertiary level has been accompanied by a fall in the level of public expenditure in real terms'. This is at a time when, according to an independent working group for the Prime Minister's Science, Engineering and Innovation Council (PMSEIC), China and India, as well as the USA and Europe, are increasing the rate of investment in human capital as a matter of priority: 'Today we stand at the brink of a new era – investing in our education and research base now will create opportunities to build a technology-based Australian economy that is internationally engaged'. Yet caution may have to be taken when judging Australia's performance, since public investment may be countered by the higher levels of private investments with more families sending their children to private school in Australia than overseas, specifically Europe.

An additional measure to consider as a point of comparison is the 'quality of Australia's education system'. Here, Australia ranks 8 out of 131 according to the Global Economic Forum. On the 'quality of higher education and training' Australia ranks 14 out of 131, still behind leading western countries (see Table 1 and the 'How Do We Fare?' section for details).



## Society for Knowledge Economics

A key priority for a national innovation policy is the development of education and training systems, which provide people with the capabilities to contribute to innovation success. Research suggests not only the importance of the development of strong technical skills in the workforce but also those associated with communication, teamwork, problem solving, entrepreneurship and leadership. A capacity for change and tolerance for dealing with ambiguity are likewise important skills which underpin innovation activity.

However, there is evidence to suggest that whilst Australian education and training systems generally fare high in terms of quality, they are not meeting the innovation needs of industry. For example, the Allen Consulting report, *World Class Skills for World Class Industries* (2006), found that many employers have difficulty accessing employees with appropriate levels of 'soft skills'. Furthermore, a recent study by the Australian Bureau of Statistics illustrates that Australians lack the basic skills which underpin innovation, and estimates that 46% of Australian adults have poor or very poor skills across one or more of the five domains of prose literacy, document literacy, numeracy, problem solving and health literacy.

Strengthening innovation in society and at the workplace will involve addressing both the development of basic skills and, more specifically, the development of innovation skills across all levels of education. A national adult learning program would help develop the basic skills that underpin innovation, including language, literacy and numeracy. Education and training systems should be charged with ensuring that Australian children are provided with the capabilities and skills for innovation. This requires teaching students, at primary, secondary and tertiary levels, industry-relevant technical skills, as well as capabilities associated with communication, teamwork, problem solving, entrepreneurship, leadership and a greater capacity for change and tolerance for how to deal with ambiguity. Opportunities also exist to increase participation rates in post-compulsory education and training, specifically in the innovation foundation subjects of maths, science and technology, but also in subjects such as arts and design, philosophy, and people and business management, which are likewise important to building a culture of innovation. Greater support may also be given to the development of industry placements and exchanges, mentoring programs and, more broadly, networking opportunities between students and industry. Such programs can aid the development of innovation skills by increasing the transfer rates of knowledge and by providing stimuli from multiple environments. Last, the current efforts at developing national competency standards on innovation are critical to developing skills across all levels of the workforce.

Opportunities also exist to introduce measures to raise the percentage of people in business with tertiary qualifications in science and technology. Employment of tertiary-level graduates is an indicator of the labour market's innovative potential and displays a general trend towards upskilling. The OECD scoreboard ranks Australia number ten in terms of tertiary-level graduates in total employment (2004).

However, developing innovation skills in students also requires support for teachers and their teaching methods to ensure these contribute to the development of innovation skills. Currently, opportunities exist to strengthen the professional development of teachers, particularly of maths, science and technology, who are not qualified in those areas, to extend their qualifications. Furthermore, an opportunity exists to examine and identify the usefulness and impact of different teaching methods (i.e. field trips, practice-based learning versus PowerPoint lecturers, etc) for developing innovation skills in students.



## Summary Table: Recommendations on Education and Training

### 4. Education and Training

*Objective: Enhance policy focus and strategic investment in education and training to improve the innovation capabilities and culture of our people*

- Ensure education and training systems, including VETs, are providing Australian children and adults with the capabilities to become innovative by:
  1. Teaching students, at primary, secondary and tertiary levels, industry relevant technical skills, as well as capabilities associated with communication, teamwork, problem solving, entrepreneurship and leadership.
  2. Instituting course curricula in business school programs and professional qualification programs to further build innovation management and leadership capabilities aimed at, amongst other things, the development of skills on how to leverage relationships and collaboration to increase innovation activity.
  3. Develop a greater tolerance for change and ambiguity in students and recognise 'change management' as a key area of skills development in course curricula.
  4. Improving participation rates in post-compulsory education and training, particularly in the innovation foundation subjects of maths and science, but also in subjects such as arts and design, philosophy and people, and business management, which are likewise important to building a culture of innovation. Government's promise to double the number of Australian Postgraduate Awards for PhD and Masters by research students is a welcome initiative.
  5. Providing greater support for the development of industry placements and exchanges, mentoring programs and, more broadly, networking opportunities between students and industry.
  6. Introduce a national post-school *Entrepreneurs and Innovators Internship* program, allowing young people the opportunity to gain from the experience of working for and with practitioners, including those based overseas.
  7. Continue to support the development of national competency standards on innovation skills development.
  8. Sustaining high levels of support available for workers to update or upgrade skills that support and build innovation skills, including IT, communication and general business skills, and more generally, life-long learning.
- Introduce measures to raise the percentage of people in business with tertiary qualifications in science and technology.
- Support teachers and teaching methods that contribute to the development of innovation skills and creativity by:
  1. Strengthening the professional development of teachers, particularly of maths, science and technology to extend their qualifications.
  2. Strengthen the professional development of teachers to teach innovation skills in existing courses, for example, by examining and identifying the usefulness and impact of different teaching methods for developing innovation skills in students.
- Introduce a national adult learning program to develop the basic skills that underpin innovation, including language, literacy and numeracy.



### **3.5. Leadership, Culture and Management at the Workplace Level**

The significance of management skills associated with managing knowledge and innovation *at the workplace level* is being increasingly recognised.

An OECD study (2004) found that creating a knowledge sharing culture and alliances for acquiring knowledge were becoming more widespread internationally, and that a clear association could be observed between such practices and innovation and productivity, though not one which is well researched or understood. A recent Economist Intelligence Unit (2006) world-wide survey of executives and managers found that most identified knowledge and innovation management, in preference to areas such as marketing and product development, as the source of the greatest anticipated productivity gains over the next 15 years.

Yet evidence suggests that Australia can do more to develop management skills in these areas. The World Economic Forum's Global Competitiveness Report indicates that Australia lags behind in terms of business management and innovation capabilities at the workplace level. For example, in the 'capacity for innovation' category, Australia ranks number 30 whilst Germany comes in at number 1, with the Scandinavian countries following close thereafter. Furthermore, on the 'sophistication of company operations and strategy', Australia ranks number 24 (the USA is number 1). (See Table 1 and 'How Do We Fare?' in the appendices for more details).

Specifically, culture and leadership styles (besides organisational bureaucracies, silo-based structures and slow decision making due to hierarchical layers) can inhibit and/or enable knowledge sharing and innovation to take place. An opinion survey by Open Forum (2008) on behalf of the SKE, identified the following issues as barriers to innovation in Australia:

- Social and political conservatism, including a tendency for risk-averse and 'insurance-driven' thinking
- the tall poppy syndrome
- short-termism in business thinking
- a lack of systemic support for innovation
- a lack of leadership and communication in business<sup>18</sup>

Opportunities may exist to incorporate into business schools and professional qualification programs curricula which aim to further build innovation management and leadership capabilities, including how to manage knowledge and how to use relationships and collaboration to increase innovation activity.

Strengthening innovation capabilities at the workplace level may, however, also require policy interventions over and above the more traditional levers of education and training. Larger scale, collaborative industry research projects, such as the five-year intellectual capital project with 150 organisations funded by the Danish Ministry of Science, Innovation and Technology, take a different approach to workplace transformation by providing opportunities for practice-based learning. Centres such as Ireland's National Centre for Partnership and Performance, which coordinated the 2003-04 Forum on the Workplace of the Future, and the Workplace Development Program in Finland, are other examples of a more practice-based approach to transforming workplace practices. Table 4 summarises some of the more significant workplace development initiatives internationally (see also the summary of Workplace Development Initiatives in the

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<sup>18</sup> The opinion survey also found that enablers of innovation included: technology adoption; a 'can do' and pioneering attitude; cultural diversity; high education standards; networking and sociability; and a distributed society.



appendices for more details). Such centres support a more informal approach to workplace transformation and learning by offering and running workplace development projects, providing access to informal learning networks, and by disseminating information on high performance management and work practices to the business community.

**Table 4: Workplace Development Initiatives – International Examples**

Ireland	National Workplace Strategy – Workplaces of the Future
Finland	Workplace Development Program
UK	The Work Foundation
Canada	Workplace Skills Initiative
Sweden	Future Workplace

Australia does not currently have a ‘National Forum for Workplace Development’ or a ‘Leadership Centre Australia’. Yet increasing innovation participation rates above the current 34% may require a different approach to transforming workplace practice than those offered through education and university training. An Australian Futures Centre or a Forum for the Workplace of the Future could play a role in this. Such a centre could, for example, provide leadership by: 1) researching, assessing and communicating the usefulness and impacts of alternative leadership styles, management structures, organisational cultures and people management practices as drivers and/or impediments to innovation activity at the workplace level; 2) building learning networks, for example through larger scale collaborative industry research projects where diverse stakeholders (public and private companies, researchers, associations and others) jointly solve practical business problems and pilot new goods, service and processes; and 3) examining, researching and communicating to and with the business community alternative business strategies, processes and staff capabilities for lifting innovation activity and developing learning networks to this end. Such a forum may be hosted by a third-party organisation with demonstrated skills and competencies in industry-based research, collaboration, and in leveraging and building high quality networks across government, industry and academia. It may be done in collaboration with, for example, the new statutory body, Skills Australia, and should be jointly owned and operated by government, academia and business.

Greater insights into workplace performance are also required to direct better management efforts to this end. This could, for example, involve a broader investigation of management and leadership methods at the workplace level (in line with the original Karpin report from 1995)<sup>19</sup>. Such a review could in turn feed into a subsequent assessment of management education programs to ensure that Australia’s education system is focused on delivering the capability needs of managers in coming decades. A second possibility is to initiate a national Human Capital, or Workplace Performance, Survey in Australia. The USA has in place a Federal Human Capital Survey, which measures national performance across four pillars, including Leadership and Knowledge Management; Results-Oriented Performance Culture; Talent Management; and Job Satisfaction (See ‘How Do We Fare?’ in the appendices for more details).

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<sup>19</sup> See Karpin (1995) ‘Renewing Australia’s Managers to Meet the Challenges of the Asia-Pacific Century Industry Task Force on Leadership and Management Skills’. The 27 reports resulting from this three-year study provided the most comprehensive insights ever into the way Australia prepares its managers for work and leadership, and also presented policy recommendations and options based on the Task Force findings.



Such initiatives (i.e. a Karpin II and a national Human Capital, or Workplace Performance, Survey) could be developed in Australia under the auspices of a National Futures Centre, or Forum for Workplace Development.

Undoubtedly, the success of Australia's national innovation system will increasingly depend on the quality and relevance of capabilities at the organisational level. Accordingly, as workplaces become more flexible and responsive in a changing competitive environment, the emphasis of economic reform will need to evolve to a new stage – *the leadership, culture and management of Australian organisations*, and the educational infrastructure and programs required to support the development of innovative capabilities within organisations.

### Summary Table: Recommendations on Leadership, Culture and Management

#### 5. Leadership, Culture and Management at the Workplace Level

*Objective: Improve innovation practices in public and private organisations*

- Strengthen innovation capabilities, leadership skills and management practices at the workplace level by:
  - Generating widespread discussion through a 'National Forum for the Workplace of the Future' or 'Leadership Centre Australia'. Such a centre would enable workplace transformation through a more practice-based and participative approach to learning. It could be jointly governed and managed by government, industry and researchers and oversee a nationwide workplace development strategy. Such a body could strengthen innovation activity by:
    - a. Assessing, researching and communicating the usefulness and impacts of alternative leadership styles, management structures, organisational cultures, and people management practices as drivers and/or impediments to innovation activity at the workplace level.
    - b. Build learning networks to lead and coordinate larger scale collaborative industry research projects where diverse stakeholders (public and private companies, researchers, associations and others) jointly solve practical business problems and pilot new goods, services and processes.
    - c. Examining, researching and communicating to and with the business community alternative business strategies, processes and staff capabilities required to lift innovation activity and develop learning networks to this end.
    - d. Coordinating a Karpin II to feed into a subsequent assessment of management education programs to ensure that Australia's education system is focused on delivering the capability needs of managers in coming decades.
    - e. Providing input to, and possibly coordinate, a national human capital survey or workplace performance survey in Australia looking, for example, at leadership and knowledge management; results-oriented performance culture; talent management; and job satisfaction.
  - Consider the development of collaborative (cross organisational) professional development and management of education programs.

### 3.6. Technology Infrastructure

The effective provision of information, communication and technology infrastructure is a key transformational source of innovation for all industry sectors including the educational, cultural, environmental and not-for-profit communities. Measures should be taken to enhance the quality of Australia's infrastructure systems, in particular widespread deployment of high quality information and communications infrastructure, including broadband, which is a vital underpinning for an innovation economy.



Whilst Australia has increased its position on the World's Bank index on ICT from 1995 till 2007<sup>[1]</sup>, it still lags behind leading countries such as Sweden in terms of telephone, internet and computer penetration (see Table 1 and 'How Do We Fare?' in the appendices for more details).

Government's promise to invest up to \$4.7 billion to establish the National Broadband Network in partnership with the private sector is a much welcomed initiative to strengthen Australia's broadband capability. This deployment will improve the underpinning platform infrastructure to create future innovative products and services. It is noted, however, that the rate of technology change in this area is rapid and that the infrastructure needs to be suitably flexible and upgradeable to support future change and become a global leader.

Opportunities also exist to make government a leader in accelerating the uptake and introduction of new technologies, as done in, for example, Sweden, where government is a leader, not a laggard, in the proliferation and uptake of new technologies. Furthermore, opportunities exist to closely align the governance of government ICT strategy (i.e. AGIMO) to the national innovation governance structure (discussed in the section on Strategic Action; see also the Executive Summary).

A high degree of local ICT innovation is driven from the Small and Medium Enterprise (SME) sector. Consideration needs to be given to providing the most appropriate business climate to ensure that this is developed and enhanced. This includes a review of the R&D taxation concessions, a review of overall tax systems (see below), and providing a partnering and mentoring infrastructure that supports SME entrepreneurs in their growth aspirations locally and internationally, as well as the connection to large international ICT firms.

Further, it should be noted that ICT is at the forefront of market globalisation and that support needs to be provided to ensure that innovative new technologies developed in Australia can rapidly be promoted to overseas markets.

### Summary Table: Recommendations on Technology Infrastructure

<p><b>5. Technology Infrastructure</b></p> <p><i>Objective: Improve the nation's technology infrastructure, recognising that ICT is an enabling source of innovation for all industry sectors</i></p>	<ul style="list-style-type: none"><li>• Ensure Australia's information and communications infrastructure, specifically broadband, is 'leading edge' and globally competitive. The government's \$4.7 billion promise to establish a National Broadband Network is a welcome initiative, but more may need to be done to ensure future enhancement capacity.</li><li>• Align the governance of government ICT strategy (i.e. AGIMO) to the national innovation governance structure.</li><li>• Ensure government leads the acceleration and uptake of new ICT technologies in service delivery.</li><li>• Actively encourage a supportive business climate and partnerships for and between SME ICT firms and global ICT players and develop a continued set of incentives to take local ICT innovations to a global market.</li></ul>
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<sup>[1]</sup> ICT is measured as the simple average of the normalised scores on three key variables: telephone; computer; and internet penetrations (per 1000 people).



### **3.7. Business Environment and Regulation**

Innovative capabilities are strongly influenced by the business environment in which firms compete and innovate. Of critical importance are the policy frameworks that affect this business environment. These frameworks include general macro-economic policy settings, competition policy, regulatory frameworks, infrastructure systems, workplace relations frameworks and taxation policy.

Currently, many of these policy frameworks are inhibiting innovation in Australia. For example, firms have expressed increasing concern that the overall regulatory environment in Australia is reducing their desire to engage in entrepreneurial risk and affecting their ability to transform their businesses. In particular, various aspects of the taxation system have failed to adequately support business innovation expenditure and have acted as a constraint to the attraction and retention of skilled workers.

The lack of appropriate policy measures to incentivise innovation in Australia is reflected in the Knowledge Assessment Methodology (KAM) 2007 report by the World Bank. Specifically, the index shows that Australia lags behind its international counterparts on the economic incentives and institutional regime<sup>20</sup>, where Australia ranks behind Sweden, Finland, Denmark, Ireland, Norway, Switzerland, The Netherlands, Canada, USA, UK and New Zealand (see 'How Do We Fare?' in the appendices for more details). Furthermore, the World Economic Forum's Global Competitiveness Report 2007-08, shows that Australia ranks 68 out of 131 nations on the 'Burden of Government Regulation' measure, and 83 out of 131 on the 'Total Tax Rate' measure.

These findings emphasise the importance of continued efforts by governments to undertake economic reform to provide the type of business environment in Australia which encourages and enables innovative activity amongst firms, and the vital nature of such reforms to successful innovation policy.

More broadly, it is essential to pursue comprehensive taxation reform that aims to ensure personal income tax rates and taxes that impact on businesses in Australia are internationally competitive. We need to attract and maintain business investment and highly capable people if we are to be an innovative nation, and the competitiveness of our taxation system is vital to achieving this. Payroll tax is one area which may lend itself to further inquiry and which can be critical to lifting innovation during the start-up and growth phases of SMEs. The section below further discusses the significance of lifting the innovation rates of SMEs.

#### Small- and Medium-sized Businesses: An Example of Government Procurement Policy

The Australian Bureau of Statistics innovation study shows that the proportion of small- and medium-sized businesses engaged in innovation is lower compared to the proportions for large businesses. Yet SMEs contribute a large proportion to Australia's GDP and comprise a major segment of national economic production. Efforts at improving national innovation rates must prioritise incentives specifically targeted at the SME segment.

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<sup>20</sup> This is measured as the simple average of the normalised scores on three key variables: tariff & non-tariff barriers; regulatory quality; and rule of law.



Table 5, which has been taken from the ABS (2005) study, shows the lower level of participation in innovation by SMEs. Around 58% of businesses with '250 or more' employees are innovating, compared to 46% and 48% in the medium-sized category (with '20 to 49' and '50 to 99' employees respectively). Yet only 25% and 34% of businesses with '5 to 9' employees and '10 to 19' employees respectively are involved in innovation.

**Table 5: Estimated Total Number and Proportion of Innovating Businesses by Employment Size – 2004 to 2005**

	Total estimated businesses	% of innovating businesses
	no.	%
Employment size		
5-9	65 300	25
10-19	38 100	34
20-49	26 000	46
50-99	6 300	^48
100-249	2 900	^45
250 or more	2 700	^58
<b>Total</b>	<b>141 300</b>	<b>34</b>

Measures that aim to increase the innovation participation rates of small- and medium-sized businesses should be taken. Providing equal access to government procurement is one example. It is currently challenging for SMEs to get into the procurement cycle and to gain equal access to, for example, infrastructure building opportunities. Often this is because the risks to government of working with an SME are too high.

The objective in government procurement is generally to minimise risk, maintain probity and achieve rapid implementation, none of which necessarily nurture innovation. This is unfortunate, since the government spend in Australia on infrastructure and other forms of procurement surpasses the limited funds available for venture capital investment. Small- and medium-sized businesses need to be given fair opportunity to participate in government procurement. The case study on government procurement in the appendices, prepared by Dr Rowan Gilmore, provides a practical illustration of this tension. It indicates that greater collaboration and involvement with SMEs from government is required as part of a collaborative procurement process, and to align R&D and facilitate collaborations. Government could play a role in establishing collaborative frameworks and mechanisms between government, research organisations and industry, to better align and inform early stage R&D with forthcoming government procurement spends, in order to allow smaller firms to have collaborations in place and developments underway so they can participate in staged procurement. Similarly, procurement policies and processes need to allow for improved risk and innovation management when small businesses are part of the procurement cycle.

In the USA, the three-phase Small Business Innovation Research (SBIR) Program provides funding to SMEs, encouraging them to explore their technological potential and providing the incentive to profit from its commercialisation. Its impact is to make US SMEs more competitive and it helps them offset up to the full cost of their product development, if they are successful. The US SBIR program mandates that each year 11 federal agencies reserve over 2% of their entire



development budget for funding projects within small American-owned businesses. Funding is provided across three stages – project feasibility, project development to prototype and commercialisation. It is critical to allowing SMEs access to the procurement cycle. The program is fully open, transparent and competitive, and has been very well adopted by the US Department of Defence, NASA, the Department of Energy and other government agencies. Opportunities exist to consider the use of similar programs in Australia, for example in supporting innovation within the sustainability sector, including for water and energy efficiency and management (building of dams, desalination plants, etc), where large spending occurs but where there are few opportunities for SMEs to participate.

### Summary Table: Recommendations on the Business Environment and Regulation

#### 6. The Business Environment and Regulation

*Objective: Undertake continuing micro-economic reforms that improve and sustain a business environment suitable for innovation*

- Reduce the burden of government regulation to ensure corporate governance systems do not inhibit entrepreneurial behaviour, and continue to support schemes that work well, such as export grants.
- Support SMEs, for example, by improving Government Procurement Policy to provide equal access for SMEs, the US SBIR being one example.
- Review the taxation system to ensure it encourages higher levels of innovation, specifically for SMEs (payroll tax being one example).

#### 4. The Way Forward to a National Innovation Framework

Innovation has been encouraged and supported by governments and business in recent years. But despite its growing importance to passing on prosperity, it has not been treated as a key public policy priority for the nation. We therefore view the review of the national innovation system as an opportunity to address this concern.

The challenge of innovation is not just for the innovators but for the whole range of stakeholders in a modern and prosperous economy, positioning itself for long-term competitive success in global markets. These stakeholders include government, research and education institutions, business and individuals. Collaboration increases the 'interconnectedness' of the system, providing more and varied pathways to use and the marketplace. It must be accepted and understood that all have a part to play in building innovation capabilities at the organisational level and, as a result, delivering high performance across Australian industries and services.

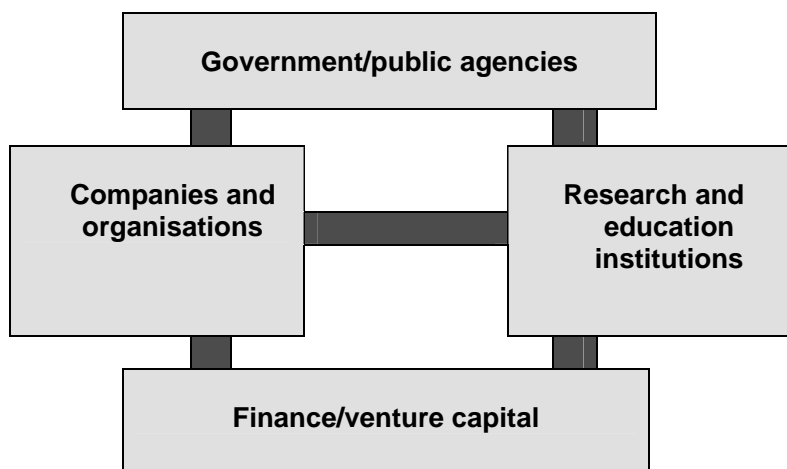
The recommendations outlined in this submission are underpinned by the need for a clearer understanding of roles and responsibilities around building Australia's innovation system and capacities. The Framework and its recommendations recognise that only with a clearer understanding of these roles and responsibilities will a sustained and strategic effort to improve our innovation capabilities be possible.



In summary, these roles and responsibilities are:

- *Governments* have responsibility for establishing, prioritising and leading the development of key elements of the national innovation system. Because the effectiveness of the framework is dependant on collaboration and coordination, the role of government is critical in creating environments that remove bureaucratic barriers to collaboration and promote strategic policy objectives and initiatives that facilitate the linkages needed to bring innovation to the marketplace.
- *Research and education institutions* must prepare graduates for a labour market that values knowledge and skills, identify research with commercial application and join innovation partnerships. They, too, have an important collaboration role, at an intellectual, technological and cultural level.
- *Business* must develop innovation capabilities and cultures internally and in collaborative networks and clusters, so that knowledge may be shared and deployed as a source of competitive advantage. Business must also create workplaces that enable people to reach their potential, including by continuing to learn and develop their skills, and to contribute to innovation.
- *Finance and venture capital* is vital for innovation success in Australia. Both the government and the private sector play a role in ensuring sufficient access to capital resources for innovative activities. We need to address issues and determine appropriate roles for both sectors in areas where there is currently a lack of investment in innovative activity. This is especially the case in the early stages of developing new products and technologies.

**Figure 3: National Innovation System – Roles, Responsibilities and Linkages**

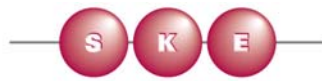




## 5. Conclusion

Harnessing our innovation potential is vital if Australia is to build on its current advantages and sustain prosperity in the long term. Continuing success in the global economy, on which Australia now increasingly relies for jobs and investment, will depend on Australia's ability to compete with other economies on the basis of value delivered by innovation in the production of goods and services. Because innovation is a key driver in lifting productivity, becoming an economy based on innovation is critical if we are to continue to improve our standard of living.

Australia needs to elevate developing its national innovation system and the corresponding innovation strategy to a position as one of its key whole-of-government policy priorities. Business obviously has a critical role, as do education and university systems and the research sector, in producing the intellectual and market outcomes for successful innovation. But ultimately it is governments that bring the policy leadership and means to facilitate the systems and structures that maximise the potential and opportunity for these intellectual and market processes to occur in a sustained way. The suggestions for 'strategic action' and 'operational action' outlined in this submission recognise the importance of first, clarifying and second, joining these roles and responsibilities into a coherent and sustained innovation system.



## Appendices

### Case Studies

**SME Case Study**  
**by Dr Rowan Gilmore**

#### **Russell Mineral Equipment – A Journey to Successfully Collaborate with the Research Sector**

When Russell Mineral Equipment (RME), a specialist mining equipment technology company with its design and manufacturing facilities based in regional Queensland, donated \$200,000 in 2001 to a local university, they expected better collaboration with the university and ultimately commercial outcomes from the partnership. As a highly innovative and successful business committing 4% of their total income to R&D activity, RME thought it worthwhile to assist the university to retain one of their gifted academics through the donation, and to increase their access to the university's advanced computer modelling capability. Unfortunately, their contribution did not do the trick; RME saw no direct increase in collaboration between themselves, or any other business, and the university.

At the same time, RME's approach to collaborate with another national research organisation was declined. That research organisation stated that they feared losing annual funding from a foreign multinational who might see such collaboration as competitive.

After these experiences, RME were introduced to TechFast, an intermediary service specialising in facilitating collaborations between SMEs and research organisations. The service assisted RME to explore various technology commercialisation and collaboration opportunities with multiple research organisations across Australia. RME Managing Director John Russell said TechFast was 'the perfect adaptor plate between academia and industry that also showed RME what it should do to better engage'.

Subsequently, RME were able to leverage an unspent portion of their donation to win an ARC Linkage grant with the university, but needed additional expertise from the Julius Kruttschnitt Minerals Research Centre (JKMRC). Unfortunately, the ARC grant made reallocating existing project funding to bring in a third collaborator complex. Still determined, RME paid additional money to integrate JKMRC into the project. John Russell said 'after two years the collaboration is yielding quite interesting results, although progress is geological'.

Because of this increased collaboration, JKMRC recognised RME's extensive commercialisation experience and capability and so approached RME to assist them to take a new JKMRC technology to the market. The first units of this technology will soon be delivered to customers, and sales of more than one million dollars have already been secured.

'Australia must do better in creating the right environment and connecting mechanisms between SMEs and universities to meet our critical challenges,' John Russell said.



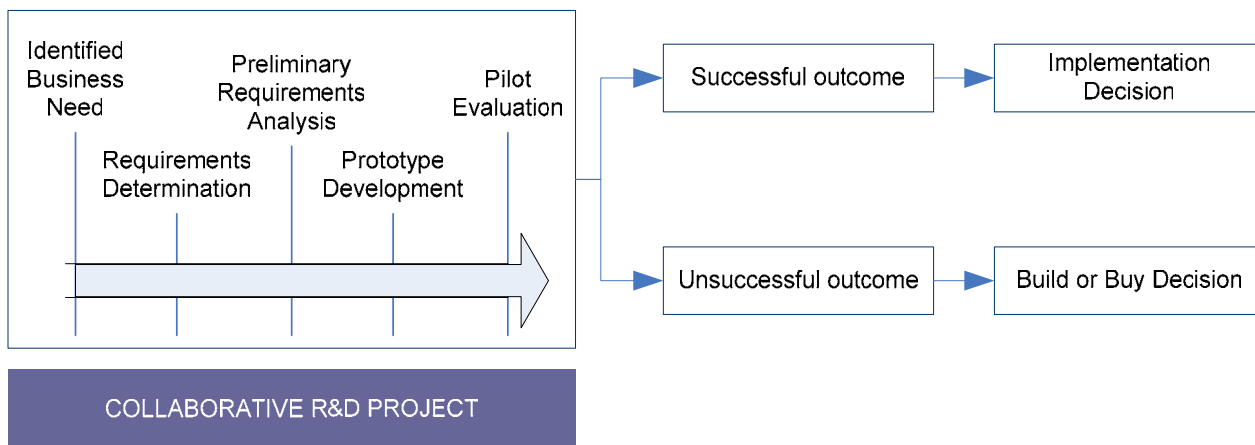
**Innovation and Government Procurement**  
by Dr Rowan Gilmore

R&D is a major source of investment by governments. Government procurement spends are significantly higher, but innovation is often overlooked. If government procurement can be preceded by collaborative R&D projects, perhaps to solve an identified problem faced by the agency or the industries they serve, innovation can flourish. Projects handled this way can leverage technical expertise and capability in the industry and research sector, test perceived solutions to problems, and mitigate risk for government in validating requirements prior to formal policy announcements, procurement or implementation.

In the case of Queensland Health's (QH) Regional Emergency Care Collaborative (RECC) project, the need for a proof of concept was immediately apparent. The project seeks to implement vital signs monitoring technology to support a QH Coordinated Care Centre trial which involves emergency response, clinical management, patient transit decisions and underlying systems connectivity between service partners. The project sponsor, utilising the AIC's Collaborative R&D framework, recognised the need for collaboration with numerous other government and non-government service partners to clarify project requirements and build a new service model. Rather than jumping directly to procurement, the collaboration is allowing the agency to identify leading edge local innovation and foster industry partnerships that are emerging during the collaboration.

Projects such as RECC are collaborative R&D exercises in which industry and research sectors take a shared approach to cost, risk, resourcing and IP. Such approaches reduce the high technical risk involved in implementing complex and innovative systems, and leverage the know-how, expertise and business systems (IP) across multiple service partners, providing diverse technical expertise and capability.

To this end, the RECC project is not a technology project, but rather a pilot to develop and support an innovative operational service model supporting coordinated emergency response and patient care in rural and remote settings. The value of a workable model being trialed and tested in this way mitigates the risk for government by validating requirements and service delivery outcomes, informs procurement, and ultimately can provide a commercialisation opportunity to industry partners for broader implementation both nationally and globally. If the project is unsuccessful, the government and other service partners will be further informed about service model requirements and investment requirements moving forward.





## Workplace Development Initiatives – International Examples

### Ireland

The **National Workplace Strategy (NWS)** is the Irish government's blueprint to help transform Ireland's workplaces into *Workplaces of the Future*, by promoting greater levels of partnership-led change and innovation in all places of work, regardless of size or sector. The strategy's underlying premise is that all companies and organisations can achieve improved performance and an enhanced quality of working life by improving their capacity to manage change and innovation within the workplace. The strategy highlights several issues that underpin the capacity of stakeholders at enterprise level to respond effectively to change. These include:

- building better leadership and management skills;
- developing human resource management capacities, including better strategic HRM;
- improving information and consultation practices;
- developing better approaches to employee involvement and participation;
- addressing operational concerns and barriers to employee financial involvement;
- developing workplace partnership practices; and
- ensuring effective dispute avoidance and resolution systems.

### Finland

Finland has instituted a **Workplace Development Program (TYKES)**. TYKES (2004-2009) promotes the modes of operation of Finnish companies and other work organisations, with an eye to simultaneous enhancement of productivity and the quality of working life. This is called 'qualitatively sustainable productivity growth'. Development activity in the program projects is based on cooperation between the management and staff of the workplaces concerned. In addition, TYKES promotes the dissemination of project results and expertise on workplace development.

TYKES is based on the view that the most effective way of generating new innovative solutions for working life is close cooperation and interaction between workplaces, researchers, consultants, public authorities and social partners. The capacity of the different parties to join forces is, for a small country like Finland, a precondition for coping with the globalising economy. Success in the new competitive environment increasingly calls for workplace innovation. The program's forms of activity are:

- to support workplace development projects;
- to support method development projects;
- to support learning networks;
- to disseminate information on workplace development; and
- to reinforce expertise on workplace development.

### UK

The UK Department for Innovation, Universities and Skills aims to deliver the government's long-term vision to make Britain one of the best places in the world for science, research and innovation. It will ensure that the UK has the skilled workforce it needs to compete in the global economy. Ensuring Britain has a highly skilled workforce, a dynamic business community which seizes new technology and innovation opportunities and a world-class science base is at the heart of the new **Department for Innovation, Universities and Skills (DIUS)**.

Further, 'The Workforce Development: How Much Engagement Do Employers Have with Higher Education', a review conducted by the Council for Industry and Higher Education in February 2007, referred to as the 'Leitch Review', called for a more demand-led skills system. It suggests that a cultural shift towards viewing



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learning as something people at all levels and at all ages need to be doing is needed, and not just something that is to be done by young people before they enter the workforce.

**The UK Work Foundation** is another example of an organisation that is dedicated to improving national competitiveness and organisational sustainability through a dedicated focus on better managing knowledge, innovation, technology and people

### Canada

To help businesses address the human resources challenge and maintain a competitive edge, the government of Canada is implementing the **Workplace Skills Initiative (WSI)**. The WSI, a three-year initiative, will fund employers and their partners to:

- promote and test new ways of enhancing the skills of their workforce; and
- improve human resources practices in their workplaces.

Canadian companies are facing challenges in the 21st century from increased global competition and rapid changes in technology to an aging workforce. A particularly critical issue is the availability of qualified, skilled employees. A major review, 'Shaping the Tremendous Change', is taking place in the workplace as some traditional 9-to-5 jobs are displaced by a 24/7 world.

The WSI promotes partnerships to address these challenges. The government of Canada works with business, labour unions, educational institutions and other governments to help establish knowledge networks and build momentum on skills development in the workplace. By participating in the WSI, the workplace is anticipated to benefit from:

- increased knowledge of how and why an organisation needs to develop the talent and creativity of employees to succeed;
- improved human resources policies and practices to support organisational structure and strategy; and
- a more productive and innovative workplace.

The WSI also states that it will promote sharing best practices and celebrate success stories through a rewards and recognition program.

### Sweden

**Future Workplace** is a new platform for debate on how, why and where people want to work in the future. The purpose of this initiative is to collect thoughts, concepts and ideas for Swedish and International work environments that really push the envelope.

The four goals for the ministry of finance which target for workplace health promotion are:

- a common culture – a common value system;
- a suited-to-purpose organization and effective work reforms;
- well-functioning communication; and
- a plan for promoting competence.

### USA

The **21<sup>st</sup> Century Workforce Initiative** mission statement is: 'To succeed in the 21st Century, our nation must be prepared to adapt to changes in our economy – in how we work, where we work, and how we balance our professional and family lives. The Department of Labor cannot and must not simply react to



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changes. We must anticipate them, thus helping all workers to have as fulfilling and financially rewarding careers as they aspire to have.'



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## How Do We Fare?

### Australia's Performance on Selected Innovation Indicators

(This table has informed Table 1. It draws on data from a variety of sources, mainly the World Bank, OECD and the World Economic Forum. The data used is normalised data.)

	Australia (%, index measure or rank)	Top performer(s) internationally (country and %)	Australian rank	Relevant notes about the data (source, year etc)
<b>1. Collaboration</b>				
All types of external collaboration by companies	28%	EU27: 26 Denmark: 43 Ireland: 32 Finland: 44 Netherlands: 39 Sweden: 43	Australia ranks 20 as compared to the EU27 nations  EU27 average is slightly less than the Australian measure	ABS Cat. 8158.0 Eurostat <i>news release 27/2007</i> 22 February 2007
Collaboration with clients or customers	12%	EU27: 14 Denmark: 28 Ireland: 25 Finland: 41 Netherlands: 22 Sweden: 28	Australia ranks 19 as compared to the EU27 nations  EU27 average is slightly higher than the Australian measure	ABS Cat. 8158.0 Eurostat <i>news release 27/2007</i> 22 February 2007
Collaboration with suppliers	11%	EU27: 17 Denmark: 28 Ireland: 23 Finland: 41 Netherlands: 30 Sweden: 32%	Australia ranks 23 as compared to the EU27 nations  EU27 average is relatively higher than the Australian measure	ABS Cat. 8158.0 Eurostat <i>news release 27/2007</i> 22 February 2007
Collaboration with	2%	EU27: 9	Australia ranks 27 as compared to the EU27	ABS Cat. 8158.0

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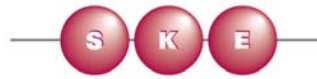
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universities or other higher education institutes		Denmark: 14 Ireland: 10 Finland: 33 Netherlands: 12 Sweden: 17	nations and stands at par with Cyprus  - EU27 average is almost four times the Australian measure - Note also that the World Economic Forum Competitiveness Index (2007-08) ranks Australia #22 on university-industry research collaboration - The OECD also ranks Australia last out of 26 OECD countries for research collaboration between industry and universities	Eurostat <i>news release 27/2007</i> 22 February 2007
Collaboration with public research institutes or government agencies	3%	EU27: 6 Denmark: 7 Ireland: 6 Finland: 26 Netherlands: 9 Sweden: 6	Australia ranks 25 as compared to the EU27 nations  - EU average is double the Australian measure - Note also that the OECD ranks Australia second last out of 26 OECD countries for research collaboration between industry and public research organisations	ABS Cat. 8158.0 Eurostat <i>news release 27/2007</i> 22 February 2007
Collaboration on innovation with a different country within the APAC region	Indicator not available for Australia  Suggest adding this measure to future innovation surveys done in Australia	Denmark: 8.9:1.4 Luxembourg: 8.7:1.4 Finland: 8.4:0.5 Belgium: 6.9:1.3 Sweden: 5.3:1.2 Czech Republic: 5.3:-0.1 Norway: 3.2:-0.2 Netherlands: 3.4:-0.5 France: 1.8:-0.7 Austria: -0.4:1.4 Greece: 0.5:-0.3 Germany: -3.9:2.8	N/A	<a href="http://puck.sourceoecd.org/vl=15129646/cl=16/nw=1/rpsv/sti2007/q-7.htm">http://puck.sourceoecd.org/vl=15129646/cl=16/nw=1/rpsv/sti2007/q-7.htm</a>  This measure is available for European countries, 2002-2004. No measures are available on Australia. It measures the intensity of foreign cooperation within a region.



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Collaboration on innovation with a different country outside the APAC region	<p>Indicator not available for Australia</p> <p>Suggest adding this measure to future innovation surveys done in Australia</p>	Denmark: 14.4:5.0:- Luxembourg: 14.3:5.5: Finland: 13.0:5.9:- Belgium: 12.3:5.6:- Sweden: 10.6:3.4:- Czech Republic: 9.4:2.4:- Norway: 7.2:3.6:- Netherlands: 7.0:3.2:- France: 5.3:3.1:- Austria: 5.2:1.6:- Greece: 4.3:2.2:- Germany: 3.0:1.7:- Canada:-:-: 10.2 New Zealand:-:-: 8.0 Korea:-:-: 1.4 Japan:-:-: 1.0 Australia:-:-: 1.0	N/A	<a href="http://puck.sourceoecd.org/vl=15129646/cl=16/nw=1/rpsv/sti2007/g-7.htm">http://puck.sourceoecd.org/vl=15129646/cl=16/nw=1/rpsv/sti2007/g-7.htm</a>  This measure is available for European countries. No measures are available on Australia.
<b>2. Research and Development</b>				
Gross domestic expenditure on R&D – GERD (% of GDP)	1.76%	UK: 1.78 Norway: 1.52 Sweden: 3.89 Denmark: 2.45 Ireland: 1.26 New Zealand: 1.15 USA: 2.62 China: 1.34 India: 0.69	Australia ranks 17th out of 39 OECD nations	<a href="http://miranda.sourceoecd.org/vl=1296811/cl=23/nw=1/rpsv/figures_2007/en/page17.htm">http://miranda.sourceoecd.org/vl=1296811/cl=23/nw=1/rpsv/figures_2007/en/page17.htm</a>
Business expenditure on R&D (% of BERD)	53.5%	Sweden: 74 UK: 61.6 Norway: 53.7 Denmark: 68.3 Ireland: 65.3 New Zealand: 42.5 USA: 69.6 China: 68.3 India: 25.3	Australia ranks 26th out of 39 OECD nations	<a href="http://fiordiliji.sourceoecd.org/vl=185308/cl=13/nw=1/rpsv/figures_2007/en/page17.htm">http://fiordiliji.sourceoecd.org/vl=185308/cl=13/nw=1/rpsv/figures_2007/en/page17.htm</a>  Similarly, on 'Company spending on R&D' Australia is ranked 22nd by the World Economic Forum's Global Competitiveness Report 2007-08



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R&D indicator	8.71	Sweden: 9.72 Denmark: 9.43 Norway: 8.86 Finland: 9.60 Netherlands: 9.41 Switzerland: 9.82 Canada: 9.35 USA: 9.44 UK: 9.21 New Zealand: 8.69 China: 5.09 India: 3.93	Australia ranks 19th out of 140 nations	<a href="http://info.worldbank.org/etools/kam2/KAM_page5.asp">http://info.worldbank.org/etools/kam2/KAM_page5.asp</a>  This is measured as the average of the normalised scores on three key variables: researchers in R&D, patent applications granted by UPSTO, scientific and technical journal articles
Availability of scientists and engineers	34		Australia ranks 34th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
Science and engineering enrolment ratio %	4.60	Sweden: 7.13 Denmark: 2.76 Norway: 1.26 Finland: 9.54 Netherlands: 0.80 Switzerland: 6.67 Canada: 3.79 USA: 0.92 UK: 4.71 New Zealand: 1.72 China: n/a India: n/a	Australia ranks 5th on a list of 10 (see column to the right)  Sweden, Finland, Switzerland and UK perform better than Australia	This includes the field of science except social science, engineering, manufacturing and construction <a href="http://info.worldbank.org/etools/kam2/KAM_page3.asp">http://info.worldbank.org/etools/kam2/KAM_page3.asp</a>
Quality of scientific research institutions	15		Australia ranks 15th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
Brain drain	36 (World Economic Forum)  7.03 (World Bank)	Sweden: 7.80 Denmark: 7.80 Norway: 9.66 Finland: 9.24 Netherlands: 8.98 Switzerland: 9.07 Canada: 7.80	Australia ranks 36th out of 131 nations (World Economic Forum)  Australia ranks 8th on a list of 12 (see column to the right)  Sweden, Denmark, Norway, Finland, The	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>  The World Bank measure is based on a statistical score on a 1-7 scale of a large sample group in a particular country



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		USA: 9.92 UK: 8.47 New Zealand: 4.58 China: 6.36 India: 6.10	Netherlands, Switzerland, Canada, USA and UK perform better at retaining people than Australia	asked to rate whether the country's talented people (1=normally leave to pursue opportunities in other countries, 7=almost always remain in the country) <a href="http://info.worldbank.org/etools/kam2/KAM_page3.asp">http://info.worldbank.org/etools/kam2/KAM_page3.asp</a>
Availability of venture capital	8.66	Sweden: 9.08 Denmark: 9.08 Norway: 9.50 Finland: 9.66 Netherlands: 9.66 Switzerland: 7.98 Canada: 7.98 USA: 9.92 UK: 9.50 New Zealand: 8.66 China: 2.35 India: 8.32	Australia ranks 15th out of 129 nations  Australia ranks 7th on a list of 12 together with New Zealand (see column to the right)  Sweden, Denmark, Norway, Finland, The Netherlands, USA and UK generally provide VC more easily for risky projects than Australia	This is based on a statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether entrepreneurs with innovative but risky projects can generally find venture in their country (1= not true, 7= true) <a href="http://info.worldbank.org/etools/kam2/KAM_page3.asp">http://info.worldbank.org/etools/kam2/KAM_page3.asp</a>
<b>3. Education and Skills Development</b>				
Public expenditure on education (% of GDP)	4.28%	Sweden: 6.55 Denmark: 6.7 Norway: 6.45 Finland: 6.02 Netherlands: 4.55 Switzerland: 5.96 Canada: 4.59 USA: 5.4 UK: 5.12 New Zealand: 5.67	Australia ranks 25th out of 33 OECD nations  Australia ranks 10th on a list of 10 (see column to the right)	<a href="http://fiordiliji.sourceoecd.org/vl=3410209/cl=37/nw=1/rpsv/figures_2007/en/page24.htm">http://fiordiliji.sourceoecd.org/vl=3410209/cl=37/nw=1/rpsv/figures_2007/en/page24.htm</a>  2007 figures
Quality of the educational system	8		Australia ranks 8th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>



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Quality of higher education and training	14	Australia: 5.46 Sweden: 5.98 Denmark: 5.96 Norway: 5.60 Finland: 6.01 Ireland: 5.16 Netherlands: 5.57 Switzerland: 5.63 Canada: 5.49 USA: 5.68 UK: 5.42 New Zealand: 5.53 China: 3.77 India: 4.13	Australia ranks 14th out of 131 nations  Australia ranks 8th on a list of the 12 Western countries (see column to the right)	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
Education and human resources	9.17	Sweden: 8.98 Denmark: 9.22 Norway: 9.20 Finland: 9.20 Netherlands: 8.74 Switzerland: 7.44 Canada : 8.62 UK: 8.50 USA: 8.35 New Zealand: 9.30 China: 4.09 India: 2.22	Australia ranks 5th out of 137 nations	<a href="http://info.worldbank.org/etools/kam2/KAM_page5.asp">http://info.worldbank.org/etools/kam2/KAM_page5.asp</a>  This is the simple average of the normalised scores on three key variables: adult literacy rate, secondary enrolment, tertiary enrolment
Gross secondary enrolment rate	9.93	Sweden: 8.76 Denmark: 9.85 Norway: 9.56 Finland: 9.27 Netherlands: 9.71 Switzerland: 6.57 Canada: 9.12 USA: 6.93 UK: 8.83 New Zealand: 9.64 China: 3.43 India: 2.48	Australia ranks 1st on a list of 12 (see column to the right)	<a href="http://info.worldbank.org/etools/kam2/KAM_page3.asp">http://info.worldbank.org/etools/kam2/KAM_page3.asp</a>  Ratio of total enrolment regardless of age, to the population of the age group that officially corresponds to the level of education shown



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Tertiary enrolment	9.09	Sweden: 9.70 Denmark: 9.32 Norway: 9.55 Finland: 9.85 Netherlands: 8.03 Switzerland: 7.27 Canada: 8.26 USA: 9.62 UK: 8.18 NZL: 9.77 China: 4.09 India: 2.88	Australia ranks 6th on a list of 12 (see column to the right)	<a href="http://info.worldbank.org/etools/kam2/KAM_page3.asp">http://info.worldbank.org/etools/kam2/KAM_page3.asp</a>  Ratio of total enrolment regardless of age, to the population of the age group that that officially corresponds to the level of education shown
<b>4. Leadership, Culture and Management at the Workplace Level</b>				
Extent of staff training	20		Australia ranks 20th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
% of Australian companies that innovate	34%	EU27: 42 Denmark: 52 Ireland: 52 Finland: 43 Netherlands: 34 Sweden: 50	Australia ranks 15th as compared to the EU27 nations  Australian measure is less than the EU27 average	ABS Cat. 8158.0 Eurostat <i>news release 27/2007</i> 22 February 2007
Sophistication of business strategy and operations	24	Sweden: 3 Denmark: 5 Norway: 15 Ireland: 22 Finland: 9 Netherlands: 7 Switzerland: 4 Canada: 17 USA: 1 UK: 11 New Zealand: 25 China: 54 India: 27	Australia ranks 24th out of 131 nations  Australia ranks 9th on a list of 13 (see column to the right)	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>  This is measured as a rank and relates to the productivity of companies and depends on the sophistication with which companies compete. The Value Chain provides the conceptual framework to analyse company operating practices and strategy



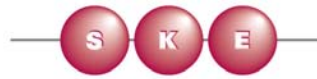
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Production process sophistication	23		Australia ranks 23rd out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
Willingness to delegate authority	14		Australia ranks 14th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
Federal human capital survey:  - Leadership and knowledge management index  - Results-oriented performance culture index  - Talent management index  - Job satisfaction index	Indicator not available for Australia  Suggest making these available for Australia via a National Human Capital Survey	USA only  - 59% positive  - 53% positive  - 59% positive  - 66% positive	N/A	<a href="http://www.fhcs2006.opm.gov/">http://www.fhcs2006.opm.gov/</a> : Federal Human Capital Survey Report 2006  Leadership and Knowledge Management Index (indicates the extent to which employees hold their leadership in high regard, both overall and on specific facets of leadership)  Results-Oriented Performance Culture Index (indicates the extent to which employees believe their organisational culture promotes improvement in processes, products and services, and organisational outcomes)  Talent Management Index (indicates the extent to which employees think the organisation has the talent necessary to achieve its organisational goals)  Job Satisfaction Index (indicates the extent to which employees are satisfied with their jobs)
Value chain breadth	1.88 (World Bank Score)  86 (World Economic Forum index)	Sweden: 9.32 Denmark: 9.32 Norway: 5.98 Finland: 8.97 Netherlands: 8.97 Switzerland: 9.83 Canada: 5.98 USA: 8.63 UK: 9.57 New Zealand: 6.58 China: 5.30 India: 8.03	Australia ranks 86th out of 131 nations  Australia ranks at the bottom on a list of 12 (see column to the right)	<a href="http://info.worldbank.org/etools/kam2/KAM_page3.asp">http://info.worldbank.org/etools/kam2/KAM_page3.asp</a> This is based on a statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether exporting companies in your country are 1= primarily involved in resource extraction or production, 7= not only produce but also perform product design, marketing, sales, logistics and after-sales services  World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>



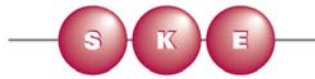
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Capacity for innovation	30		Australia ranks 30th out of 131 nations	<p>World Economic Forum's Global Competitiveness Report 2007-08  <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a></p> <p>The 'Capacity for innovation' indicator comes from the results obtained to the following survey question: In your country, companies obtain technology 1 = exclusively from licensing or imitating foreign companies, 7 = by conducting formal research and pioneering their own new products and processes</p> <p>Respondents are asked to evaluate, on a scale of 1 to 7, the current condition of their particular operating environment (1 = the worst possible operating condition, 7 = the best)</p>
<b>5. Technology Infrastructure</b>				
ICT coverage	9.25	Sweden: 9.76 Denmark: 9.25 Norway: 9.17 Finland: 8.52 Netherlands: 9.25 Switzerland: 9.28 Canada: 8.40 USA: 8.95 UK: 8.93 New Zealand: 8.44	Australia ranks 5th out of 131 nations	<p><a href="http://info.worldbank.org/etools/kam2/KAM_page5.asp">http://info.worldbank.org/etools/kam2/KAM_page5.asp</a></p> <p>Telephone, internet and computer penetration per 1000 inhabitants</p>
Broadband subscribers per 100 inhabitants	22.7	Australia lags behind: Denmark Netherlands Switzerland Korea Norway Iceland Finland Sweden Canada Belgium	Australia ranks 12th out of 30 nations	<p>See OECD  <a href="http://www.oecd.org/document/7/0,3343,es_2649_34223_38446855_1_1_1_1,00.html">http://www.oecd.org/document/7/0,3343,es_2649_34223_38446855_1_1_1_1,00.html</a></p> <p>See also Robert Atkinson's paper on Information Technology and Innovation Foundation (ITIF), which ranks Australia at 14 based on penetration, speed and price (the raw data is still taken from OECD source)</p>



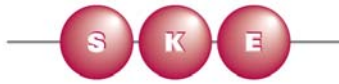
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		UK		
Technological readiness	5.20	Sweden: 5.87 Denmark: 5.64 Norway: 5.46 Finland: 5.36 Netherlands: 5.65 Switzerland: 5.67 Canada: 5.34 Ireland: 4.65 Norway: 5.46 USA: 5.43 UK: 5.27 NZL: 4.82 China: 3.00 India: 3.17	Australia ranks 17th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>  Measures the agility with which an economy adopts existing technologies to enhance the productivity of its industries
<b>6. The Business Environment and Regulation</b>				
Economic incentive and institutional regime	8.39	Sweden: 8.59 Finland: 8.95 Denmark: 8.97 Ireland: 8.95 Norway: 9.45 Switzerland: 9.42 Netherlands: 8.69 Canada: 9.38 USA: 8.45 UK: 8.54 New Zealand: 8.81 China: 4.27 India: 3.49	Australia ranks 16th out of 137 nations  Australia ranks at the bottom of the list compared to other Western countries (see column to the right)	<a href="http://info.worldbank.org/etools/kam2/KAM_page5.asp">http://info.worldbank.org/etools/kam2/KAM_page5.asp</a>  This is the simple average of the of the normalised scores on three key variables: tariff and non-tariff barriers, regulatory quality and rule of law



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Burden of government regulation	68		Australia ranks 68th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
Total tax rate	83		Australia ranks 83rd out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>
Quality of the national business environment	15	Sweden: 4 Denmark: 5 Ireland: 24 Norway: 13 Finland: 3 Netherlands: 7 Switzerland: 6 Canada: 14 USA: 1 UK: 11 New Zealand: 20 China: 57 India: 33	Australia ranks 15th out of 131 nations	World Economic Forum's Global Competitiveness Report 2007-08 <a href="http://www.gcr.weforum.org/">http://www.gcr.weforum.org/</a>  This is measured as a rank and relates to internal choices and capabilities within a nation's companies which are central to competitiveness. A higher-quality business environment and the presence of a deep cluster significantly affect the capabilities a company can build, the competitive choices it can make, and the output that it can generate from its internal assets. Thus, the business environment can be understood in terms of four interrelated areas: the quality of factor (input) conditions, the context for firm strategy and rivalry, the quality of local demand conditions, and the presence of the related and supporting industries, all of which are measured by these metrics



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## List of Abbreviations

ABS: Australian Bureau of Statistics  
ACMER: Australian Centre for Minerals Extension and Research ARC  
APAC: Asia-Pacific Countries  
BCA: Business Council of Australia  
BERD: Business Expenditure on Research and Development  
CEDA: Committee for the Economic Development of Australia  
CEO: Chief Executive Officer  
COAG: Council of Australian Governments  
CPA: Chartered Practising Accountants  
CSIRO: Commonwealth Scientific and Industrial Research Organisation  
DEST: Department of Education, Science and Training  
DITR: Department of Industry, Tourism and Resources  
ECN: Enterprise Connect Network  
EU: European  
GDP: Gross Domestic Product  
GERD: Gross Expenditure on Research and Development  
IBM: International Business Machines Corporation  
ICT: Information and Communication Technology  
IP: Intellectual Property  
KAM: Knowledge Assessment Methodology  
MGSM: Macquarie Graduate School of Management  
MNE: Multinational Enterprises  
NASA: National Aeronautics and Space Agency  
NIA: National Innovation System  
NSW: New South Wales  
OECD: Organisation for Economic Cooperation and Development  
PMSEIC: Prime Minister's Science, Engineering and Innovation Council  
R&D: Research and Development  
SBIR: Small Business Innovation Research  
SKE: Society for Knowledge Economics  
SME: Small Medium Enterprises  
Tekes: Finnish Funding Agency for Technology and Innovation  
UK: United Kingdom  
UNSW: University of New South Wales  
USA: United States of America  
VET: Vocational Education Training  
WA: Western Australia  
WICI: World Intellectual Capital Initiative