

## 3.1

# Innovation Australia: How we measure up

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## Introduction

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Australia's long-running commodity prices boom has come to an even more abrupt end than most economists and policymakers anticipated. While new investment in resources production will continue to drive an expansion of output and exports, it will attract lower rates of return than was previously the case and provide little or no terms of trade boost to our national income. While this scenario may not have been widely foreseen, it was already canvassed in CEDA's 2007 publication *Competing from Australia* with reference to the experience of other countries:

"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. Whether this boom proves to be temporary or longer lasting, significant adjustments will be required for Australia to take advantage of its good fortune and prepare for an uncertain future. Possible scenarios for Australia in coming years include the so-called 'Dutch disease', where a rise in the exchange rate associated with North Sea gas discoveries made much of Dutch industry uncompetitive, or Britain in the 1980s, where a North Sea oil windfall was squandered on domestic consumption, or alternatively Norway, which has leveraged its oil wealth for strategic investment in research, education and infrastructure."<sup>1</sup>

Paradoxically, the commentators who mistook the commodity cycle for longer term structural change, with the claim that manufacturing would be superseded by mining and services, are now among the most conspicuous in the search for new sources of growth and competitiveness. Equally, however, trade exposed sectors such as manufacturing have a more formidable competitiveness challenge than in the recent past due to the combination of a strong currency and productivity slowdown. In this context, the future of Australia's economy and living standards will depend more than ever on a transformation of our productivity performance, which in turn must be driven by a coordinated, strategic approach to innovation policy and management.

Here we consider the evolution in Australian innovation policy from *Backing Australia's Ability*, with its strong focus on public investment in science and technology, to the 2008 Cutler Review's broader view of the national innovation system, leading to the emphasis on talent and creativity in the 2009 innovation white paper *Powering Ideas*, and finally to the 2012 Prime Minister's Manufacturing Taskforce and the development of an "Innovation Partnerships" program in the *Plan for Australian Jobs*. We examine this policy evolution and review future options in the context of a high wage economy with relatively low productivity growth. Clearly, this is an unsustainable combination as it means that unit labour costs are increasing much faster than in other advanced countries with the prospect that we cannot match the intensifying global competition at the high end of the value chain or from lower cost, faster growing emerging economies.<sup>2</sup>

In these circumstances, where terms of trade are wound back and the exchange rate remains relatively high, our argument is that the strategy to improve our productivity performance will depend largely on a greater rate of technological change and innovation, including non-technology innovation such as design-led innovation, new business models and the development of management and workforce capability. It will also require smart specialisation to promote the growth of national and regional innovation ecosystems, encompassing micro-multinationals as niche suppliers in global value chains, in conjunction with a technology foresight to identify future enabling technologies and capabilities. The effectiveness of these innovation ecosystems will depend on deep collaboration among businesses, public agencies and research

and education institutions, with an increased demand-side emphasis on enhancing enterprise absorptive capacity through targeted public procurement and business improvement services, such as Enterprise Connect, as well as the supply of research and skills. With the Rudd and Gillard governments, Australia had its first minister for innovation and a second who was given the opportunity of a comprehensive joined up portfolio of innovation, skills and productivity. The problem both ministers faced was complacency induced by the commodity boom, the financial constraints ultimately brought about by the end of the boom and the ideological opposition to any government intervention beyond public research and research and development (R&D) tax concessions. The effectiveness of the Abbott Government's new Minister for Industry will depend on his scope and ability to address this problem.

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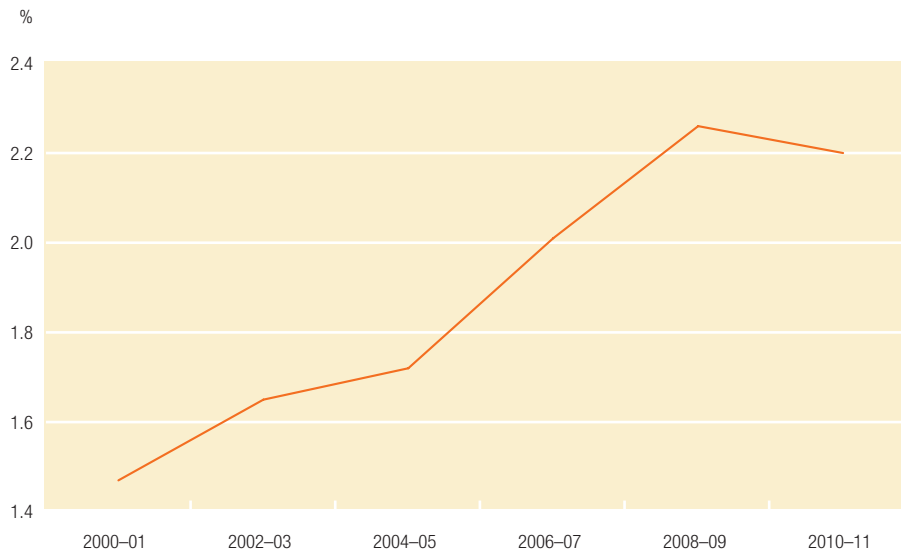
## Tracking Australia's innovation system

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In recent years, Australia like most advanced countries, has conceptualised innovation policy in terms of a national innovation system, which has been depicted as the “network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies” and the “elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge”.<sup>3</sup> While previously innovation was identified with investment in science and technology and related skills development, the understanding of innovation has now been broadened to encompass management and organisational change, as well as creativity and design, which are crucial to innovation capability and performance at the level of the enterprise. The pace and scale of innovation now demands active collaboration across firms, industries and economies with a significant role for government in promoting innovation through direct funding support, tax incentives, public procurement and the co-production of innovation. In this context, Australia's innovation performance has been described as mixed, with some world class achievements, considering the relatively small size of the economy, and some continuing deficiencies.<sup>4</sup>

While R&D is no longer the total sum of innovation performance, if it ever was, Australia's gross expenditure on R&D (GERD) as a proportion of gross domestic product (GDP) grew steadily from 2000 and has levelled off in the last few years. According to Australian Bureau of Statistics data, R&D spending reached a high point of 2.25 per cent of GDP in 2008–09, with the share of business expenditure on R&D (BERD) increasing to almost two thirds of the total over the previous decade and the government share declining to one third. GERD then fell back marginally to 2.22 per cent of GDP in 2010–11, primarily as a result of a slower rate of growth of business R&D expenditure. According to the Organisation of Economic Co-operation and Development (OECD), Australia's R&D intensity remains below the OECD average, but is higher than that of the EU27.<sup>5</sup> While the growth of R&D spending has now stalled in Australia, at least as a proportion of GDP, the most recent OECD data indicate an overall real growth rate for GERD of 1.3 per cent in 2010 and 2.1 per cent in 2011 for the OECD area driven by a gradual recovery in business R&D (2.8 per cent) and sustained growth in research in the higher education sector (2.5 per cent), despite a reduction in government R&D (–1.2 per cent).<sup>6</sup> On the other hand, Australia's GDP growth has been well in excess of the OECD average, partly as a result of the continuation of the commodity boom, which is embodied in a terms of trade effect rather than underlying productivity growth, and partly due to a well calibrated response by the Australian government to the global financial crisis.<sup>7</sup>

**FIGURE 1**  
**GROSS EXPENDITURE ON R&D (PERCENTAGE OF GDP)**



Source: ABS 2012

A major problem in Australia is that the growth in R&D spending does not seem to be translating into improved innovation outcomes. The *Australian Innovation System Report* notes that, “despite significant growth in R&D expenditure and intellectual property registrations (traditional measures of national innovation systems), the proportion of innovation-active businesses has hovered around 41 per cent since 2006–07 and R&D expenditure is dominated by a small number of large businesses in Australia”.<sup>8</sup> This is occurring even with evidence suggesting that compared with businesses that do not innovate, innovative Australian businesses are twice as likely to report increased productivity.<sup>9</sup> Disturbingly, the report finds that the proportion of businesses facing one or more barriers to innovation increased to almost half in the last five years. These barriers include market failures such as cost barriers, where the cash flow or profitability of firms is insufficient to permit them to invest in productivity enhancing measures, or where deficiencies in capital markets prevent firms accessing capital at a sufficiently low price to effect improvements. In addition, there may be inadequate information on the part of managers regarding opportunities and benefits of innovation or inadequate management resources to implement change. From a broader perspective, an Open Forum survey for the Society of Knowledge Economics found that key impediments to innovation are short-termism in political and business thinking, under investment in education and infrastructure and risk-averse and insurance driven attitudes.<sup>10</sup>

Many of these impediments apply with particular force to small sized firms, with data showing that the propensity of firms to innovate, the intensity of that innovation, and expenditure on innovation as a share of sales or value added, is attributed to larger firms in our innovation system. Indeed, large firms, with more than 100 employees are more than twice as likely to innovate as small firms, with less than 20 employees, and large firms account for the bulk of innovation expenditure despite representing only a small minority of total firms in Australia.<sup>11</sup> Such findings have important implications for the role of government in facilitating and providing an effective policy framework for innovation. Small and medium sized firms, potential micro-multinationals, can benefit from technology diffusion and demonstration projects provided by large firms, access to high quality business and management improvement services, incentives to undertake capital investment and R&D, support for workforce training and the development of high performance work and management practices.<sup>12</sup>

Significantly, the *Australian Innovation System Report* points out that while Australia's performance in technological innovations (product and/or process) has remained steady or declined, it has begun to improve in relation to managerial, organisational and marketing innovations.<sup>13</sup> Nevertheless, the Report also confirms the finding that Australian business management capability and innovation culture remains poor by international standards and may be a factor in the declining rates of productivity growth. Increasingly, we have seen public policy is recognising and supporting different forms of innovation and is placing a strong emphasis on the development of management and innovation capability at the enterprise level as part of its productivity-enhancing agenda: "One future focus of the Australian Government's industry and innovation policies will be on building innovation capacity and performance at the enterprise level... Government support for business innovation... must recognise the complexity of the innovation process and the different forms that innovation can take".<sup>14</sup>

This approach has been reinforced by the white paper on *Australia in the Asian Century* which notes that, "Businesses are adopting new models of innovation, focusing more on better integrating internal activities, such as marketing, operations and design, and less on traditional research-intensive approaches. At the same time, they are more open to external ideas and the possibility of new routes to market, engaging with a larger number and wider range of collaborators".<sup>15</sup> In addition, the report of the Non-Government Members of the Prime Ministers' Manufacturing Taskforce recommended the development of enterprise-level innovation capability, including enhancements in the scale and scope of Enterprise Connect, but also increased support for collaboration between industry, public agencies and research and education institutions in "innovation hubs and precincts".<sup>16</sup> This is a prevalent and well tested model in knowledge-based economies and regions around the world and was adopted by the former Australian Government in its Innovation Precincts Program, later retitled Innovation Partnerships.<sup>17</sup>

## Innovation performance in a global context

Australia's recent economic history suggests that our commitment to innovation is sharpened by adversity, but conversely blunted by the wealth effects of a commodity boom, which engenders what former prime minister Keating depicted as policy indolence. It was as much in response to the lack of reform imagination of the last Coalition government as to the formidable challenges ahead that Rudd-Gillard Labor formulated its own more far reaching but inadequately resourced innovation policy. Now a new Coalition government once again has the opportunity to take up the reform baton.

**TABLE 1**  
**COMPARISONS OF LABOUR AND ENVIRONMENTAL PRODUCTIVITY AND R&D, 2005-10**

	Labour productivity, GDP per hour worked in USD, 2010	Annual growth rate, 2005-10	Environmental productivity, GDP per unit of CO2 emitted in USD, 2009	Annual growth rate, 2005-09	GERD, as percentage of GDP, 2010 2.82	Annual growth rate, 2005-10	GERD publicly financed, as percentage of GDP, 2009	Annual growth rate, 2005-09
Australia	49.8	0.7	2.24	2.2	2.24	10	0.78	5.6
Germany	53.6	0.8	3.94	2.9	2.82	3.7	0.84	4.9
Norway	75.3	-1.0	7.14	0	1.69	3.9	0.84	6.8
Finland	47.9	1.1	3.46	0.7	3.88	3.2	1	3.2
Sweden	49.9	0.4	8.27	4.7	3.4	0.6	1.01	3.6
Canada	45.2	0.5	2.45	2.4	1.74	-1.2	0.83	1.6

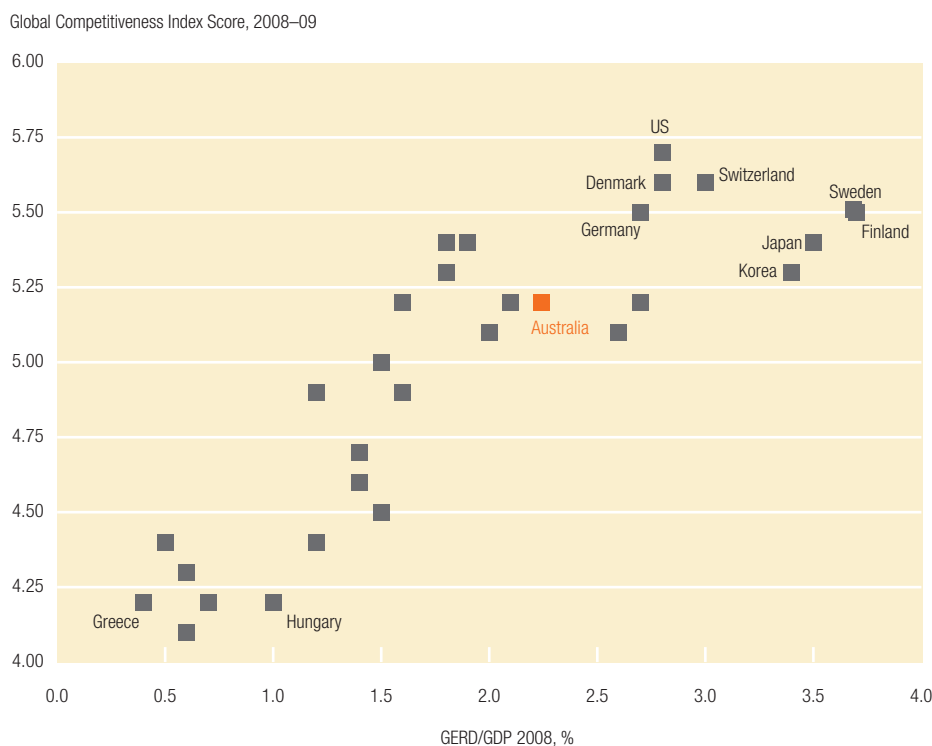
Source: OECD. (2012a). OECD Science, Technology and Industry Outlook. Paris, OECD. <http://www.oecd.org/sti/oeecdsciencetechnologyandindustryoutlook.htm>

Significantly, Australia dropped in the 2011–12 global competitiveness rankings to 20 out of 142 countries; and while we perform well in some areas, we languish at 26 for technological innovation and business sophistication, which are “critical drivers of competitiveness for advanced economies”.<sup>18</sup> The World Economic Forum Report pointed out that although there are economic gains from improving institutions, building infrastructure, reducing macroeconomic instability and improving human capital, “all these factors eventually seem to run into diminishing returns. The same is true for the efficiency of the labour, financial, and goods markets. In the long run, standards of living can be enhanced only by technological innovation”.<sup>19</sup> In addition, the report notes the importance of industry clustering for innovation:

“When companies and suppliers from a particular sector are interconnected in geographically proximate groups, called clusters, efficiency is heightened, greater opportunities for innovation in processes and products are created, and barriers to entry for new firms are reduced. Individual firms’ advanced operations and strategies (branding, marketing, distribution, advanced production processes, and the production of unique and sophisticated products) spill over into the economy and lead to sophisticated and modern business processes across the country’s business sectors.”<sup>20</sup>

According to the analysis of advanced economies by the OECD *Science and Technology Outlook*, Australia was “one of the world’s most resilient during the past five years”, having benefited significantly from the global commodities boom, but it has not stimulated the interest in innovation and knowledge-driven growth that may be found in other countries, particularly the Nordic countries and some in East Asia such as Singapore, Korea and Taiwan.<sup>21</sup> As may be seen from Table 1 above, Australia’s comparative rate of growth of GERD in general, and BERD in particular, is higher than the OECD median, but more competitive countries (in terms of innovation) have much higher investments in intangible capital, rather than physical capital, as a share of GDP.

**FIGURE 2**  
**GLOBAL COMPETITIVENESS AND R&D INTENSITY (GERD/GDP), 2008**



Source: Department of Industry, Innovation, Science, Research and Tertiary Education (DISRTE). (2012). *Australian Innovation System Report 2012*. Commonwealth of Australia, Canberra; World Economic Forum. (2012). *Global Competitiveness Report*. Geneva, World Economic Forum. [http://www3.weforum.org/docs/WEF\\_GCR\\_Report\\_2011-12.pdf](http://www3.weforum.org/docs/WEF_GCR_Report_2011-12.pdf)

*The Australian Innovation System Report* characterises Australian business as a fast follower rather than a first mover – we are not one of the leaders when it comes to the proportion of new-to-world innovations and their impact on competitiveness.<sup>22</sup> The report also shows the overall relationship between R&D intensity and global competitiveness among OECD countries, see Figure 2 above.

Policymakers around the world have recognised that innovation is much more than science and technology and encompasses various forms of non-technological innovation, including changes in organisational culture, management practices and leadership and business model innovation. Chesbrough argues that business model innovation has become as important as technological innovation, with the observation that cutting edge technology delivered through a mediocre business model may actually be less profitable than a mediocre technology delivered through a cutting edge business model.<sup>23</sup> As the *Australian Innovation System Report* points out, “business models involve a significant reorganisation of inputs such that significant productivity gains and other value can be realised without necessarily large capital expenditure or significant technological innovation”.<sup>24</sup>

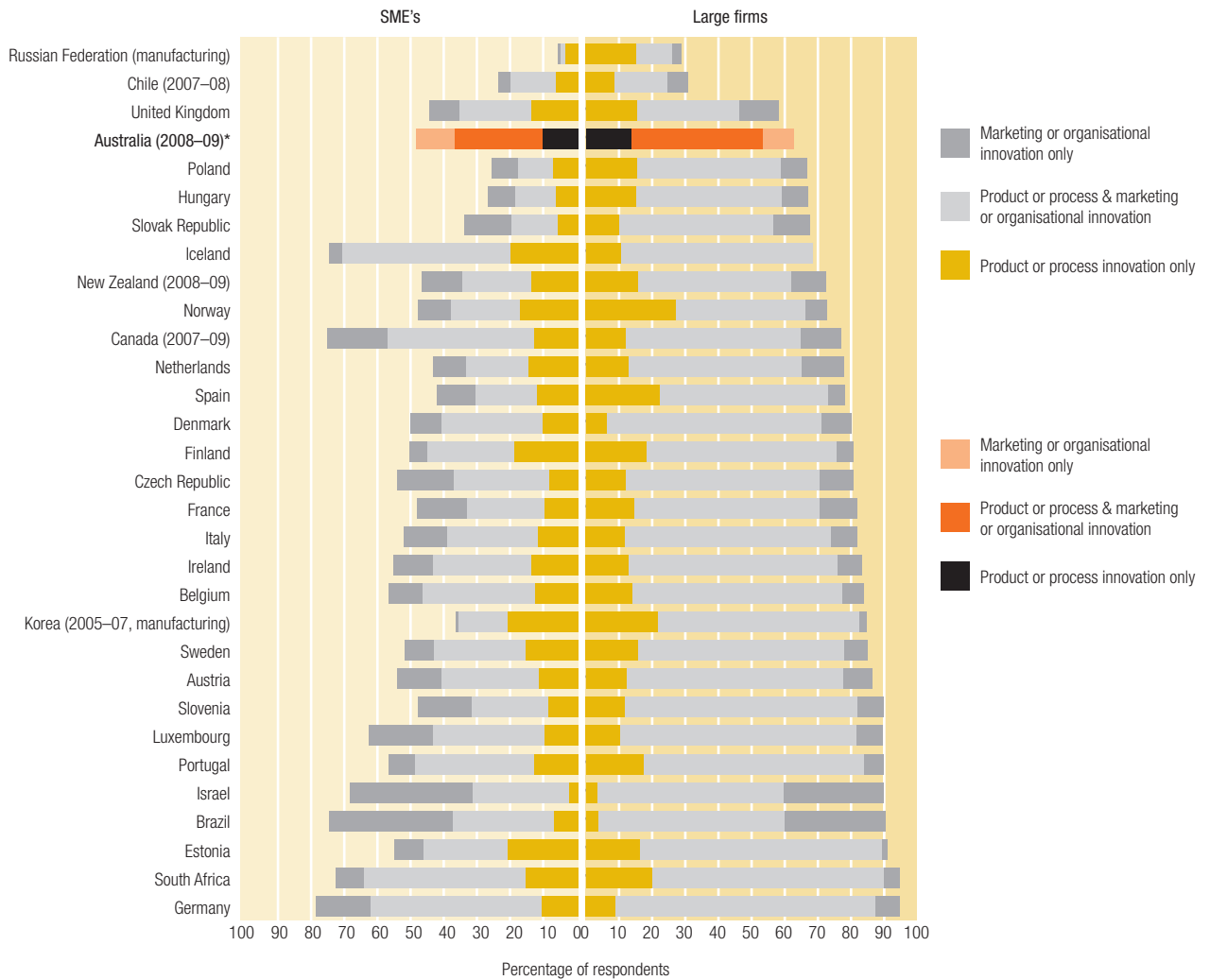
In this context, the policy emphasis in advanced national innovation systems is shifting. For example, Finland’s agency for technology and innovation, Tekes, has redirected substantial funding from R&D driven projects towards non-technological innovation, services activities and SMEs. Similarly in Canada, another country with a large resources sector and poor productivity performance, almost half of R&D activity now takes place in the services sector and the growth of non-technological innovation is reflected in trademark data, with SMEs playing a key role.<sup>25</sup> In addition, the strategic repositioning of firms and organisations through more innovative business models increasingly embodies design thinking, a human-centred problem solving approach which is being used to shape the design of products, services, businesses and policies. Many governments have begun to focus on the role of creativity and design and how it can be fostered as an integral part of innovation systems and as an enabler of productivity and innovation. Far from superseding the role of manufacturing in high cost economies, design led innovation is reconstructing traditional sources of competitive advantage and creating new ones.<sup>26</sup> As the Prime Minister’s Manufacturing Taskforce notes:

“Until recently, Australian industrial design has primarily been focused on efficiency concepts such as lean manufacturing and resource productivity. However, today design is evolving as a broader and more compelling concept for business. Design should be seen as a ubiquitous capability for innovation... This perspective on design has led in recent years to the rapid development of the field of “design thinking” (or integrative thinking). This sees design as combining user understanding, creativity and analysis in tackling complex practical challenges. Design thinking is now encouraging both start-up and firm growth, with new programs emerging that recognise how scientific, managerial and creative support can help firms get off the ground and grow.”<sup>27</sup>

This approach has also been promoted in the *Australia in the Asian Century* white paper which argued that, “Using creativity and design-based thinking to solve complex problems is a distinctive Australian strength that can help to meet the emerging challenges of this century”.<sup>28</sup> If we look at firm strategies towards these different types of innovation, the evidence suggests that technology innovation and non-technological forms of innovation such as organisational and managerial innovation tend to occur together. In most countries, however, SMEs tend to focus more on marketing and organisational innovation and large companies on product and process innovation. While Australia’s large firms rank almost last in the OECD on these innovation strategies, due to the predominance of technology takers rather than technology makers, SMEs are middle ranked, despite facing high barriers to innovation.<sup>29</sup>

**FIGURE 3**  
**INNOVATION STRATEGIES BY FIRM SIZE, 2006–08**

Source: DIISRTE, OECD 2011, ABS 2012

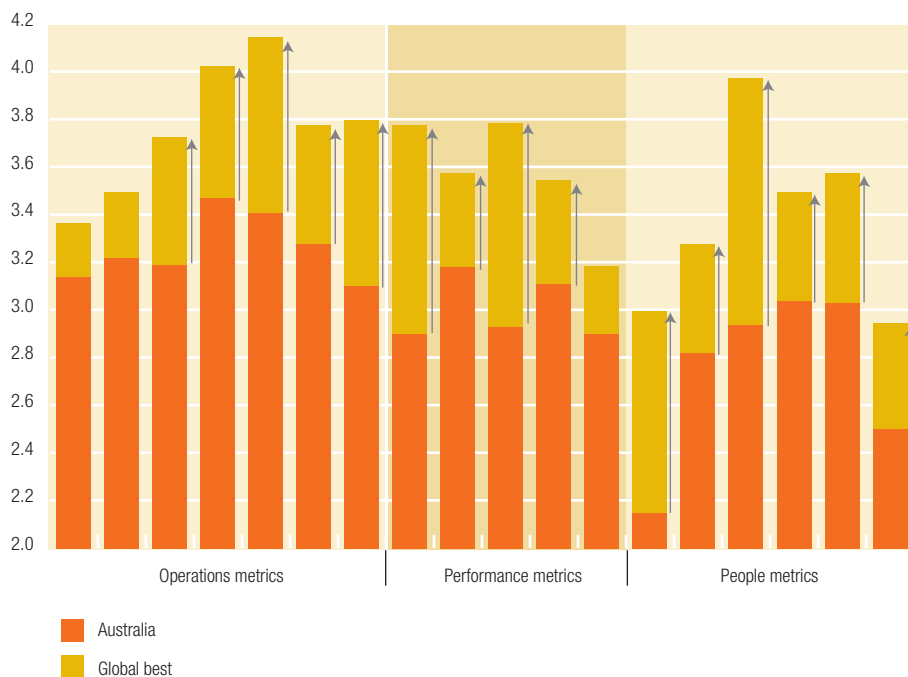


\* Indicates negative results

Source: DIISRTE, OECD 2011, ABS 2012

Non-technological innovation requires high levels of absorptive capacity in organisations (just as much as technology innovation) and the associated adoption of transformative management practices. These practices have been depicted as a set of “processes to integrate, reconfigure, gain and release resources to match and even create market change”.<sup>30</sup> There is now a significant body of research on the role of such practices and capabilities in creating value at both the enterprise and national levels and it is increasingly recognised that productivity is determined not only by tangible technologies such as machinery and new products, but also intangible technologies such as management techniques and new processes, whose encouragement by government policy is no less important.<sup>31</sup> For example, a major global study *Management Matters* found that: “Improving management practice is associated with large increases in productivity and output”, with a single point improvement in management practice (rated on a five point scale) associated with the same increase in output as a 25 per cent increase in the labour force or a 65 per cent increase in invested capital. The study concluded that, “Governments can play their part in encouraging the take-up of good management behaviour” and that “doing so may be the single most cost effective way of improving the performance of their economies”.<sup>32</sup>

**FIGURE 4**  
**AUSTRALIAN MANAGEMENT PERFORMANCE GAPS**



Source: Green, R. Agarwal, R. Van Reenen, J. Bloom, N. Mathews, J. Boedker, C. Sampson, D. Gollan, P. Toner, P. Tan, H. Randhawa, K & Brown, P. (2009). *Management Matters in Australia: Just how productive are we?* Report for Department of Innovation, Industry, Science & Research, Canberra

When Australian managers were benchmarked against other countries in an extension of the *Manufacturing Matters* study, they were found to be lagging world best practice in all 18 dimensions analysed, especially people management and “instilling a talent mindset”, which might be seen as a proxy for innovation capability, see Figure 4. While they generally measured up in large international firms where the calibre of management practice was uniformly high across all countries, Australian managers lagged global best practice most in smaller companies and in subsidiaries with limited plant autonomy.<sup>33</sup> These findings reaffirm a series of studies going back to the 1995 Karpin Report, which was among the first to highlight the key role of management in innovation and firm performance. The report emphasised non-technical dimensions of management and the role of creativity, communication skills and change management. In its 28 recommendations, the report advocated a national approach to the development of an enterprising culture based on entrepreneurship, leadership development, enhanced diversity management, the implementation of a management competencies framework and various improvements to business and management education.

Subsequently, the Australian Business Foundation found that Australia continued to rank poorly in management capability, and that our managers were “good at solving tactical and operational problems in a creative way, but lacked the ability to sustain innovation in a strategic way”.<sup>34</sup> The Business Council of Australia and Society for Knowledge Economics argued that, “the emphasis of economic reform will need to evolve to a new stage – the leadership and management of Australian organisations, and the educational infrastructure and programs required to support the development of innovative capabilities within organisations”.<sup>35</sup> Further research found that high performing workplaces “involve their people in decision making processes; are more responsive to customer and stakeholder needs; encourage a high degree of responsiveness to change and learning orientation, and enable their staff to fully use their

skills and abilities at work”.<sup>36</sup> As a result, they are up to 12 per cent more productive and three times more profitable than their peers, and performed better in “intangible attributes” such innovation. The opportunities in this area are now sufficiently well understood for the *Australia in the Asian Century* white paper to maintain that, “Using creativity and design-based thinking to solve complex problems is a distinctive Australian strength that can help to meet the emerging challenges of this century”.<sup>37</sup>

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## Collaboration and smart specialisation

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Over the past decade there has been a major shift in the understanding of innovation from linear pathways for the transfer of knowledge to the market to a broader conception of how firms create and capture value within a complex network of interactions, which contribute to the development of national and regional innovation systems. This shift reflects the evolution of the innovation process itself, which is no longer a closed, protected process to black out competitors but a more open process recognising that the best people and ideas may lie outside the boundaries of the firm.<sup>38</sup> As the United Kingdom’s Lambert Review of business-university collaboration noted, the challenge is “not about how to increase the supply of commercial ideas from the universities into business. Instead, the question is about how to raise the overall level of demand by business for research from all sources”.<sup>39</sup> By 2004, Australian public policy also recognised “the complex nature of innovation and the importance of the people, linkages and interactions between the different system elements”,<sup>40</sup> but the effectiveness of our national innovation system, as discussed in the earlier CEDA report, has been “compromised by the lack of innovation policy focus and ‘joined-up thinking’ in government, public agencies, business and universities as much as by funding deficiencies”.<sup>41</sup>

Traditionally, Australian businesses of all sizes are poor collaborators by international standards, particularly when it comes to business-university collaboration and international linkages. Yet, the *Australian Innovation System Report* demonstrates that innovative businesses which collaborate (compared with innovative businesses which do not) achieve superior outcomes, with 23 per cent more likely to report increased productivity, 48 per cent more likely to increase the range of goods and services offered, and 34 per cent more likely to report increased profitability.<sup>42</sup> Around the world, according to a recent UK report, changing the collaborative environment is the key to successful national innovation system and has far-reaching implications across firms and industry sectors, whether low or high tech, for corporate actors, competition policy, intellectual property regulation and skills.<sup>43</sup> For example, Finland has achieved world leading outcomes in education, research and technology and in the quality of its business environment through the promotion of deep engagement and collaboration. According to a recent Finnish government report, innovation policy will increasingly focus on more collaborative, open and user-centred innovation, emphasising the development of products and services meeting the needs of customers and the strengthening of users’ and developers’ mutual development work, particularly in the area of user-oriented service innovations.<sup>44</sup>

There are many other examples internationally of structures and policies to promote collaboration. In 2011, Germany introduced a specific and targeted initiative called Research Campus with the purpose of funding complex technologies with potentially radical and disruptive impact. The initiative is designed to improve collaboration between industry and academia, funding 10 highly focused proposals for long-term cooperative research and engagement between universities, public research organisations and private companies. Similarly in the UK, the Dyson Report proposes ways

for research to become more collaborative with a view to building UK's competitive advantage in global markets and supply chains, and emphasises the need to make it easier, simpler and more rewarding for academics, industry and non-profits to engage in collaborative projects. In this context, Dyson also notes the importance of formally encouraging cluster activity, based on local concentrations of companies and public institutions from a particular sector or group of sectors, often around access to shared expertise or facilities: "The co-location – and repeated exchanges between organisations – promotes both competition and co-operation, and promotes innovation and entrepreneurship".<sup>45</sup>

A further trend is for firms to move from open innovation to co-creation, increasing user involvement in production and redefining the boundaries between producers and consumers. While user led innovation is not new, the innovation platforms that provide users with the opportunity to develop and modify products and ideas are now more readily available and accessible. Such user led platforms have implications for how firms do business, from the ownership of intellectual property, to the sharing of firm information, to the managing and motivating of online communities.<sup>46</sup> A similar approach is being adopted for public sector innovation and service delivery. The Brookings Institute has argued that governments must also be more collaborative and user oriented in service innovations, requiring "governments that learn to innovate and collaborate, and develop new approaches to service delivery, transparency, and participation. This includes placing more data online and employing data analytical tools, social media, mobile technology, and search results that improve decision making".<sup>47</sup> Essentially, research programs are being redirected to solve specific challenges through new approaches to user led collaboration, with a strong emphasis on harnessing the digital economy to create long term growth and jobs.<sup>48</sup>

The announcement of a \$500 million Innovation Partnerships Program, on the recommendation of the Prime Minister's Manufacturing Taskforce, is a breakthrough for Australian public policy.<sup>49</sup> Following the pattern in other countries but adapting to the Australian context, these partnerships will combine elements of geographically concentrated clusters with broader industry led innovation networks in key areas of existing and potential competitive advantage for the economy, embedding and developing collaborative relationships within and across industry sectors. However, unlike other countries such as Sweden, Finland and most recently the US, the Australian program does not attempt to identify enabling technologies and capabilities for the future using a "technology foresight".<sup>50</sup> Instead, it opens up the program to competitive tendering by industry and research institutions, which has the advantage of allowing the government to repudiate any suggestion that it is picking winners, by enabling the winners to pick themselves, but the disadvantage of lacking a clear, comprehensively analysed and agreed focus for the allocation of public resources.

The recognition that Australia must diversify its sources of growth raises the question of what those sources of growth are and how they will be determined. It has recently been argued that, "for Australia to advance its knowledge innovation economy, there is a need to focus limited resources on doing a few things well rather than trying to do everything".<sup>51</sup> The Innovation Partnerships will require informed analysis of future enabling technologies and capabilities, some of which may be generated in Australia, others the result of diffusion and adaptation. For a country with only two per cent of the world's R&D, it would be counter-productive to attempt to be a first mover in too broad a range of technologies, and far preferable to be an agile and effective fast follower, where quite often there are greater opportunities for value creation. A recent McKinsey Global Institute report identified 12 future disruptive technologies with significant potential impact, scope and reach on industries, economies and how people work and live, including mobile internet, cloud technology, advanced robotics, autonomous

and near autonomous vehicles, next generation genomics, energy storage, 3D printing, advanced materials and renewable energy.<sup>52</sup> The CSIRO has undertaken a similar exercise in the Australian context, and internationally this approach guides innovation policy and strategic priorities for areas of both current and future competitive advantage.<sup>53</sup>

For example, the US Advanced Manufacturing Partnership recently announced the first three of many “Advanced Manufacturing Innovation Institutes” to develop areas of competitive advantage in digital manufacturing technology, lightweight composites and new alternative-power sources.<sup>54</sup> Each institute would serve as a regional hub to bridge the gap between basic research and product development, bringing together companies, universities and community colleges, and Federal agencies to co-invest in technology areas that encourage investment and locally based production. Similarly, in Europe, the “smart specialisation” strategy enables identification of areas of regional and global competitive strength for European Structural Fund investments in research and innovation, and more broadly for the Europe 2020 jobs and growth agenda:

“Smart specialisation understands that spreading investment too thinly across several frontier technology fields risks limiting the impact in any one area. A smart specialisation strategy needs to be built on a sound analysis of regional assets and technology. It should also include an analysis of potential partners in other regions and avoid unnecessary duplication. Smart specialisation needs to be based on a strong partnership between businesses, public entities and knowledge institutions – such partnerships are recognised as essential for success.”<sup>55</sup>

Germany’s innovation system, with its “thick layer of internationally competitive firms”, particularly in manufacturing, has clear policy priorities targeting specific areas of growth.<sup>56</sup> The *High-Tech Strategy 2020* has identified five societal and global challenges – climate, nutrition/health, mobility/transport, security and communication – and aims to create “forward looking projects” over the next 10 to 15 years that will lead the market. An important part of this strategy is demand-side innovation policies which include not only targeted public procurement but also policies which “strongly focus on early interaction between potential users of new technology and those actors that develop technology; interactions should facilitate mutual learning and help to introduce technologies that meet the requirements of future markets”.<sup>57</sup> Among the Nordic countries, Sweden’s 2009–12 science, technology and innovation policy identified 24 strategic areas for targeted funding allocations under four broad themes, whereas Finland has developed a focus on key emerging and environmental technologies. Norway’s White Paper on research 2009–13 defined policy goals around “creative people and creative undertakings”, with an *Action Plan for Entrepreneurship in Education* aimed at strengthening students’ personal skills, perspectives, creativity and innovative thinking.

In sum, Australia needs to identify high value adding activities, particularly those with the prospect of developing critical mass in clusters and networks, and which offer the best chance of strengthening competitiveness and future growth opportunities in global markets. Increasingly, businesses are using models of co-creation and co-innovation, which reflects an understanding that firms may be able to create and capture value by engaging in relational approaches with value created in action. These models of open, collaborative innovation may be outside in, where a firm makes greater use of external ideas and technologies in its own business, or inside out where a firm allows some of its own ideas, technologies or processes to be used by others.<sup>58</sup> For example, in competitive co-creation, a company may seek to innovate products and services through input from stakeholders, including through crowdsourcing, with models ranging from large established companies such as General Electric’s Ecomagination

to independent initiatives such as OpenIDEO.<sup>59</sup> Another model is community based competition, where the value in action may occur in exchange between customers facilitated through an online open platform, with a co-created service that produces a new product.<sup>60</sup> Beyond these models is co-innovation which is both open in the process of the creation of the service and open in the outcome<sup>61</sup>, illustrated by the Linux operating system and Wikipedia.<sup>62</sup> Can public policy encompass these new forms of innovation, and, if so, in which areas can they most effectively be deployed?

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## Building future innovation capabilities

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In the wake of the resources boom, Australia's future as a high cost economy depends more than ever on the successful deployment of knowledge and innovation. Our productivity performance has begun to improve from a low base in recent years, but much more needs to be done to achieve competitive advantage for trade exposed industries and services in global markets and supply chains. It is clear from the experience of comparable economies that this will not be achieved through the low road approach of narrow cost cutting and an unwinnable race to the bottom, but only through a high road of longer term dynamic efficiency gains in a knowledge based economy. We have argued that such an approach will require the development of enhanced management and innovation capability at the level of the firm, strategic repositioning of industry sectors around key enabling technologies and skills through smart specialisation, recognition of broader non-technological forms of innovation such as new business models and design thinking, support for deep collaboration and engagement throughout the national innovation system and a more effective and targeted approach to participation in global value chains.

Clearly progress has been made with a more deliberative understanding of Australia's national innovation system, improved but still not adequate levels of funding for the various elements of the system and a shift of policy emphasis from supply side concerns such as public research, business R&D and skill development, important though these are, to the demand side of innovation, particularly enterprise absorptive capacity, management capability, public procurement and technology diffusion. This shift is encapsulated in the new Innovation Partnerships Program, essentially industry led networks, which enable business and research institutions to determine for themselves within a broad funding framework how these elements may be combined most effectively in ecosystems of established or emerging global competitive advantage. The priority for the new coalition government should be to inform this program with a technology foresight as well as deepening collaboration within these ecosystems and value chains, especially the fast growing group of micro-multinationals in Australia, and broadening it to include integrative and design thinking around new business models and the customer experience. However, a major challenge for the Innovation Partnerships, as for the Australian economy as a whole, remains to develop workplaces where managers are able to engage the talent and creativity of their workforces and entrepreneurial start-ups which create long term growth and jobs.

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