

A Strategy to Accelerate Innovation in NSW Outline for Policy Development

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Why innovation matters in NSW: The role of innovation in economic development

The NSW Government should place innovation at the centre of its economic strategy because innovation—the development of improved products, services, and processes, the creation of new markets, and the use of new products—is critical to productivity advance. Productivity advance is, in turn, the essential underpinning of prosperity in any economy. Only by increasing economic output per hour worked can NSW ensure long-term sustainable economic development.

Innovation increases productivity both by improving efficiency (reducing cost) and raising sales (increasing customer willingness to pay). The latter is particularly important. The ability of NSW companies to develop new products and services to satisfy sophisticated customer demand, both at home and in export markets, will become the key to continuing NSW's strong economic development of recent decades.

Innovation is a new focus for productivity policy in Australia. For the last 25 years, productivity policy and microeconomic reform in our country have concentrated on two other drivers of productivity:

- Increasing the duration and intensity of work—that is, encouraging Australians to work harder and longer while maintaining their rate of output.
- Increasing capital investment (thus reducing consumption)—substituting machines for people.

As our economy approaches the high end of global rates of work hours and capital equipment per worker, however, these approaches are reaching the limits of efficacy. In future, they can be expected to offer declining marginal returns. That is, more effort and finance will be required, for less result. And indeed, statistics reveal a tapering off of productivity increase in the Australian economy since 2000.

The NSW Government should now turn to innovation to support productivity advance.

Why the NSW Government needs an innovation strategy: The goal of innovation policy

If the purpose of innovation policy is to improve productivity, its goal must be:

To enhance the innovation capabilities of companies in the economy's most important sectors.

Although an apparently simple statement, until now most discussion around innovation policy in Australia has *not* focused on this aim. Other jurisdictions in Australia have implicitly pursued one or more of several other aspirations.

The most popular have been:

- To create new companies, or even entirely new industries, in supposed 'high technology' sectors.
- To gain a financial or other return on government investment in research and education, especially through commercialisation of discoveries.
- To transform business or even community culture, to make it more 'creative' and innovative.

These aims have proven not only extraordinarily difficult or impossible for government to deliver, but the result has often been programs that *de facto* substitute the public sector for activities more appropriately performed by the private sector.

Innovation policy in NSW should aim not to substitute for the private sector, but to support the activities of private companies *when necessary innovation capabilities cannot or will not be provided by markets or companies*.

Innovation policy in NSW should follow several clear principles:

- **Have impact on sectors of sufficient weight and potential to matter.**

To exercise sufficient impact, an innovation policy must address the needs of relatively large sectors. This implies that an innovation policy cannot restrict itself to 'research-intensive' industries. It is well to recall that so-called high tech industries (usually defined as industries with R&D/Sales ratios of more than 4 per cent) make up only a small component of manufacturing in any economy, and an even smaller component of GDP.

This is true for Australia, but it is true of all developed economies: in no OECD economy does high tech manufacture make up more than 3 per cent of GDP. All OECD economies, including Australia, rest on a combination of large medium-technology and low-technology manufacturing industries (such as food and beverages, or fabricated metal products), and large-scale service activities (of which the largest are education, health, and social services). As we will observe below, this is particularly true in NSW.

Nor is it true that ‘high tech’ sectors account for the greatest proportion of either innovation or growth. Innovation surveys undertaken in Australia and many other countries show that so-called low- and medium-technology industries include significant proportions of innovating firms, that they develop new products, and that they generate significant sales from new and technologically changed products.¹

Indeed, the very distinction between ‘high’- and ‘low’-technology industries is misleading, resting as it does not on the actual ‘knowledge-intensivity’ of any industry, but on inadequate proxy for such a measure: the proportion of the industry’s R&D performed *internally* in individual firms. A more useful classification distinguishes *internal R&D*-focused industries, in which innovation is driven by formal R&D performed inside companies (producing high R&D/Sales ratios), from *distributed-knowledge* industries, in which innovation is developed externally to individual enterprises, and optimised internally. Industries can thus be ‘knowledge-intensive’ without a high degree of R&D necessarily being undertaken by firms themselves.

- **Address real needs these sectors face, based on an analytical understanding of the actual innovation process in the NSW economy.**

Innovation follows different paths in different sectors. Growing sectors innovate in different ways, with a great deal of variety in methods, approaches, and results.

In some industrial arenas, innovation takes the form primarily of new company formation; in others, it manifests through the activities of already-existing large companies; in still others innovation is developed externally by not-for-profit entities and adopted by individual market participants.

¹ In all sectors of the Australian economy at least 30 per cent of firms are typically innovating over any three-year time period. In manufacturing, the most intensively innovating sectors are machinery and equipment and chemicals, each with about 50% of firms innovating. Nevertheless in such ‘traditional’ industries as food products, textiles and metal products between 30 and 35 percent of firms are innovating: see Australian Bureau of Statistics, *Innovation in Australian Business 2003*, 8158.0, Canberra, 2005, pp.7, 10.

Innovation in certain sectors is primarily product focused; in others it is process focused. It is science-based in some sectors; in others, marketing focused.

Only by developing deep insight into the actual processes by which firms *in the specific industries important to NSW* innovate, can government policy hope to devote its resources to activities that will build a basis for sustainable innovation and productivity advance.

- **Complement, not attempt to substitute for, and certainly not compete with, the activities of private companies. It will strengthen the market position and capabilities of private firms.**

To be effective in supporting innovation in these sectors, the policy should in the first instance ‘do no harm’—that is, it should not distort market incentives by attempting inappropriately to substitute public-sector activity for those of the private sector. It should limit its domain to fields in which infrastructure, capability, and resources are both demonstrably required to support innovation and in which it is not feasible for private companies or markets, in the normal course of affairs, to undertake the specified activity.

In general, there are two broad reasons why economically necessary capabilities might be absent in an economy such as that of NSW. First, markets ‘fail’ in certain instances. In the creation of physical and knowledge infrastructure, for example, it is sometimes not possible for individual firms to capture sufficient benefit from a particular investment to make the commitment worthwhile, even though such investment might be greatly beneficial to the economy as a whole, or to an industrial, regional, or community sector. Second, individual firms or markets might not be able effectively to diversify and manage the specific form of risk involved in certain types of innovation.

Innovation policy in NSW should focus on addressing these needs rather than attempting to create new industries or provide a direct financial return to government.

Five lessons from the study of innovation

Effective innovation policy must be based on an accurate understanding of the processes through which innovation takes place in a modern capitalist economy such as that of NSW. As questions related to productivity and endogenously generated economic growth have moved to the centre of research in economics, a series of well-established insights have emerged to form a platform for effective policy. Several of these contravene conventional wisdom, and suggest new directions for innovation policy in NSW.

1. Innovation is diffused across the economy.

Innovation is *not* confined to a small group of high-technology industries, nor is it driven by a small set of sciences or technologies. Statistical studies of innovation, particularly from Australia and the European Union, reveal that innovation (in the sense of development and sales of new products and services) is distributed broadly across the economy in all developed countries.² Low and medium technology sectors are not in absolute decline in most OECD countries; they remain large and persistent as a proportion of both manufacturing output and Gross Domestic Product. Industries that are regarded as ‘traditional’, ‘mature’, or ‘low tech’ often generate substantial sales from technologically new products or processes.

Similarly, and importantly for NSW, the service sector is strongly innovative. This finding is especially important since the service sector makes up the largest component of all developed economies, and particularly so in NSW, as will be explored below.

The implication of these findings is that government policy to promote innovation should not necessarily aim to develop *de novo* industries whose *product* is high technology. Creation of an innovation-effective economy does not reduce to sponsorship of ICT, biotechnology, or nanotechnology industries, nor are R&D/sales ratios necessarily the most important focus of innovation policy in many sectors. Indeed, since business R&D is disproportionately concentrated in ‘high technology’ sectors (approximately half takes place in these sectors, which, to reiterate, account for less than 3 per cent of GDP), tax credits for R&D amount to a subsidy to a small proportion of the economy.

² Australian Bureau of Statistics, *Innovation in Australian Business 2005*.

2. **Within industries, innovation is concentrated.**

While innovation is broadly distributed across the economy, *within* particular sectors it is concentrated. Most innovation is led by a few companies, and others follow by copying or imitating.³

This finding, too, has important implications for policy. It suggests that government policy should aim to enhance the innovation capabilities of leading firms, rather than hope to raise the average or promote cultural change across entire sectors. Unfortunately, government policy frequently does the reverse: it focuses on failing or at best start-up firms, and regards successful firms as not ‘deserving’ of support.

Of course, this observation does not suggest that government should subsidise leading innovators. Rather, policy should aim to provide infrastructure, education, and knowledge resources that even leading firms cannot undertake alone, in order to enable pioneer innovators to accelerate growth or strengthen their position.

3. **Innovation usually begins with a customer problem, not a technical ‘discovery’.**

One of the most well-established conclusions of research is that innovation should not be viewed primarily as the commercialisation of scientific discovery. Much innovation policy is based on an implicit assumption that innovation processes are a sequence that begins with R&D. In this view, scientific researchers first discover useful things, engineers then transform these discoveries into manufacturable products, after which marketers sell the results to customers.

In fact, innovation projects more often begin at the end point of the sequence outlined above. Companies usually start by leveraging their understanding of particular customer needs to identify a potential new product (this does not imply that it simply ‘listens to customers’; often firms understand potential needs better than do customers). After conceiving the potential product, the company initiates an innovation project. Usually, firms endeavour to create new products by utilising their own existing capabilities; this is much the cheapest and safest route. Should they encounter problems beyond their existing expertise, however, they may launch an R&D project, whether entirely internal or partially external.

³ Australian Bureau of Statistics, *Innovation in Australian Business 2005*.

But note that R&D usually follows identification of a customer need, and is launched after the project has begun. R&D may well participate in an innovation project, along with such corporate functions as manufacturing, marketing, regulatory approval, and capital allocation, but it is rarely the *initiator* of the project.

Nor is R&D usually the major financial component of innovation projects. Statistical surveys of innovation in Australian business show that on average only 31 per cent of the cost of innovation projects consisted of R&D expenditure (despite tax-based incentives to classify as much expenditure as possible as 'R&D').⁴ Non-R&D expenditures incurred during innovation efforts for items such as training, market research, design, and engineering development were more than twice those for R&D.

Yet innovation policy in Australia has until recently consisted overwhelmingly of incentives for R&D, combined with pressure for commercialisation from publicly supported research bodies. Based on the understanding above, these policies are likely to miss the mark or produce undesirable consequences.

4. The returns from innovation are disproportionately captured by those who bear and manage its risk, often finance providers.

The defining characteristic of innovation as an economic activity is that its outcomes are much more uncertain, hence more risky, than those of routine activity. This suggests that those who bear this economic risk—by financing it—should be able to capture a significant, perhaps apparently *disproportionate*, share of its return (given their weight in total GDP). And so it is. Recent studies have shown, for example, that the proportion of total profit in the US economy captured by the finance sector has grown from 14 per cent in 1981 to 39 per cent in 2001.⁵

An important implication of this finding is that while innovation may take place broadly across the economy, the capture of the economic benefits that flow from innovation may be quite concentrated, sectorally and regionally. Communities that are effective in building finance institutions capable of managing innovation risk will likely capture more than their 'fair' share of value.

⁴ Australian Bureau of Statistics, *Innovation in Australian Business 2005*.

⁵ Steve Galbraith, 'Trying to Draw a Pound of Flesh Without a Drop of Blood', *Morgan Stanley US and the Americas Investment Research*, 8 September 2003; Steve Galbraith, 'Fading Fog', *Morgan Stanley US and the Americas Investment Research*, 21 September 2003. The Morgan Stanley data is for S&P 500 corporations.

Development of a vibrant financial sector should thus be viewed not merely as desirable to support the innovation activities of other firms, but as an end in itself—a means to capture value from innovation taking place elsewhere in the economy. As observed below, this has significant implications for Sydney, the financial capital of Australia.

A mismatch between the risk profile of a particular technology and the structure of finance vehicles may, however, inhibit propensity to innovate. Some potential innovations require finance in too large ‘lumps’, over too long time periods, with too skewed a return profile, for private financiers to be able to diversify away sufficient of the risk. Government is thus sometimes needed to assist in risk diversification for selected technology types.

5. Some essential components of an effective innovation system cannot be developed by private firms alone.

Research to identify characteristics of innovative firms highlights several typical features, each of which appear to relate to enabling factors in innovation:

- **Innovating firms are collaborators.** Knowledge creation takes place through interaction with other enterprises, organisations, and public institutions of the science and technology infrastructure. Indeed, empirical research has shown that innovating firms are almost *invariably* collaborating companies, that collaboration persists over sustained periods, and that universities and research institutes are important collaboration partners.⁶
- **Innovating firms accumulate capability over time.** Past developments tend to be utilised to determine future pathways of innovation. Cumulative capability acquisition underlies patterns of specialisation in economies, and creates differentiation among regional and national economies. Effective policy builds on, rather than ignores or counteracts, such accumulated capability.

⁶ Basri, E. ‘Inter-firm Technological Collaboration in Australia: Implications for Innovation and Public Policy’, in OECD *Innovation Networks: Co-operation in National Innovation Systems*, OECD Paris, 2001.

- **Innovating firms tend to cluster.** Multiple studies have suggested that successful firms gather together geographically, either ‘horizontally’—firms in the same type of business—or ‘vertically’—firms connected in related value chains. Firms within such clusters tend to be more successful than those standing alone, perhaps because they tap knowledge bases and related expertise that would not exist separated from the cluster. Clustering appears to help overcome limitations of scale.
- **Innovating firms in all sectors employ science not developed internally.** Many new products, while not spawned by scientific discovery, draw upon science not possessed by firms. Analyses of patents show that an increasing proportion of patents cite scientific research, and that a substantial proportion of papers cited in industrial patents were produced by public-sector research organizations. This is true as much in ‘low tech’ industries, demonstrating that while the product of these sectors may appear traditional, they are not ‘low knowledge’. In finance, for example, University-based researchers were responsible for the three major financial innovations of the 20th Century: Venture capital, options pricing, and high-yield bonds.

These findings lend weight to a key prediction from economic theory: that maintenance of a basic research and technology capability should not be left in private hands since returns from knowledge are difficult to appropriate even in the presence of enforceable intellectual property and patents.⁷ The reason is that returns from investments in knowledge often ‘spill over’ to other sectors, and that unless such returns are incorporated into the economic calculus, investment to build knowledge infrastructure might not be economically justifiable—or justifiable only for an agency such as government or a not-for-profit institution that can appropriate the return over an economy-wide base.

⁷ Arrow, K., ‘Economic Welfare and the Allocation of Resources for Invention,’ in National Bureau of Economic Research, *The Rate and Direction of Inventive Activity*, Princeton University Press.

Steps to an innovation policy for NSW

If the goal of innovation strategy is neither to develop new ‘high technology’ industries nor to ensure a financial return on government’s investment in research and education, nor especially to change Australia’s culture, then the process of developing an innovation policy needs to proceed quite differently than have most Australian government jurisdictions in recent times.

Rather than identifying a list of desirable technologies in which the nation, state, or region hopes to build an industry, or a list of alleged commercially valuable intellectual property believed to be ‘locked up’ in government-sponsored research organizations, or moving immediately to institute programs to promote more ‘commercialisation’, policy makers should begin with an analysis of the knowledge, research, capability, and resource requirements faced by actual or potential innovators in its high-impact sectors. Only on this basis can a relevant and effective policy to support companies’ innovation programs be developed.

From that platform, an understanding can be built of which elements of an effective innovation system are already present, which are likely to be developed by private organizations, and which might require government support. On the basis of such an understanding an effective innovation policy can be constructed.

The analytical underpinning of effective innovation policy should thus proceed in three steps:

1. Identify high-leverage sectors

The purpose of this phase is to identify sectors with potential most powerfully to support productivity advance. These will be sectors that combine sufficient weight in the economy to be ‘important’ with existing revealed competitive advantage.

Tests for such weight and competitive advantage would include:

- Generated high-wage jobs.
- Creates wealth—increased market capitalisation.
- Grown sales faster than average.
- Exports more than average.
- Manifests substantial productivity growth.
- Introduces new products or processes faster than other comparable sectors.

This phase of policy development requires quantitative analysis, supported by appropriate qualitative and synthetic insight into the processes by which high-impact sectors interact and support one another, creating an overall ‘character’ for the particular economic unit for which the policy is being developed.

The result will be a target list of economic sectors or industries that offer the potential to improve economic performance through innovation-based productivity advance.

2. Analyse the knowledge infrastructure, business capabilities, and resource allocation processes that support innovation in these sectors.

As noted, firms rarely innovate alone. Innovation demands continuous interaction and feedback between perceptions of market opportunities, technological capabilities, and managerial processes within firms. The ability to perceive opportunities and to invest in realizing them—that is, the processes of formulating firm strategy and implementing it through a managed portfolio of innovation projects—are among the main characteristics of innovating firms. Many firms lack such capabilities—technical, physical, and managerial—and need access to external infrastructure, capabilities, and resources to make innovation feasible.

Innovating firms thus rely on three forms of support: access to science and technology, access to capital, and access to high-quality information and knowledge infrastructure. The second phase of innovation-policy development should evaluate the extent to which these supports are present, and in what respects they can be strengthened—with specific attention to the high-impact sectors identified in the analysis above.

1. Access to science and technology.

As noted above, innovation-related problems often require firms to import and integrate knowledge and skills obtained from outside the firm, and to utilise information infrastructure provided by government. Individual firms frequently find that they cannot justify maintenance of sophisticated science and technology expertise in-house—they simply do not use such capabilities sufficiently frequently to amortize the cost of maintaining them at the cutting edge—but that they do need access to them periodically.

Cooperation and collaboration among innovating firms and suppliers, customers, design or engineering consultants, universities or research institutes are thus frequent characteristics of modern innovation processes. In this context, the role of universities and research institutes should not be seen as to

generate innovations, but to provide access to expertise of the highest quality and to solve problems relevant to innovation efforts by private firms.

2. Access to financial resources.

Innovation requires sustained investment under conditions of uncertainty. Firms cannot know the future and their strategic innovation choices can be very risky. Nevertheless, they must invest in a wide range of innovation-related assets—human skills, new capital equipment, design capabilities, strategic marketing, engineering development programmes, and more. Innovation therefore requires access to finance that both permits and encourages such investment, and that can manage the risks involved. An assessment is needed of whether the finance sector has the capability to bear and manage such risk, and possesses the scale required to diversify it.

3. Access to high-quality information and knowledge infrastructure.

Finally, innovating firms require access to high-quality physical information infrastructure. In a world in which vital ideas might be sourced from any corner of the earth, rapid movement of information is critical. But industries differ in their demand for such infrastructure, and it is necessary to build an understanding of the specific needs of particular sectors before committing to information infrastructure priorities.

3. Formulate priority initiatives to enhance knowledge and information infrastructure, reduce risk, and strengthen innovation capability.

Combining these two phases of analysis provides the foundations for an innovation strategy that can exercise sufficient impact on the NSW economy to noticeably enhance productivity.

Identifying the high-leverage sectors: Key characteristics of the NSW economy

The NSW economy, like all economies, has developed a particular pattern of specialisation—a distinct role within the Australian and world economies. Features of the NSW and Sydney economies particularly relevant to innovation are:

1. Sydney is Australia's logistics and transaction gateway.

Most international visitors enter Australia through Sydney. Perhaps more importantly, they conduct their business and move goods through there. In 2005, 54 per cent of all overseas visitors entered Australia through Sydney, and business visitation to Sydney increased by 61 per cent between 1997 and 2002. Sydney offered 500 weekly international flights and 143,000 weekly seats in 2005; the next busiest airport was Melbourne, with 237 flights and 64,441 seats. It is estimated that by 2012, visitation to Sydney will have increased by 150 per cent since 1999.⁸

Sydney is also Australia's major logistics hub. Sydney airport moved 26.4 million passengers in 2001, 8.7 million from overseas. This number is expected to increase to 35 million by 2010 and 49 million by 2022. More than 50 per cent of Australia's international air freight traffic was handled by Sydney in 2006, and Sydney moved 220,000 tonnes of rail freight each day. More than 150 freight forwarders and integrators were located within five kilometres of Sydney airport.⁹

The result is a substantial component of Sydney's economy. Sydney airport alone provided 33,500 jobs directly in 2006 and another 33,000 indirectly, amounting to 4 per cent of Sydney's total workforce.

Sydney's role is not limited to physical export—it also dominates services trade, especially transaction facilitation (described in the national accounts as 'business services'). While Sydney accounts for 22 per cent of the Australian population, and 23 per cent of national value added, Sydney accounted for 41 per cent of all Australia's services exports in 2005, with transportation and business travel services comprising 41 per cent and 45 per cent of Australia's totals respectively. Also as contributor to Australia's service exports, NSW accounted for 65 per cent of insurance, 57 per cent of financial, 79 per cent of computing and information, 80 per cent of professional, and 81 per cent of services between affiliated enterprises.¹⁰

⁸ NSW Tourism Task Force.

⁹ Bureau of Transport and Regional Economics; derived from ABS customs data.

¹⁰ ABS Cat. No. 5368.0.

2. Sydney is Australia's finance and business service centre.

Australia manages and allocates its capital in Sydney. Forty two per cent of Australia's financial services are based in Sydney. Forty three of Australia's 53 local and foreign owned banks were headquartered in Sydney (none of the 28 foreign banks operating in Australia were headquartered *outside* Sydney).¹¹

Moreover, Sydney is increasing its dominance in finance. Sydney's proportion of Australian financial services increased from 39 per cent in 1995 to 42 per cent in 2005. Sydney's financial services grew by 24.5 per cent between 1995 and 2005, compared to only 14.4 per cent for the nation as a whole. This growth reflected NSW's considerably greater investment in finance—it accounted for 46 per cent of national capital expenditure in finance.¹² It also reflected the growing importance of financial, transactional, and deal-making skills in development of Australia's resource sectors. While no mining takes place in Sydney, and NSW is only a relatively small contributor to resource extraction, Sydney's better connected, larger, and more sophisticated finance sector is increasingly capturing value from other locations, such as Perth, in financing resource development.¹³

The result has been the creation of a significant global financial cluster. Sydney's financial services sector is now one half that of global-powerhouse London, and one third that of New York. New South Wales' economic output was almost double that of financial city-state Singapore in 2004, and 30 per cent larger than that of Hong Kong.¹⁴

Financial services is also NSW's fastest-growing sector, with annual growth in total factor income of 10 per cent between 1995 and 2005. Financial services is one of the few fields in which Australia's trade position has actually improved, and Australia had a positive trade balance in financial services of \$180m in 2004. NSW financial service exports increased by 75 per cent between 1996 and 2006. Foreign exchange trading alone doubled between 2000 and 2004.

And financial services provides good jobs. Sydney's financial sector employed 151,500 people in 2005, at wages 33 per cent higher than the national average.

¹¹ In total, the service sector accounted for 82 per cent of NSW's industry income in 2005, with property and business services alone making up 15 per cent and finance and insurance a further 10 per cent.

¹² ABS data on request.

¹³ Spiller Gibbins Swan Pty Ltd and National Institute for Economic and Industry Research (2000), *South West Urban System Economic Study—Future Perth*, a report prepared for the Western Australia Planning Commission.

¹⁴ World Economic Outlook, September 2005, International Monetary Fund.

It is now the third largest component of GDP, at 8 per cent, and combined the NSW finance, insurance, property, and business services markets enjoyed a total industry income of A\$67.8 billion in 2004-05.

This growth to dominance has been driven by three factors: increased international activities of major institutions in NSW; expansion of funds management, especially superannuation; and the development of new, more advanced—and more profitable—financial services and products (NSW accounted for 92 per cent of Australia's business R&D expenditure in the finance and insurance sectors in 2004, an amount equalling \$573 million, more than half that of NSW manufacturing at \$1037 million, and is the second-largest R&D spender among NSW industries¹⁵). The sector is now a major driver of both growth and innovation in the NSW economy.

3. Sydney is Australia's leading entertainment, fashion, and creativity centre.

Sydney dominates in film, music, broadcasting, publishing, games, interactive media, software development, advertising, and industrial and virtual design sectors, with reported firm density for these activities in key inner-city Sydney locations significantly above rival centres.¹⁶ Sydney accounted, for example, for 50 per cent of Australia's film and television production industry in 2005, and in 2006 NSW companies accounted for 79% of national drama production (although only 36% was shot in NSW). An integral part of this sector has been multimedia providers. Specialist NSW information and communications technology (ICT) companies contributed just under A\$12 billion to the NSW economy in 2003.

And this sector continues to grow. Output increased nationally for these industries from \$8 billion in 1995 (2.2 per cent of GDP) to \$18 billion in 2000 (3.3 per cent of GDP). This trend has been strongly reflected in NSW, where cultural and creative industries have been the fastest growing source of employment over the past 10 years, increasing at a rate 74 per cent higher than the average for all industries.

¹⁵ ABS Cat. No. 8104.0, 2003-04.

¹⁶ National Office of the Information Economy and Department of Communications, Information Technology and the Arts, *Creative Industries Cluster Study*, pp. 46-47.

4. **Manufacturing continues to be strong, and is increasingly globally connected.**

While manufacturing in NSW accounted for only 14 per cent of state income in 2005 and 21 per cent of national manufacturing employment, NSW manufacturing was typically more sophisticated than that of other states, reflecting its often higher service content. Manufacturing was therefore an important actual and potential bearer of productivity advance.

Higher-value-added manufactured goods made up a greater proportion of NSW exports than in other states. Fields in which NSW accounted for a disproportionate share of national exports included medicinal and pharmaceutical products (46 per cent of Australia's total), photographic equipment and optical goods (39 per cent), printing, publishing, and recorded media (32 per cent), petroleum, coal, and chemical products (27 per cent), electrical machinery and appliances (25 per cent), and office machines and computer equipment (23 per cent). These are all among the most value intensive of manufactures.

The fact that manufacturing makes up a declining share of Australia's GDP has led some to suggest that manufacturing is of little consequence to the nation's economic future. There are several reasons to doubt this claim. First, manufacturing traditionally bears a disproportionately greater burden of innovation and productivity advance. Manufacturing was still by far the largest contributor to R&D spending in 2006, for example, and academic studies invariably report higher rates of productivity gain in manufacturing than other sectors. Second, much of the service economy exists to support manufacturing, and would not exist without it.¹⁷ The food industry, for example, remains the world's largest, including in most developed economies, despite the fact that only a small proportion of the workforce of developed countries is engaged directly in the physical growing and processing of food. Third, manufacturing, like finance, frequently serves as the location of value capture for technology created elsewhere, for example in laboratories.

For all these reasons, manufacturing is still a vital contributor to NSW's future innovation performance and should feature prominently in an innovation strategy.

¹⁷ Arguments that since manufacturing today comprises a relatively modest share of GDP and employment it is less important, and might even be dispensed with, are akin to claims that because in a modern army a declining proportion of employees carry weapons or engage directly in fighting, the fighters might not be necessary (most members of the armed forces today are devoted to administrative, logistical, or planning tasks). Economic activity is still ultimately about the production of goods and services that people actually use, and many other tasks are needed only because manufacturing still takes place.

5. Resources continue to contribute vital export earnings.

While mining made up only 17 per cent of NSW exports in 2005, compared to 28 per cent of Australia's, coal in particular remained a substantial contributor to state income. Coal accounted for 19 per cent of NSW merchandise exports in 2005, and at \$4.45 billion, NSW provided 13 per cent of total world exports of coal. Newcastle is the world's largest coal port.

This contribution reflects Australia's and NSW's strength in energy. Australia is one of the few OECD countries that remains a significant net exporter of energy, ranking fourth in the world (behind Norway, Venezuela, and Columbia) for self-sufficiency. Australia produces more than twice its own energy needs (226 per cent), with coal production nationally representing 376 per cent of domestic needs and gas 143 per cent. Australia is the world's leading exporter of coal (since 1986), and the seventh largest exporter of liquefied natural gas.¹⁸

Given its continued weight in the economy, two important innovation-related issues are posed for coal in NSW:

- How to defend these exports in an era of rising concern about global warming, to which coal is a significant contributor.
- How to add additional value-creating activity, in particular with related and supporting services.

These issues should be addressed in the public sector's research priorities.

¹⁸ Energy Balances of OECD/non-OECD Countries 2001-2002.

Key Sectors Needs and Capability Assessment.

As noted above, if government is to be effective in supporting innovation and productivity in these sectors, policy must be based on analysis of *the extent to which activities for which government should and does have responsibility adequately support company innovation*. In so doing, and given its tremendous weight in the economy combined with its zero cost of capital, government must be doubly careful not to damage industry innovation efforts.

What are the arenas in which government should take responsibility to support firm-based innovation efforts? As noted above, three key areas are:

1. Science and technology.

If a key purpose of research and education is to support the innovative capabilities of firms, it is vital to invest in fields in which industries have sufficient capability to absorb and utilise the results.

Government support for R&D should focus on fields in which NSW firms have strong understanding of future and potential customer needs, and therefore are likely to draw upon the expertise and results of research to develop new or improved offerings.

It is essential for government to understand:

- What are the actual revealed priorities of the NSW publicly supported research and education effort?
- To what extent do R&D and training commitments support the most important sectors, identified above?
- In particular, do R&D, education, and training commitments adequately support NSW's service-intensive economy, particularly in its highest-value and most sophisticated form?
- What gaps have been left, which will create under-performance?

2. Financial resources.

Most Australian governments undertake significant grant and finance encouragement programs aimed to encourage capital allocation to innovation, or to support young firms. Within the framework outlined here, it is vital to understand whether these programs achieve the desired end.

We need to ask:

- Is government investment in start-up support and innovation actually building private-sector commitment, or substituting for it?
- Is government grant-making inducing dependence on government, rather than the intended head start?
- What impact is government regulation, for example around corporate governance, having on innovation?
- What other options to encourage capital allocation for innovation might be available?

3. High-quality information and knowledge infrastructure.

Alongside any economy's physical logistics and support infrastructure, a network of information and knowledge infrastructure exercises substantial impact on the extent of innovative behaviour.

- Does the information infrastructure meet the needs of service and information companies, as well as those moving physical goods.
- In a transaction-dependent economy such as that of NSW, what special infrastructure needs should be addressed?
- How does NSW's information infrastructure compare to that of international rivals?

Taking initiative: Five goals for a NSW innovation policy and how to achieve them

Building on these phases of analysis, a set of coherent initiatives can support and enhance innovation capability. Examples of the kind of initiatives that might be taken—advanced here to serve as foci of discussion—are outlined briefly below.

1. Improve human capital.

For human-resource development programs to enhance innovation, they must focus on sectors in which NSW industries are most likely to devote the skills to significant innovation projects. Programs to improve human capital for innovation do not, of course, substitute for efforts in other fields, such as providing the skills any economy needs to undertake and grow its routine activities—they supplement those needs, and should be conceived as a special category.

This is especially so since many innovation-enhancing human resource programs will need to target an elite: those best equipped to take initiative at the frontier of markets and technologies. Programs designed for people in these categories might attract envy and criticism from proponents of training directed at lifting citizens at the bottom end out of underperformance.

Initiatives that could be considered to meet innovation goals include:

- Support for special programs designed to encourage excellence among the elite in fields relevant to the already-existing strengths of the NSW economy.
- Support for a world-class finance-sector research institute, aimed to train Master's and PhD-level researchers, and undertake pre-competitive research in the most sophisticated financial products and analytics. Other key global financial-transaction centres all include such institutes: Columbia Business School and New York University in New York; London Business School and the London School of Economics; Hitotsubashi University in Tokyo. Despite NSW's strength in the financial sector, it lacks this critical element of knowledge infrastructure.

- Scholarships to attract students from among the global top 2 per cent. At present, Australia's overseas student recruitment efforts aim at middle-to-bottom-level students who are capable of paying their own way. (The top tier goes to elite institutions in their own countries or the US, and are frequently subsidised to do so.) In effect, Australian educational institutions are asking students from the world's poorest countries to subsidise our activities. Aiming at the highest-performing percentiles will certainly require subsidy, but attracting some of those students would bring considerable benefit to the NSW economy's ability to innovate.

2. Upgrade knowledge and information infrastructure.

The knowledge and information infrastructure required to support innovation may be quite different from that designed to meet other purposes, such as everyday transactions or consumer entertainment. Assessment of information infrastructure priorities against the criteria of their impact on innovation will likely yield a distinct set of priorities.

NSW could consider:

- Support for construction of ubiquitous, potentially even free, broadband, including possibly through bypassing existing infrastructure through WiFi or broadband-over-powerlines. Many medium and large cities around the world, and a growing number of regions, are moving to offer broadband access as part of normal public infrastructure. By amortizing the cost of these systems across the entire population, as is done with water and sewerage or electricity and phone systems, universal access becomes feasible.¹⁹
- Substantially expanded collaborative research institutes in core sectors: Finance, creative industries, high-end manufacturing, energy efficiency (Clean coal and systems integration).

¹⁹ Several cities, including San Francisco, employ public-private partnerships to offer free Wi-Fi Broadband access; others such as Boston have established not-for-profits to perform the same function. Cities to offer universal WiFi include: New Orleans, San Francisco, Tempe Arizona, Niue (not just a city, but an entire Polynesian nation), Prague, Chicago, Dayton Ohio, Cambridge Massachusetts, Madison Wisconsin, and Taipei. San Francisco's free universal Wi-Fi access will be provided under the auspices of City Government by a joint venture between Google and Earthlink. See **Appendix A**.

3. Reduce the cost to NSW businesses of utilising science and technology.

Most government programs to encourage commercial interaction between publicly funded research institutions and private companies effectively aim to *increase* the price of science and technology to private companies. This result may not be intended, but it creates a powerful obstacle to private access to public research.

As governments focus on gaining the maximum-possible return from public science and technology investment, and as research agencies strive to demonstrate their value to government, governments in many jurisdictions have created incentives for research institutions to capture as much benefit as possible for themselves rather than for private industry. They do this by maximizing the price of intellectual property and technology consulting. These incentives have been promulgated under the banner of ‘promoting a more commercial-oriented culture’, but the effect of raising the price of any good is usually to reduce its demand, and hence its usage.

Rather than pushing public research organizations to raise their prices, government should encourage these institutions to *reduce* their prices as far as is feasible. Of course, if the price is reduced too far, firms may not sufficiently value intellectual property, but certainly if it is increased excessively, its adoption will decline.

To offset this tendency, the NSW Government could:

- Create incentives for universities to release intellectual property.
- Support universities to collaborate with businesses for problem solving.

4. Encourage capital allocation to innovation

With more than \$1 trillion in privately managed investment capital in 2006, the Australian economy possesses in aggregate more than enough capital to support its innovation needs. The problem is that too little of this capital is devoted to the risk-laden activities of innovation.²⁰

²⁰ 50.3 per cent of businesses surveyed by the ABS reported difficulties gaining finance—which included ‘excessive economic risk perceived by business’, ‘excessive economic risk perceived by financiers’, and ‘cost or availability of finance’—as important obstacles to innovation. Australian Bureau of Statistics, *Innovation in Australian Business 2005*.

Several governments have attempted to redress this difficulty by offering taxpayers' funds to start-up and technology companies, through extensive networks of grant programs targeted at a myriad of special niches. Most focus on new companies in high-technology sectors. Alternatively, governments have offered generous tax concessions for R&D expenditure, in an effort to promote business-backed innovation.

Neither of these approaches has been demonstrated to increase real innovation in the Australian economy. Both appear to distort capital allocation processes and entrepreneurial activity in undesirable ways.

In the first instance, they amount to subsidies to high technology, as noted a tiny proportion of the economy. More seriously, they can induce widespread system-gaming behaviour by firms and dependency on government largesse. Increasingly, firms oriented to these programs fine-tune their activities in ultimately suboptimal ways to remain eligible. Among undesirable consequences of government free-grant programs to support innovation are:

- Selection of senior management on the basis of close relationships with government, and skill and experience with grant programs—not ideal characteristics for entrepreneurial leaders.
- Channelling of firm activity to meet government reporting formats, evaluation measures, and poorly formulated targets.
- Deliberate restriction of firm growth, in order to remain below eligibility thresholds.
- Development of a mendicant, government-dependent corporate culture.
- Direction of attention away from real customers, real markets, and real capital providers towards 'free' government money.
- Curtailment of growth in private risk-capital vehicles, which are required to gain commercial returns on investment and cannot compete with taxpayer-subsidised investment capital.

Yet, as noted above, the issue remains: too little Australian investment capital is allocated to innovation activities. The underlying reason is that private investment vehicles cannot manage the associated risks and do not foresee sufficient return to accept innovation risk.

Government can play an important role in remedying these ‘market failures’, not by substituting itself, but by *tilting the playing field in favour of productive investment in innovation projects*. The principle to be adhered to in this endeavour is that capital be allocated by private investors, who have the experience to assess and accept risk themselves, rather than by government officials or government-appointed boards. Proposals to achieve this end might include:

- Avoidance of free-money grant programs for companies. Government should at the very least require that all taxpayer-funded grants be matched by private money. Since even this requirement is so readily ‘gamed’, however, the NSW government should not initiate new grant programs aimed at private companies in its effort to promote innovation, rather it should increase financial support to innovation in other forms, thereby freeing both substantial capital and time of officials to devote to other programs.
- Create subsidised loans pools for innovative companies, replenished by repayment on achievement of sustained profitability. In place of grants, government could create a pool of low-interest loans, repayable on success, which would self replenish. Such a scheme could be modelled, in amended form, on the successful Higher Education Contributory Scheme (HECS). While such loan pools will not be appropriate or needed in many sectors, which need larger amounts of capital best taken in equity form, where access to relatively small amounts of lesser-risk capital is needed, but lacking, such a financial vehicle may be valuable.
- Reduce innovation risk by co-investing with investment funds. These funds could be made non-terminating, allowing them to support innovation projects of longer duration than most venture-capital entities, which must wind up after seven years. Government could effectively increase the risk-adjusted return to investment in innovation by partnering with private capital providers, thus bearing a proportion of total risk in such vehicles, while accepting a below-market rate of return. In such entities, if government ‘capped’ its return at a relatively low interest rate, private partners could take the return above that level. The result would be a rise in risk-adjusted return, without distortion to the investment decision-making process, making such investments more appealing to private investors.
- Allow pre-profit businesses to accumulate advantaged tax credits. This also would serve to increase long-term returns, and hence attractiveness, of investment in innovation risk.

- Augment the State's financial risk management skill base, through specialised education and training programs, partnerships with industry, and a world-class financial-services research institute, referred to above.

5. **Reduce regulatory barriers to innovative NSW companies.**

One of the most powerful ways government can influence innovation is by adjusting its regulatory regime to support or discourage it. This lens is rarely employed to evaluate regulation in the Australian economy, which emphasises consumer and investor protection above all other objectives. The NSW Government could:

- Undertake a dedicated audit of NSW regulation to assess its impact on innovation risk and incentive.
- Remove its ban on GMO crops, at least initially for non-human food crops.

All these proposals would, of course, require substantial further investigation before adoption, but they illustrate a choice of means by which NSW's capability to raise productivity through innovation might be enhanced. As such, they provide a basis for discussion of the way forward.

Appendix A

From the *San Francisco Chronicle*:

Google Offers San Francisco Wi-Fi—For Free Company's Bid is One of Many in Response to Mayor's Call for Universal Online Access

Verne Kopytoff, Ryan Kim, Chronicle Staff Writers

Saturday, October 1, 2005

Google Inc. has offered to blanket San Francisco with free wireless Internet access at no cost to the city, placing a marquee name behind Mayor Gavin Newsom's effort to get all residents online whether they are at home, in a park or in a cafe.

The offer by the popular Mountain View search engine was one of more than a dozen competing bids received by the city before its deadline Friday. Officials will review the submissions and decide which, if any, of the candidates gets the green light to build the so called Wi-Fi service, which would be free or inexpensive for users.

In joining the competition, Google is showing yet another sign of its ambition. In the past few months, the company has released a succession of new products, including instant messaging and Internet telephone calls, that take it further from its roots.

The proposal raises speculation that Google intends to create a free national Wi-Fi network, a business in which the company has limited experience. If so, it could pose a serious challenge to existing Internet service providers such as SBC-Yahoo, Earthlink, Comcast and America Online, which charge subscriptions for wire connections.

"This is a great opportunity to provide a community service to the Bay Area," said Chris Sacca, who oversaw Google's bid in San Francisco. "This furthers the goal of providing access to all residents and visitors on as wide a scale as possible."

Newsom set a goal of a free or inexpensive city-wide Wi-Fi network last year. He portrayed the idea as a way to boost San Francisco's technology credentials and help bring Internet have-nots -- especially the poor -- into the digital age.

Since then, officials have been weighing how to carry out the plan despite a tight budget. Over the summer, they opened a window for proposals called a "request for information" that immediately drew attention from an array of companies.

Peter Ragone, a spokesman for the mayor, said a decision about a winner would be made "in weeks, not months." He added that Google had no advantage because of its high profile and that the ultimate decision would be based on what was in their plans.

As part of its 100-page bid, Google said it could install a Wi-Fi network without cost to the city. Users with Wi-Fi-enabled computers could then log on to basic service, without paying, no matter where they are within the city limits.

The speed of basic service would be 300 kilobits per second, which is much faster than dial-up Internet service but slower than some broadband.

Sacca said that Google, which makes virtually all its money from online advertising, had yet to determine whether it would include ads in the service. But Google said it would make its Wi-Fi network available for a fee to companies that want to offer paid Internet services. Sacca said there were no plans to share any revenue with the city.

San Francisco is a notoriously difficult city for blanket Wi-Fi coverage because of its hills, valleys and tall buildings. To ensure a good signal, Google would install up to 30 small Wi-Fi antennas per square mile.

Competitors who submitted responses to the city's request said Google's proposal was not entirely surprising. But they questioned the company's ability to follow through on its plans.

Donald Berryman, executive vice president of municipal networks for Earthlink, asked whether Google had the know-how to be an Internet service provider. And providing the deal for free, he said, is not sustainable in the long run.

"We've looked into free service, and we haven't found a model where free works," said Berryman. "At some point free becomes less sustainable because there's no way to upgrade service and the networks when no one's paying for it."

Google's experience in Wi-Fi is limited to tests at a gym and cafe near its headquarters and at Bryant Park in New York City. Google also sponsors free Wi-Fi service in San Francisco's Union Square in conjunction with a local start-up, Feeva.

For now, Google's Sacca said his company's Wi-Fi ambitions were limited to the Bay Area. However, others believe Google has much bigger plans.

"This is really exciting because they're not going to just do this in San Francisco, if they are serious about it," said Jeff Thompson, a founder of TowerStream, a company in Middletown, R.I., that sells wireless Internet connections to businesses, including some in San Francisco, but did not submit a proposal to the city.

Chuck Haas, CEO of MetroFi, which runs two Wi-Fi networks in Cupertino and Santa Clara, wondered whether Google would meet the city's goals for coverage.

But he said the idea of free service was not entirely far-fetched. He said his company had submitted a proposal in which wireless broadband would be free across San Francisco but would be paid for with ads and would have no technical support or services for users. For \$19.99 a month, subscribers would get enhanced service with no ads and customer support.

"I believe we'll have enough people that want full security and customer support with no ads that we could make money," Haas said. "But no matter who the city chooses, I don't think the city will have to pay for this network."

SBC spokesman John Britton said his company encourages competition but believes that governments should seek greater investment from private companies to increase broadband service. He said San Francisco already was served by SBC and enjoyed more than 400 free Wi-Fi hotspots, more than any other city in the country.

"We feel there is already widespread broadband available today," Britton said.

Some of the existing systems are along parts of Castro, Fillmore and Chestnut streets and are provided by AnchorFree Wireless, which also made a proposal to cover the entire city with free Wi-Fi at a cost one of the Sunnyvale company's founders estimated at \$10 million.

Vince Vasquez, a policy fellow with the Pacific Research Institute, a think tank that supports free markets and receives funding from SBC, said he opposed any

municipal involvement in Wi-Fi. Even if it's free, it may exceed the city's proper role in a sector that should be left to private industries, he said.

"Our concern is with public money and publicly controlled Internet access," said Vasquez. "We take a lot of caution about how government should intervene in the market."

A brief history of Internet access

In the beginning, there was dial-up, and it was good -- until the thrill wore off and people noticed that loading some pages or downloading a song could take days. It's cheap, but the only people who use dial-up today are those who can't afford something faster or don't know better.

Dial-up begat DSL, and it was better. For little more than the cost of an extra phone line, it is fast and fairly reliable. Depending on your perspective, the price-vs.-speed ratio either strikes a nice balance or is unsatisfactory on both counts.

Next came the cable modem, which allowed users to download music, video and pictures at blazing speeds. The monthly bill, about \$50, maybe more, once the special introductory rate expires, offsets the rush.

Now, there's citywide Wi-Fi, which, if all goes according to plan, will allow you to e-mail your aunt in Omaha from anywhere in San Francisco. You can't beat the price City Hall is seeking -- free -- but there are questions about speed and reliability, especially because of the hills.

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SAN FRANCISCO (Reuters) - Internet search leader Google Inc. and service provider EarthLink were selected to provide a basic free wi-fi Internet service covering the entire city of San Francisco.

Google (Research), which gets for 99 percent of its revenues from advertising, hopes to defray the costs of offering a free service through contextual advertising.

Google says users linking up with wi-fi transmitters placed around cities can be located to within a couple of blocks. This would open up a new level of

advertising opportunities for the company, allowing it to serve tightly focused ads on its web pages from local businesses in the immediate area.

The Department of Telecommunications and Information Services said late Wednesday that the city will begin contract negotiations with EarthLink (Research) and Google.

EarthLink and Google are working with wireless equipment suppliers Motorola (Research) and Tropos Networks to construct a mobile network for residents, businesses, municipal government and visitors.

EarthLink also has been selected to build a municipal Wi-Fi network for the city of Philadelphia, and more recently, for Milpitas, California, in Silicon Valley.

Donald Berryman, president of EarthLink's municipal networks unit said in a statement: "We look forward to taking the next step to negotiate a contract to build a municipal wireless broadband network."