Queensland Government Submission to the

Productivity Commission Draft Research Report: Public Support for Science and Innovation

Table of Contents

Introduction

The Queensland Government commends the current review and consideration by the Productivity Commission of issues surrounding public sector support for science and innovation in Australia. The Queensland Government recognises the importance of government support for innovation in maintaining and enhancing the international competitiveness of industry and in capturing environmental, social and economic benefits from research and scientific and technological progress.

The Queensland Government recently released the *Smart State Progress Report 2006/07* as a guide to Queensland's progress in its transformation to the Smart State. Recognising the Smart State Strategy is a long term investment in Queensland's future, the *Smart State Progress Report* uses a range of quantitative and qualitative indicators which demonstrate the success of the Strategy in delivering real benefits to the people and businesses of Queensland. This includes the role of research, science and innovation in delivering such benefits.

Queensland's expanding research capacity is creating the ideas on which Queenslanders are strengthening the State's current industries and building new ones. The Queensland Government is recognised both nationally and internationally for its substantial investment in world-class infrastructure and in attracting and nurturing eminent researchers. The Queensland Government invests more in research and development - $60 per person in 2004-05 – than NSW ($44), Victoria ($40) and the Commonwealth Government's investment in Queensland ($41)[1], illustrating its exemplary commitment to research, science and innovation and its associated economic and social benefits.

Queensland is also recognised for the research and commercialisation success of its higher education research sector. Queensland's higher education sector is far more aligned to business and industry than its counterparts in other states with approximately 60% of expenditure on R&D by the Queensland higher education sector on applied and experimental research. This is higher than the Australian average (48.4%) and is further reflected in strong commercial outcomes[2].

According to the *National Survey on Research Commercialisation 2002*, the University of Queensland (UQ) outperforms other Australian universities across all commercialisation measures. These results include:

- The highest level of invention disclosures by researchers (95 in 2002)
- The highest number of patents issued (31 in 2002)
- The highest number of licences, options and assignments (97 between 2000 and 2002)
- The highest amount of gross licence, option and assignment income (over $62 million between 2000 and 2002) and
- The highest number of start-up companies operational at the end of 2002 (34)[3].

The Queensland Government's extensive financial support for the establishment of world-class research infrastructure has been a key driver in the strengthening performance of Queensland's tertiary research institutions.

The Queensland Government has also commissioned investigations into a range of issues similar to those raised in the *Productivity Commission Draft Research Report: Public Support for Science and Innovation,* through the work of the Smart State Council, an external advisory of senior representatives from business and the research community. The Smart State Council produced

[1] ABS 8109.09 and 3101.0
[2] ABS 8111.0
[3] Department of Education, Science and Training, *National Survey on Research Commercialisation*, Commonwealth of Australia, 2004

three significant reports in 2006 on how the State Government can most effectively assist industry in facing global challenges and a changing competitive landscape. These are as follows:

- Smart regions: characteristics of globally successful regions and implications for Queensland
- Business investment in research and development in Queensland - including access to capital
- Opportunities in tropical science, knowledge, research and innovation for Queensland.

These reports explore a range of issues on how Government can drive a more innovative economy and capitalise on the significant research undertaken in the tertiary sector.

The *Smart Regions* and *Business Investment in R&D* Smart State Council reports and the *Smart State Progress Report 2006/07* are highly relevant to a range of issues raised in this submission. As such, the Queensland Government's comments and recommendations in this submission draw, where appropriate, on information provided in these reports. These reports can be accessed on the Queensland Government website www.smartstate.qld.gov.au.

General Comments

The Queensland Government acknowledges the extensive coverage of the Productivity Commission Report. The Report is comprehensive in the issues addressed and the focus on science and innovation is broadly supported by the Queensland Government. The body of this submission provides responses to certain specific issues raised in the Commission's Report, which are of particular interest. A few, more general comments on the overall approach are provided below.

- The Report in general provides a strong focus on extracting benefits from public investment in R&D. The Queensland Government acknowledges this as an important issue for government but believes that the Report would benefit from greater acknowledgement of the innovation system in its totality. The Queensland Government believes that R&D is one component of a national innovation system and that the role of Government in driving innovation extends beyond its investment in research. In particular, the Queensland Government would point to the importance of service industries in driving innovation and considers that the Report does not explore these issues sufficiently (see Specific Comments, section 1.2).

- The Queensland Government agrees that public R&D investment is often an input into activities that are public goods, such as defence, environmental issues and health services and this complicates the evaluation of economic and social benefit.

- The Queensland Government supports the Commission's judgement that there are positive net impacts from publicly supported R&D undertaken in universities and public sector research agencies, with those impacts being sufficient to justify current levels of support.

- The Queensland Government believes that the Commonwealth should increase its support for basic research undertaken in Australia's leading research institutes, in particular in areas such as tropical science where Australia has a strong domestic interest and potential to export its expertise to the rest of the world.

- The Queensland Government agrees that R&D:
    - increases preparedness and reduces risks in some areas;
    - has been widely adopted in a range of settings (public health, risk abatement in the environment and social and educational policy);
    - develops advanced problem-solving skills among Australian graduates; and
    - provides spillovers to business, for example in the mining industry.

- The Queensland Government believes that while there is no present shortage in scientists at a national level, global demand for science, engineering and technology skilled workers is forecast to increase significantly in the near future. There is a need to recognise the skills shortages that will be created by the emergence of greater demand for science technicians and technologists in Australia, particularly in light of the increased diffusion of sophistication of research technology being introduced into Australian research organisations. The supply of skilled individuals to meet this demand is a primary role of the higher education sector in the Australian innovation system.

- The Queensland Government supports the analysis undertaken by the Productivity Commission in adjusting Australia's BERD intensity for industry structure and other factors. The Queensland Government believes this analysis provides a more accurate and relevant representation of Australia's BERD intensity in comparison to other countries, allowing for more effective policy options to be identified and implemented to further improve BERD in Australia.

In addition, the Queensland Government recommends the inclusion/expansion of a number of issues raised in the Productivity Commission Report. These are outlined in the remainder of this submission.

Specific Comments

A range of issues were raised and considered by the Report. Queensland Government comments have been broken into the following themes:

1. Rationales for Public Support
2. Commercialisation and Utilisation
3. Performance Evaluation and Benchmarking
4. Other Issues

1. Rationales for Public Support

The Queensland Government agrees that there are strong rationales for the provision of public funding support for science and innovation and has specific comment on the following issues:

- Spillovers
- Innovation in services
- Risk, uncertainty and capital markets and
- Successful firms and transformed industries

1.1. Spillovers

The Queensland Government agrees that private sector investment in research is impeded where the benefits of such research cannot be confined to the firm. It is in areas where there are potential benefits to the community or economy as a whole (such as the environment, enabling technologies and health) where government has an important role in ensuring that research is undertaken.

Support for research by the Queensland Government has historically been in the form of research infrastructure funding. Issues of cost and third-party access prevent the development by the market of a critical mass in multi-disciplinary research infrastructure. Queensland funding has been provided through the *Smart State Research Facilities Fund* and, more recently through the *Innovation Building Fund,* in collaboration with Commonwealth, international and philanthropic funding sources. A recent example of Queensland Government support for research is the proposed establishment of a *Translational Research Institute* to build critical mass in translational research by bringing Professor Ian Frazer's cancer vaccine research team together with cancer researchers working with Professor Derek Hark of the Mater Medical Research Institute.

Such infrastructure funding is supplemented by targeted project support through the *Smart State Innovation Projects Fund* and *Smart State Innovation Skills Fund*. The *Innovation Projects Fund* provides support to facilitate collaborative involvement between research organisations and with industry. Similarly, the Queensland Government recognises that the attraction and retention of eminent researchers can significantly influence the capacity of a research base to secure external grant and contract funding. The *Innovation Skills Fund* provides support to retain and attract top researchers to work in Queensland research insittutes.

1.2. Innovation in Services

The consideration of service sector innovation and the potential role for government needs further exploration as the research-push model advocated for the physical goods sectors is inadequate. There is potentially, however, a substantial role for government to influence service sector innovation, including through its investment in infrastructure and procurement of services.

The Commission could explore the substantial body of recent research on service sector innovation, recognising that the growth of creative industries and business and professional services are key drivers of innovation in modern economies.

1.3. Early Stage Business Finance and the 'Innovation Gap'

The issue of access to finance by early stage business was examined in the Smart State Council Report, *Business Investment in R&D and Access to Capital.*

The Report argues that rather than a market failure per se, the lack of finance for early stage business (commonly referred to as the 'innovation gap') is a natural response by finance providers to cost and risk factors. In other jurisdictions, including the US, this 'innovation gap' has been addressed by philanthropic individuals and business angels who invest under different parameters from venture capital providers and other sources of finance. However, evidence supports however, the existence of a continued shortfall in innovation financing and there may be a role for government to address the issues of early-stage business finance.

While generally, government should not seek to assume the risks and costs associated with early stage businesses, there are a number of existing programs that attempt to address the 'innovation gap'. These include the Commonwealth Government COMET and Commercial Ready Programs which are referred to in the Report. The Queensland Government believes that these programs, in addition to the Queensland Government Innovation Start-Up Scheme (ISUS), have an important role in addressing the 'innovation gap'.

The Report could benefit from an examination of public sector support for science and innovation in overseas jurisdictions. One potential program that could be analysed is the US Small Business Innovation Research (SBIR) program. In the US, 60% of small business funding support is provided through the SBIR program. Despite criticisms in the Report regarding the poor level of investment additionality, SBIR is highly regarded with the US Government Accounting Office assessing that SBIR successfully incorporates small businesses into the US Federal R&D arena[4]. Academic review has supported this finding and deemed that SBIR is an effective form of early stage business finance in light of what is regarded in the US as a market failure[5]. However, perhaps the greatest benefit of SBIR is that it allows US Federal Agencies to tailor specific solutions from the business sector to meet operational or strategic issues that they can then procure[6].

The Report could also benefit from further examination of alternate strategies for addressing impediments to early stage business finance. These could include Strategies to address:

- The size of early stage business finance deals and the associated costs of managing such deals.
- The informal and ad hoc manner in which business angels and other non-equity market sources of business finance invest in early-stage businesses.
- A shortage of fund managers experienced in early-stage business investment.
- The fact that public sector researchers and inventors do not normally possess the necessary business management or entrepreneurial skills to attract finance and manage commercial undertakings.

[4] "Federal Research: Observations on the Small Business Innovation Research Program" The United States of Government Accountability Office Testimony Before the Subcommittee on Environment, Technology, and Standards, Committee on Science, House of Representatives, June 28, 2005,

[5] Lerner, J. "The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program" National Bureau of Economic Research Working Paper Series, Working Paper 5753 September 1996, 8

[6] Procurement contracts are often provided by associated US Federal Agencies in Phase 3 of SBIR - Small Business Association: http://www.sba.gov/BIR/indexsbir-sttr.html

1.4. Innovation Policy as a Driver of Economic Development

The Queensland Government's commitment to innovation is based on the premise that Queensland's and Australia's long-term prosperity will depend on transforming the economic base to higher value adding, knowledge-intensive industries. Tertiary institutions play a key role in this process as they contribute the human capital assets which determine an economy's absorptive capacity to take on novelty and generate research outputs which may create new competitive advantages within the economy.

A key goal of the Smart State Strategy is to broaden Queensland's economic base to create higher value outputs with a long-term sustainable competitive advantage. Through the Smart State Strategy, the Queensland Government drives the growth of knowledge-based sectors which have strong future growth potential and can leverage Queensland competitive strengths. As a result of the Governments commitment to biotechnology, Queensland is recognised as a leading centre of biotechnology research within Australia.

Government support to facilitate the development of knowledge-intensive sectors is primarily in ensuring that the conditions for their successful growth are met. These include:

- Strategic investment in infrastructure,
- Support for skills development,
- A support regulatory environment and,
- Strong economic fundamentals.

The Queensland Government recognises that the 'push' model of economic transformation (based on increasing R&D in industry) is insufficient and that the Report's claim that innovation policy cannot effect economic transformation is primarily based on the implementation of such a model. Instead, it is argued that investment in research must be supplemented by 'demand-pull' factors[7]. Such factors are analogous with the mechanics of natural economic transformation in which customer demand drives the emergence of new sectors. One component of such a 'demand-pull' model of innovation is recognising the role of government as a source of sophisticated demand.

Sophisticated demand was identified as a key driver of innovation systems in *Smart Regions,* the Smart State Council Report,. An example of Government procurement policy as a driver of innovation is the recently introduced *SME Participation Scheme*[8]*.* This Scheme aims to help ICT small to medium enterprises (SMEs) gain greater access to the Queensland Government market and thus provide an incentive for such firms to invest in R&D and other product/service innovations.

[7] Scherer, F.M. "Demand-Pull and Technological Invention: Schmookler Revisited" The Economics of Science and Innovation. Volume 2, 2000, pp. 292-304, based on the work of Jacob Schmookler (1962 and 1966).

[8] Innovation Industries Bureau, Department of State Development and Trade http://www.iib.qld.gov.au/markets/qld_govt/SME_Participation.asp

2. Commercialisation and Utilisation of Research

The Queensland Government believes that realising the commercial benefit of research outputs is a key component of the national innovation system and that government has a role in providing a broad, flexible economic environment conducive to innovation. This relates to the commercialisation of both business and public sector research. This is discussed in relation to the following:

- Traditional sectors as sources of sophisticated demand;
- Global sources of innovation and
- The impediments to commercialisation.

2.1. Traditional Sectors as Sources of Sophisticated Demand

The Report highlights that Australia's success in commercialising new technologies is centred on the traditional, dominant sectors of mining and agriculture. Although these sectors are highly innovative in terms of introducing new technologies into their production processes, it is important to recognise the influence such industries have on innovation through their sophisticated demand for novel products.

For example, the Queensland mining technology and services sector, a knowledge intensive sector, is world-renowned. However, categorising this sector by its primary customer base of mining hides the fact that companies within this sector also provide ICT, advanced manufacturing and environmental technologies and high-level consulting services to transport, energy, telecommunications, infrastructure and government sectors[9]. The mining technology and services sector is an effective example of how sophisticated demand from large companies and industries provide an initial market for knowledge-intensive products, services and enabling technologies, reducing the risk of the investment by business or universities in the initial research and its subsequent commercialisation into other markets[10].

2.2. Global Sources of Innovation

A key factor observed for the Australian economy is that Australian businesses purchase disproportionately less Intellectual Property (IP) from overseas than they produce as a share of global IP[11]. For Australia to compete in the long-term with the most sophisticated economies in the world, Australian businesses and universities will need to deepen their global linkages and extract greater value from innovation occurring elsewhere.

Government has a key role to play in assisting and supporting activities which may increase these linkages. One limitation of the Australian model of innovation is the widely held view that Australian businesses must commercialise Australian research. It would be more important to consider how Government can ensure that research capacity in Australia can enable firms and institutions to access and commercialise innovation originating from any location around the world.

[9] Information on Queensland Mining Technology and Service companies is accessible via the *Mining Innovation in Queensland Directory*
http://www.sd.qld.gov.au/dsdweb/v3/guis/templates/content/gui_cue_cntnhtml.cfm?id=281
[10] Note 6
[11] Barlow, T "The Australian Miracle – An Innovation Nation Revisited" Pan Macmillian Australia, 2006, 22

2.3. Impediments to Commercialisation

The Report lists a range of impediments to commercialisation in Australia, which were identified during the initial consultation/submission stage of the process. These include:

- Australia's economic remoteness;
- Effective research-firm linkages; and
- Intellectual property rights.

Australia's Economic Remoteness

The Queensland Government believes that Australia's relative remoteness (Australia is the second most remote economy in the OECD, behind New Zealand) does constitute a role for government through innovation and commercialisation policy. A recent review by Gene Tunny (Australian Treasury) of OECD studies on innovation suggests that Australia's relatively low BERD intensity is partly attributable to the nation's low exposure to foreign R&D through trade[12]. Foreign organisations are an effective source of innovation that can be adopted or commercialised by Australian businesses (see section 2.2) and are also a source of sophisticated demand for novel solutions. The Queensland Government believes that government has a role in promoting international linkages, trade and collaboration to overcome Australia's geographical isolation from major global economic centres.

Effective Research-Firm Linkages

The issue of research-firm collaboration was raised in the Queensland Smart State Council report, *Business Investment in R&D and Access to Capital*.

While there are some circumstances in which research organisations and business can collaborate, there is often a disconnect between the incentives, goals, timeframes, and desired outcomes for each party. Specific barriers to effective and extensive collaboration between firms and research organisations can include:

- cultural issues, such as the tension between the 'publish or perish' imperative on academic researchers and preservation of intellectual property in a commercial environment
- insufficient weight given to commercialisation in university criteria for staff promotion
- limited industry involvement with education systems
- preserving academic freedom from commercial imperatives[13].

There are several Queensland programs that bring research organisations and industry together to find a mutually-beneficial application for research outputs in the form of a commercialised product or service. These may provide effective examples of models by which research-firm linkages can be promoted.

- *TechFast*, run by the *Australian Institute of Commercialisation*, aims to identify technology-responsive SMEs that have a track record in their sector and are ready to grow. TechFast supports SMEs by sourcing research and technologies with commercial potential from research organisations and providing this information to the firm.

- *UniQuest*, the commercialisation branch of the University of Queensland employs the reverse approach to that of TechFast to commercialise its research outputs. UniQuest identifies and packages research through finding industry applications for completed

[12] Tunny, G, "Innovation across the OECD: a review of recent studies" Australian Treasury, 2006
[13] Department of Education, Science and Training, *Mapping Australian Science & Innovation. Summary Report*, Commonwealth of Australia 2003

research, then commercialising it through licences, patents and establishing start-ups. It also extends this service to research outputs from other universities.

The Report also highlighted that the present 'supply-push' approach to encouraging linkages between research organisations and firms affords little consideration to the needs and capabilities of the SMEs. One scheme, identified by the Smart State Council, which embodies a 'demand-pull' approach to research transfer, is the Netherlands' *Innovation Vouchers* program. The program provides vouchers with a face value of €7,500 that can be used by SMEs to purchase knowledge from a pre-approved research organisation or large R&D intensive companies. The results from the initial round of Innovation Vouchers conducted in the Netherlands were positive with 80% of the vouchers used to commission research that the firms would not have otherwise undertaken[14].

Intellectual Property

With regard to intellectual property protection, the Queensland Government believes that there is a need to strike a balance between providing sufficient economic certainty to justify investment in research and the free and effective diffusion of knowledge within society. IP protections were specifically recognised in the Productivity Commission Report as an impediment to the commercialisation of public sector research undertaken by universities.

The Queensland Government is focused on improving commercialisation of publicly funded research conducted in Queensland. Currently, the Queensland Department of State Development and Trade is developing an online whole-of-Government Intellectual Property (IP) Register. The IP Register is designed to improve the management, commercialisation and dissemination of IP assets within the Queensland Government and will provide greater access and visibility of IP assets developed or owned by Queensland Government agencies.

The IP Register will allow members of the public, research institutes, SMEs and venture capitalists, from both Australia and overseas, to view significant IP assets owned, either whole or in part, by the Queensland Government. Providing access to such records will improve commercialisation of publicly funded research conducted in Australia by increasing the visibility of such assets to other entities and promoting appropriate opportunities for collaboration.

[14] http://trendchart.cordis.lu/tc_article.cfm?ID=3125&NEWSID=12

3. Performance Evaluation and Benchmarking

The Queensland Government supports the broad need to develop and refine evaluation and performance measures for assessing the effectiveness of public sector investment in R&D and innovation more broadly. This applies to metrics developed at both a Strategy and an initiative level.

The Queensland Government recently released its first annual progress report, *Smart State Progress Report 2006/07,* containing a range of quantitative and qualitative indicators on Queensland's progress towards becoming a Smart State. The indicators analysed centre on the key drivers of Smart State growth – education, skills, research and innovation – and have an outcome, rather than output/activity focus. The development of new and better indicators of innovation is identified as a key task of future iterations of the annual progress report and work is presently being undertaken, in association with the Commonwealth, State and Territory Advisory Council on Innovation Working Group on Innovation Indicators to achieve this goal. A copy of the *Smart State Progress Report* is available online at www.smartstate.qld.gov.au.

At an initiative level, outcome measures are being developed for all Smart State initiatives in line with both internal reporting improvements and the recognition that initiative measures feed effectively into Strategy-wide reporting. These efforts generally align with the Report's recommendations regarding performance evaluation and reporting arrangements.

4. Other Issues

In addition to the above comments, the Queensland Government would like to make the following comments:

- Objective measures of R&D in reports such as research publications and citations are required but in many cases, these statistics are academically biased and may exclude the "grey science literature". This literature includes many State Department publications, such as technical reports. Access to these publications is available on departmental web sites and often can be tracked (including citations) via less-academic search engines such as Google Scholar. It is recommended the Productivity Commission revisit this area of their report to provide a more comprehensive indication of science products and publications.

- The Queensland Government would suggest that the Commission's findings on public investment in agricultural research could be interpreted differently if the environment and ecological benefits of this research were more fully appreciated

  Primary industries research also has important social benefits, particularly in the field of biosecurity - not only in the detection and response to the incursion of exotic pests and diseases, but also in the certification of the health status of Queensland plants and livestock.

- The Queensland Government believes that current Commonwealth research priorities do not recognise the economic, social and environmental importance of Australia's tropical environment. When considering public investment in R&D, the lack of public investment in tropical science R&D may be one of the reasons why the leading global centres of tropical science expertise are not located in Australia.

- The Queensland Government agrees that the original objectives of the CRC program — the translation of research outputs into economic, social and environmental benefits — should be reinstated.