Submission to

The Productivity Commission

on

Public Support for Science and Innovation

from

The Department of Industry and Resources

Western Australia

Introduction

The Western Australian Government is committed to growing a diversified economy as part of its "beyond the boom" strategy. Productivity and innovation driven by investment in education, R&D and the development and adoption of new technologies is the key to achieving these outcomes.

We now live in a world where continuous improvement is no longer enough to grow business. Governments must create and maintain an environment to foster innovation if we are to maintain global competitive advantage.

In order to keep up with global trends, more and more governments and businesses throughout the world are heavily investing in infrastructure and programs to support an environment of innovation in the economy, industry and the community.

The Western Australian Government has increased the focus on technological innovation with the creation of a dedicated new Science and Innovation portfolio.

For the purposes of this submission we have taken the view that "public support" means cash or in-kind support from either Federal Government or State Government agencies. This submission is compiled with a Western Australian perspective and highlights some areas of concern that are unique to this State.

Please note that the department has available data and material that may be useful to the Productivity Commission for its study. Examples are data on the Centres of Excellence Program and Technology Park/Precinct. The Commission is welcome to contact the Department if it would like to pursue further information.

1. The economic impact of public support for science and innovation in Australia and in particular, its impact on Australia's recent productivity performance and whether there are adequate arrangements to benchmark outcomes from publicly supported science and innovation.

Firstly it is important to define the two types of scientific research. Joshua S. Gans (University of Melbourne) in his submission to the Productivity Commission referred to Vannevar Bush's publication *Science: the Endless Frontier (1945)* where the explanation of "basic research" is given as to enhance understanding and "applied research" is to find a use. Professor Gans then states that "basic research was a critical input into the production of useful knowledge i.e. it is the pacemaker of technological progress". The underlying suggestion is that both types of research are fundamental to a healthy science and knowledge-based economy. Unfortunately the impact of basic research is not easy to measure in comparison to applied research and therefore suffers as a poor relation to undertaking research to overcome a particular problem or to identify a solution where the end benefit is already visible.

Impact is hard to measure

The ability to measure the impact of scientific research in the many differing programs over a period of time is a difficult exercise to undertake. The economic benefits may not be visible for some time after the program has finished and it may be near impossible to measure correctly during the course of the program. If an assessment or a measure is made during a program and it was made purely for economic purposes to access further funding or such, then the outcome may be compromised in that a result was found that isn't a true indication and this may question the credibility of the program as a whole. A study[1] carried out on the benefits generated from research carried out by the Telethon Institute of Child Health Research (ICHR) indicated that the benefits (in this case) did not accrue until well after the research program was completed. For another project which had only recently been completed, the benefits could only be forecast and not realistically quantified so soon after completion.

Indirect impacts are just as important

Other benefits of programs may come in the form of hidden benefits that have no directly visible economic benefit however the flow-on effect and by-products have been felt by the community in different ways. The ICHR report is instructive in this regard, identifying benefits in community health terms. A further example of this is the tourism benefit of the publicly-funded Ningaloo Research Project where a Curtin University study estimated that tourism contributes around $100 million to the regional economy[2].

A United Nations global study estimates the value of coral reefs at US$100,000 to $600,000 per square kilometre[3]. This study also supports the findings by Curtin University that the benefits are there but are difficult to evaluate.

Benefits also come in the form of expertise obtained from visits by eminent persons. While little tangible benefits are visible and/or measurable, the long term value lies in interaction between local industries and visiting academia or such. An example that supports this claim is the Intergovernmental Oceanographic Commission project (part of UNESCO) and partly funded by the Western Australian State Government that has resulted in over 3,000 scientists visiting Western Australia in the last 4 years. As well as the easily identified costs involved in travel, accommodation and meals the real value lies in the knowledge and experience gained by local scientists.

The WA Science Council developed the following principles to guide the allocation of funding under the InnovateWA scheme:

- research should be based on excellence;
- research should be directed to where we have a distinct comparative and competitive advantage;
- research should be supported with a view to build critical mass; and
- should involve collaboration openly and freely between like institutions.

In the absence of easy and early measures of impact, the application of these principles has been shown in the Western Australian context to increase the likelihood that positive research outcomes that meet our policy objectives will be produced.

Leverage is a partial measure

The benefit of leverage is an important and easily identified factor that needs to be viewed as an effective measure of a program/project. A review of the WA Innovation Support Scheme was conducted in 2001 by DoIR and found for every $1 of grants approved under the scheme research and development activities of nearly $3 in total resulted. Likewise the return on funds granted under the WA Innovation Capability Scheme—Capital Access was around $7 million for the $700,000 (approximate) input. This scheme assists companies seeking further investment for commercialisation of innovative products and services. For example, the Scheme helps companies tap into the $100 million AusIndustry-funded Renewable Energy Development Initiative.

Centres of Excellence in science and innovation based in Western Australia bring together the resources and capability of government agencies, the state's academic institutions and the private sector. These centres cover a broad range of endeavours from mining and agriculture to information and communication technologies, biotechnology and nanotechnology.

The Centres of Excellence program run by the Office of Science, Technology and Innovation in WA has produced leverage of 6.5:1 for active centres still running and 10:1 for concluded centres. At present there are 57 active programs with ancillary benefits ranging from new patents being registered, software developed, commercialisation of projects, to spin-off companies starting up. The immense value of graduate and post-graduate education and training or the downstream application of the knowledge they generate is a casualty of the measurability of these centres. This is the area that is difficult to measure effectively and to attempt to do so may result in compromising the

integrity of the findings, so to adopt a narrow economic rationalist approach would be ineffective.

A Productivity Commission working paper[4] reinforces the view that R & D does have an impact on productivity however it can't be effectively measured. Nevertheless it is agreed that attempts to effectively benchmark the impact of science and innovation should continue. The examination and measurement of the benefits of public support for science and innovation needs to be as all-encompassing as possible and needs to include qualitative measures as well as quantitative, intangible as well as tangible, subjective as well as objective, social as well as economic. Reliance on a narrow, 'economic rationalist' approach will lead us to the wrong conclusions.

The outcomes of science and innovation are long-term in nature and require a long-term approach from government. Short term approaches, with term-of-government policies and programs, and accompanying narrowly focused measurement systems, will produce sub-optimal results. This means programs must be prolonged past short-term endpoints even if the data is not available at that time to substantiate the decision to continue. Or they should be continued when it is apparent that traditional performance measurement data will not be available. Governments need to have faith that supporting science and innovation is essential and worthwhile, even when the benchmarking systems are inadequate.

[1]*Child Health Research – Estimating the Contribution of the Telethon Institute of Child Health Research, Centre for International economics, 2004*
[2]Wood, D & Dowling (2002). *Tourism surveys in the North West Cape region 1989-2002. A summary report prepared for the Department for Planning and Infrastructure.* Curtin University of Technology and Edith Cowan University, Perth, Western Australia.
[3]*2002, In the front line - Shoreline protection and other ecosystem services from mangroves and coral reefs.* The United Nations Environment Programme World Conservation Monitoring Centre
[4] *Econometric Modelling of R&D and Australia's Productivity, Staff Working Paper,* Sid Shanks and Simon Zheng, Productivity Commission April 2006

2. Identify impediments to the effective functioning of Australia's innovation system including knowledge transfer, technology acquisition and transfer, skills development, commercialisation, collaboration between research organisations and industry and the creation and use of intellectual property and identify any scope for improvements.

The Western Australian Government has identified many of the traditional impediments to the effective functioning of the Australian innovation system, as identified above, as impacting in Western Australia. To that extent it undertakes a range of policy and program measures to address these issues.

Involvement in decisions

Impediments to collaboration and access to research and commercialisation infrastructure and funding are particularly relevant. A major impediment identified for this State is the tyranny of distance between WA and the eastern seaboard. The cost of travel is just one consideration, the other being time consumed in the process. The lack of a Western Australian presence in the locations where decisions are made as to research dollar allocations is a concern felt by WA more than other states. The basic ability to network and build up a good rapport with colleagues in the eastern states is a very real problem for WA.

Access to information

Collaboration, knowledge sharing and technology acquisition between research institutions needs to be an open and accessible process. To be effective, researchers need access to the latest research results and methodology being used by other research programs. This raises the question of IP ownership, however in research being done for the public good the results are generally made public as breakthroughs occur, rather than at the end of the project. Future research needs to use past research as the foundation and build upon those milestones already achieved. This can only happen if knowledge transfer and technology acquisition is readily available throughout the course of research.

Access to infrastructure

There also needs to be a national audit of R & D and innovation infrastructure. There is a current lack of knowledge as to what is available and accessible in either area. If the information existed it would assist in allocation of resources and planning to maximise viability of projects in the transition to commercialisation.

Last year the Western Australian State Government announced the development of a State Infrastructure Strategy (SIS) to identify and prioritise Western Australia's infrastructure needs for the next 20 years. It will involve developing a plan for delivering more certain infrastructure outcomes, promoting better informed decisions in both public and private sectors, and encouraging the Commonwealth to undertake a greater share of infrastructure provision for nationally beneficial outcomes. Access to national R & D and innovation infrastructure needs to be included in this strategy.

Access to skills

Shortage of skilled workers has adversely affected the ability of Australian industry in the productivity and innovation arena. State bodies in the past committed resources to training apprentices and their workforce in general. They were able to concentrate on training because their focus was not on achieving an economic return to the same extent as private business. They effectively invested in the state and the nation's future productivity and innovation. With the demise of Western Australian agencies like State Engineering Works, State Print and the Railways Workshops as economic rigour demanded, it not only reduced the number of opportunities available for training but also had an impact on the standard of training. Private companies are restricted by economic considerations as to how many apprentices are inducted each year and generally only undertake training in a specialised area for immediate benefit to the company when a demand arose. The private sector cannot be expected to entirely replace public sector agencies in the training of the future workforce. Expertise has gradually been eroded at all levels of the workforce from technical/scientific staff to blue collar staff. The loss of skills and expertise impedes the step from innovation to commercialisation and the retreat by the public sector from the funding of technical skills training is now impacting as the demand for skills rises.

Retention of skills

Likewise this deteriorating skills problem is also present in R & D. The 'brain drain' continues towards the more commercial aspect in preference to basic research, or scientists take up overseas posting and export their expertise and knowledge. This is symptomatic of the remuneration paid to scientists in the different areas of research. In situations where there is a commercial gain identified, it reduces the ability to choose which direction a scientist will take and motivates them to concentrate their efforts in the more financially rewarding direction. A more rewarding environment needs to be developed to not only retain Australia's top scientists but to also attract overseas knowledge and expertise.

Forecasting of skills requirements

Australia (and Western Australia) lacks a reliable system of employment forecasting. At present there doesn't appear to be an efficient model for forecasting future employment requirements in sectors with future growth demand. Education and training processes are time consuming and cannot be relied upon to fill demands in the short term. A long-term approach needs to be adopted and a reliable model developed to better forecast future employment needs and to provide the innovation system with the specific skills at the time they are required.

Support for business R & D

A consistent approach and policy needs to be in place to encourage long term private support in all areas in science and innovation. A House of Representatives Committee found that "particular importance of the development and maintenance of consistent and stable innovation incentives in order to give certainty to business that their innovation activities will be

supported in the long term and that frequent changes to such policies can significantly undermine R & D and innovation efforts".[5]

Short-term thinking
Term-of-government programs and policies should be avoided in favour of long term initiatives that bridge successive governments. A stable and encouraging environment will provide benefits to the research organisations and to society as a whole.

The National Manufacturing Summit Workshop Discussion Paper of December 2005 lists the factors hampering innovation in appendix 1. It details 17 factors in order of gravity of impediment. This paper also lists the barriers to innovation investment as identified by the "Business Investment in R & D in June 2003, the House of Representatives Standing Committee on Science and Innovation". As indicated above, the majority of these impediments have been identified as impacting in WA and a proportion of them have been identified as requiring government resources to overcome.

Lack of management skills
Lack of understanding of the business planning process by small and medium enterprises can hamper their efforts in innovation, as can an inherent lack of business management skills. These are issues of particular concern in a State with a traditionally high proportion of SMEs making up the innovative business sector. Lack of awareness of, and access to, business skill services, business information and market information are also common problems.

Lack of access to information and services
Broker organisations can be set up to assist companies in their early innovation stages. A lack of knowledge of what assistance is currently available could be overcome by a one-stop-shop to guide clients through the process. The Western Australian Government is encouraging innovation with the establishment of the Western Australian Innovation Centre as a hub for innovation programs and emerging industry small to medium businesses.

[5] *House of Representatives Standing Committee on Science and Innovation, op cit, sections 5 and 9.*

3. Evaluate the decision-making principles and program design elements that:

a) **influence the effectiveness and efficiency of Australia's innovation system; and**
b) **guide the allocation of funding between and within the different components of Australia's innovation system;**

and identify any scope for improvements and, to the extent possible, comment on any implications from changing the level and balance of current support.

Influencing the innovation system

There needs to be more equitable representation of Western Australia on national funding bodies. Western Australia's physical remoteness from the other States and Territories should not be seen by the decision-making bodies as a deterrent to Western Australian representation. Notwithstanding access to current technology such as teleconferencing to assist with communication, the value of face-to-face representation is immeasurable and the ability to build networks with counterparts in other States and the Commonwealth is critical to Western Australia receiving an appropriate share of national funding and participating more effectively in the national innovation system.

Guiding the allocation of funding

There are certain programs that are a government responsibility to run on behalf of the community, for example, air, water and climate change monitoring and improving health and emergency services. Basic research and 'public good' research will always remain the responsibility of governments to support, with appropriately designed programs. Nationally focussed research should be funded at the Commonwealth level, leaving state government resources free to address issues that are more particularly affecting their own jurisdiction.

Scope for improvement

R&D tax concession benefits should be overhauled. There is clear evidence that the current concession program is not delivering an adequate level of business R & D, thereby placing the onus on government itself to sponsor the research directly or to allow the output of the national innovation system to deteriorate.

Failure is viewed as unacceptable in the Australian culture. If a project is not allocated funding in the first instance, it generally does not receive an allocation of funding on further attempts. In other countries failure is merely seen as a necessary risk and treated as a learning experience. The public programs need to adopt an approach which will assist in modifying the culture such that good projects are ultimately funded to the level they deserve, rather than be scrapped after one funding rejection.

4. Report on the broader social and environmental impacts of public support for science and innovation in Australia

There is an unmistakable role for governments in science. The responsibility for research in the areas of environment and 'public good' rests wholeheartedly on the shoulders of government.

There are some areas that traditionally will not attract private funding. Projects that are for the good of the community in general rarely result in economic returns and therefore can only survive on public funding. The likelihood of a commercial by-product from this research is low, though any IP developed in the course of the research has the benefit of remaining in government control.

It is strategically important for governments to fund quality basic research as well as the more popular applied research. Applied research with definite economic outcomes may attract other forms of funding however basic research without any target outcome in sight poses little or no economic incentive for privately sourced funding. The importance of government intervention to cover all aspects of research is fundamental to the development of a science-based culture. Any IP produced as a spin-off should be viewed as a collateral benefit or alternatively, when first identified, it could possibly be used to attract private funds with the view to involving private companies in the project.

Business, the education and government sectors need to work together on diversifying our economy and enhancing growth from our core industries by developing efficient and supportive infrastructure, encouraging R&D and uptake of technology and giving our young people 21st century education and skills. To do this Australia must improve incentives for our young people to pursue science and technology-based careers and improve the public perception of science. Our diversifying economy requires investment in a tertiary education system that anticipates and responds to this diversification.

Recognising the importance of a close private-public sector alliance in the area of R&D and innovation, governments need to focus on the establishment of partnerships with the private and education sectors, investment in research and commercialisation across a range of technologies and support infrastructure. As an example, the Bentley Technology Park was established adjacent to Curtin University to facilitate close interaction between researchers and innovative technology companies. The Western Australian Government has committed to expand the existing Technology Park in Bentley and establish the Technology Precinct. In addition, the largest hub of chemists in the southern hemisphere is being created at the Precinct by relocating the State's Chemistry Centre along with Curtin University's Faculty of Applied Chemistry, the CSIRO's Division of Mineral Products and Murdoch University's AJ Parker Centre for Hydrometallurgy. The Australian Marine Complex in Henderson has been developed to facilitate and enhance the opportunities created by the clustering of marine, defence, resource manufacturing and fabrication In Western Australia These examples of the

development by government of world-class science infrastructure, in conjunction with the education and industry sectors, are producing very measurable outcomes and impacts in terms of employment and exports in innovative, knowledge-based industry sectors, as a result of government support for innovation.

General Comments on Government's Role and Focus

Broad-ranging measures of impact

The examination and measurement of the benefits of public support for science and innovation needs to be as all-encompassing as possible and needs to include qualitative measures as well as quantitative, intangible as well as tangible, indirect as well as direct, subjective as well as objective, social as well as economic. Reliance on a narrow, 'economic rationalist' approach will lead the nation to the wrong conclusions.

Long-term support

The Federal Government has a duty to the Australian nation to uphold the value of science, technology and innovation. The benefits of supporting and expanding a scientific, knowledge-based culture will be felt for decades to come. Ultimately it will lead to the development of a critical mass where Australia will be a leading nation in scientific research and innovation. In the absence of readily available early measures of impact, governments need to have faith that supporting science and innovation is essential and worthwhile and to hold that position over the long term.

Basic contributor to growth

Science and innovation are such basic drivers of growth and global competitiveness that it will always be a role for government to support them and provide the environment in which they flourish – it cannot be left to the private sector alone, nor should the private sector (and other developers of innovation) be forced to operate in an environment that is not supportive of science and innovation.

Setting priorities

There are many national/state research facilities, e.g. CSIRO, AIMS, universities, that are excellent at their own sciences *per se*, but are not charged with the responsibility of prioritising the national science and research effort. We need effective mechanisms to ensure Australia's science and innovation capacity is optimally geared towards the highest priorities i.e. those that are most important for the nation as a whole. It is important to strike the correct balance between pure, strategic research and applied research driven by contemporary community and market needs. This will always remain a role for government.