AUSTRALIAN TECHNOLOGY NETWORK OF UNIVERSITIES

ATN SUBMISSION TO PRODUCTIVITY COMMISSION DRAFT REPORT: PUBLIC SUPPORT FOR SCIENCE AND INNOVATION

1.0 INTRODUCTION

The ATN welcomes the opportunity to provide feedback on the Productivity Commission's comprehensive draft review report on the Public Support for Science and Innovation, and agrees with the Commission's findings that there are significant economic, social and environmental benefits to Australia from its support of science and innovation.

However, the ATN has concerns that the Commission considers that there is no reason to increase current public expenditure on science and innovation in light of the recent low national success rates in the ARC and NH&MRC funding schemes and the requirement for Australia's innovation system to be globally competitive.

2.0 R&D INTENSITY IN THE OECD

The ATN strongly believes that increasing the percentage of the nation's investment in research and development to a level comparable with our OECD counterparts is clearly required if we are to compete effectively. In terms of GDP, both the gross domestic expenditure on R&D (GERD) and expenditure on R&D in the business enterprise sector (BERD) in Australia are significantly below the OECD averages (see table below).

1.10 Main indicators of R&D investment 2002[a]

OECD countries and non-member countries	GERD PPP	GERD as a % GDP	BERD as a % of GDP	HERD as a % of GDP	GOVERD as a % of GDP	Basic research expenditure as a percentage of GDP	Average annual real growth rate of GERD in 1992-2002
	$b	%	%	%	%	%	%
Australia	9.6	1.69	0.87	0.45	0.33	0.42	4.50
China	71.3	1.22	0.75	0.12	0.35	0.07	14.95
India (2000)	20.7	0.85[a]	*	*	*	*	*
United States	276.3	2.65	1.86	0.36	0.32	0.49	3.33
EU-15	197.7	1.91	1.25	0.43	0.25	*	2.61
Japan	108.2	3.12	2.32	0.43	0.30	0.39	1.80
OECD Average	655.8	2.24	1.52	0.39	0.28	*	*

Sources: OECD, Main Science and Technology Indicators Database 2005/2, based on 2002 data

[a] UNESCO Institute of Statistics Database March 2005, based on 2000 data

* Denotes that no data was available

NOTE GERD: Gross domestic expenditure on R&D

BERD: Expenditure on R&D in the business enterprise sector

HERD: Expenditure on R&D in the higher education sector

GOVERD: Expenditure on R&D in the Government sector

BUILDING PARTNERSHIPS FINDING SOLUTIONS

The interaction between knowledge and globalisation continues to be at the centre of the ongoing transformation of OECD economies. Emerging issues identified in the recent OECD Science, Technology and Industry Scoreboard (2005) include the:

- international mobility of researchers and scientists,
- the increasing pace of innovation as measured by patenting,
- the growth of the information economy,
- the changing role of multinational enterprises,
- new patterns in trade competitiveness, and;
- the emergence of key international players outside the OECD area, notably China.

The increased investment in R&D represents a commitment by OECD countries to the potential benefits of a 'knowledge-based economy'. Government R&D budgets in OECD countries have increased annually by an average of 3.5% (in real terms) since 2000. In 2003 Sweden had the highest 'R&D intensity' (4% of GDP), followed by Finland, Japan and Iceland (all over 3%). Flowing from these commitments is the recognition of the importance of investment by governments in research carried out in publicly-funded research agencies.

The European Parliament's Industry, Research and Energy (ITRE) Committee put forward an ambitious proposal for the EU Seventh Research Framework Programme 2007–2013 (FP7). Sub-titled "Building the European research area of knowledge for growth", FP7 is designed to respond to the competitiveness and employment needs of the EU. In the UK, the government's stated objective in the 'Science and Innovation Investment Framework 2001-2014' is to increase investment in R&D from its current level of around 1.9% to 2.5% (from around 16.5 to 39 billion pounds) by 2014. This will require an annual growth rate across the aggregate public and private research sector bases of around 5.75%. The pattern of major growth in R&D investment in the OECD seems likely to continue through to 2015.

2.1 India and China

It is proposed that investment in science and technology in India will rise to $US 8 billion by 2015, including the formation of 20 new national research centres, and China proposes to double its research investment over the next 15 years to reach 2.5% of GDP by 2020.

In the period 1991-2004, total investment in R&D in China grew thirteen-fold. The number of higher education graduates grew 288 per cent between 1997 and 2004, 43 per cent of whom were in science and engineering fields. Over the past decade India has demonstrated a similar pace of change, including passing the 1 per cent threshold for gross expenditure on R&D as a proportion of GDP in 2004. The number of universities rose from 209 in 1990 to more than 300 in 2005. Over a similar period, enrolment in higher education institutions rose from 4.9 million to 9.9 million, and science degree holders rose 60 per cent and the number of science postgraduates rose 50 per cent. In 2002 science and engineering accounted for 46 per cent of doctoral degrees earned in India, 13 per cent of which were in engineering.

The recent report from the PMSEIC Working Group on Asia concluded that, to capitalise on the opportunities arising from the rapid growth of India and China, Australia needs to build a stronger business research base, improve our environment for innovation and encourage R&D that addresses the highest priority needs of China and India in areas where Australia have global strength (priority areas identified were energy, water, agriculture and health and 'emerging areas of interest' nominated were biotechnology, medical devices, engineering design and animal health). The Working Group also indicated that "Australia needs to enhance the linkages with China and India by developing a whole of government strategy for engagement and by investing in collaborative knowledge infrastructure."

2.2 Australian Investment

The Productivity Commission acknowledges that it is impossible to accurately quantify the cost-benefit ratio of the total public investment in science and innovation. The ATN would argue that there is therefore no evidence to suggest that we have exhausted the benefits of R&D, and these uncertainties are particularly high in the less tangible non-economic areas of social and environmental concerns.

Australia has to adjust to a globalising economy and the need for increased productivity for a host of reasons, not least that associated with an ageing demographic profile, and so there is a risk in taking a conservative viewpoint on the additional marginal public spillovers from an increased public investment in R&D. It would therefore be complacent and short-sighted to assume that, given the evidence of positive benefits and the large uncertainties in assessing these matters, our current below average BERD and our current level of public R&D investment will prepare us adequately for the future.

Therefore, given the evidence provided, an increased investment in R&D to at least 2% of Australia's GDP is essential in order to ensure that the innovation system does not continue to lag behind current global trends in R&D investment.

3.0 THE ROLE OF UNIVERSITIES

The report states the view that the core role of universities is the provision of teaching and the generation of high quality, openly disseminated, basic research. The Commission also highlights the importance of the transfer, diffusion and utilisation of knowledge and technology. The ATN universities focus strongly on the application and transfer of knowledge for innovation, wealth creation and environmental and social sustainability. **In this context, the ATN recommends that the Commission consider the importance of a national funding system which supports an increased level of diversity in the higher education sector.** Some institutions may focus primarily on fundamental research and the academic quality of research outputs whilst others may focus predominantly on generating research outputs which will make a broader impact. A 'one size fits all' RQF with funding allocated on the basis of a fixed proportion of quality and impact of research outputs, would not appear to support the diverse range of research missions of different Universities.

3.1 Research Impact

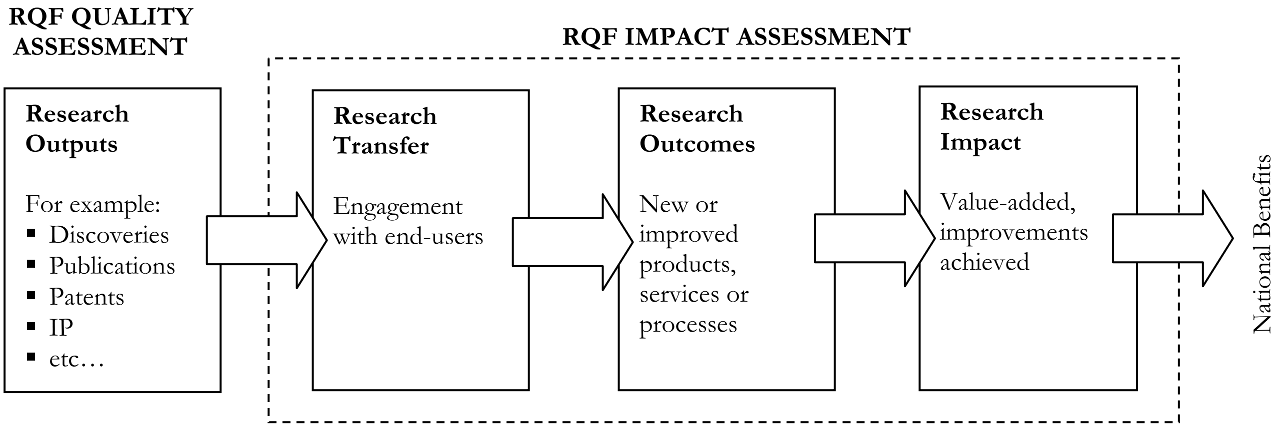
Impact is defined as the extent to which research is successfully applied to achieve social, cultural, economic and/or environmental outcomes. What is inherent in this definition is the expectation that such outcomes will necessarily be beneficial in alignment with the broad intent or goal of the National Research Priorities i.e. to improve Australia's future prosperity and well-being.

The ATN agrees with the Commission's finding that the assessment and rewarding of research which has impact through producing economic, social and environmental benefits is a current gap in the system. There is now an expectation that this will be addressed via the critical inclusion of impact assessment within the Research Quality Framework (RQF), however it will be necessary to ensure that the RQF funding model rewards the broad impact of research outputs on an equal basis with the academic quality of research.

Whilst the Commission considers that it may be premature to develop a national funding allocation system based on the measurement of the broad impact of research outputs, the experience of the ATN is that this **is** feasible. Based on the experience of reviewing over 200 impact case studies submitted for assessment in the 2005 ATN RQF Trial, it was clear that researchers are able to provide tangible examples of how their research outputs have and continue to have impact.

It also became apparent in the trial that there are substantive differences between research 'outputs', research 'outcomes' and research 'impact', although often these terms are used interchangeably. In order to clarify the scope of research activities that may appropriately be considered under the impact assessment component of the RQF, the ATN developed the following model to define the fundamental nature of research impact, namely that impact is best understood on a continuum with key identifiable stages. Although the ultimate aim of achieving impact is at the end of the continuum, it should be recognised that the activities undertaken within each stage of the process also demonstrate a level of impact (see Figure 1).

Figure 1: ATN Model of Research Impact Scope



This model simply outlines the process involved in achieving research impact. Although concentrating on a linear explanation of the activities, it is also acknowledged that the process is, in actuality, often iterative and cyclical. Nevertheless, the fundamental concept is that examples of impact can be identified and demonstrated at each stage along the continuum.

An important point of clarification is that the first stage of impact, which the model refers to as 'research transfer', should not be confused with 'knowledge transfer'. Although knowledge transfer is heavily integrated with research, it covers much more than a University's research activities. Nevertheless, when attempting to define the extent of research impact, we need to clearly differentiate between the production of research outputs, the development of research outcomes and the achievement of impact. Based upon the ATN experience it is possible to clearly articulate an auditable trail for impact.

The Productivity Commission's *Draft Finding 7.1* states:

Performance evaluation and reporting arrangements have developed significantly in recent years, particularly through the adoption of an outputs/outcomes focus. There are, however, examples of major deficiencies. Arrangements should be reviewed against the following criteria.

- *Outputs and intended outcomes should be defined in relation to the rationales for public support and to the community benefits expected from that support.*
- *Evaluation should be developed in a benefit–cost framework, balancing greater precision against administrative and compliance costs.*
- *Where undertaken, selective case studies of impacts should be placed in a supplementary rather than central evaluation role.*
- *Assessment should be undertaken with adequate frequency – this might vary between different types of measure.*
- *Assessment should be as independent and transparent as reasonably possible.*
- *Feedback mechanisms that promote continuous improvement in terms of funding allocation to programs and to projects should be developed and implemented.*

The ATN confirmed in its RQF trial that case studies are a legitimate way of capturing intangible benefits. While case studies are integral to assessing impact, it is recognised that within those case studies both qualitative and quantitative measures can be used to support the impact claims. The trial demonstrated that both measures were used with varying degrees of effectiveness. To some extent, discipline variations affect the availability and robustness of the indicators, with the commercialisation and economic impact measures being more widely studied and available.

Nevertheless, some impact measures identified in the ATN trial, which can be reliably attributed to the different stages of the impact process continuum, are given in Table 1. While by no means exhaustive, it does give an indication of the type of indicators which may be applicable at different stages according to the type of impact being claimed, be it economic, commercial, social, cultural and/or environmental.

Table 1: Impact Indicators

Impact Type	Research Transfer	Research Outcomes	Research Impact
Economic **Commercial**	• Licences, options, assignments (no and value) • Royalty agreements (no and value) • Pilots, prototypes, clinical trials (no) •	• New products, services (no) • Gross revenue • Start-ups/spin-outs (no and revenue) • Joint ventures (no and revenue) • Repeat business (% of contracts with previous clients) •	• Fuel or time savings • Reduced risk • Increased productivity • Reduced costs • Increased competitiveness • Improved processes/ efficiency • Increased employment • Increased investment
Social **Cultural** **Environmental**	• Informing government or industry policy • Engagement in community groups •	• Changed practice in waste management • Uptake of recycling techniques developed • New or improved government policy •	• Reduced consumption of fossil fuels • Reduced waste • Reduced water consumption • Improved health and/or well-being •

At DEST's RQF Guidelines Scoping Workshop, "it was believed that quantifiable metrics were unlikely to be identified for assessing impact, but rather the claim of impact would be assessed against the 'evidence' provided." The trial also confirmed that, in the absence of available indicators, the following types of evidence can assist with validating claims and confirming the extent of the impact (see Table 2).

Table 2: Impact Evidence

All Stages	Research Transfer	Research Outcomes	Research Impact
• End-user statements • Third-party surveys, analyses or data • References/citations in policy documents, regulations etc. • Media attention • Presentation invitations •	• ARC Linkage or other NCGs with end-user participation • CRC participation in end-user sponsored projects • Supporting testimonials by industry collaborators •	• Transfer of ownership of IP • Licensing agreements with industry • Independent valuations of spin-off companies or IP packages •	• Evidence of significant commercial value through product sales, process savings etc. • Evidence of employment or health outcomes at a population level • International or national awards •

3.2 Industry Links

As stated in the Business Council of Australia's (BCA) recent report 'New Pathways to Prosperity: A National Innovation Framework for Australia' (2006), a 2005 "DITR-DEST report on collaboration and commercialisation of research in the Australian science industry highlighted that the main institutional impediments to more effective collaboration in Australia remain a poor alignment of public research with industry needs, poor interaction between industry and researchers, and high costs associated with transferring IP from the public sector to industry."

The BCA goes on to say that the level of effective collaboration between businesses and universities and research institutions, and more broadly between the private and public sectors, is of fundamental importance to innovation success. Furthermore, while Australia has benefited from examples of highly effective collaboration, there continues to be considerable scope to improve the level and quality in all sectors – in particular between industry and public sector research institutions and universities (2006, p. 28).

The Productivity Commission's *Draft Finding 8.1* states:
There is no evidence that the overall quantum or mix of public support for science and innovation in Australia is currently inappropriate for Australia's needs and aspirations. However, there are concerns if the trend towards publicly funding applied science and innovation, at the expense of basic and strategic science and innovation, goes too far.

The ATN disagree with this finding as the impact of applied work is fundamental to economic, social and environmental development. Basic research is essential for the maintenance of the R&D pipeline, whilst applied research is fundamentally important as we move towards a knowledge economy.

The Productivity Commission is concerned that if the basic/applied mix of research goes "too far", then this could be problematic for Australia. It is unclear as to what exactly would be defined as "too far", but the finding implies that there is an inadequate level of basic research being undertaken and that this trend is increasing. The ATN disagrees with this finding as basic research often dominates competitive grant funding. Furthermore, much of the applied research undertaken by Universities in collaboration with industry is essential as agencies often lack the in-house expertise in areas with broad public benefit.

The Productivity Commission's *Draft Finding 6.1* states:
Decision making within universities in relation to the transfer, diffusion and utilisation of research outputs should not focus unduly on an objective of commercialisation to the detriment of maximising the social return from the public's investment.

Furthermore, the Productivity Commission suggest in Draft Finding 9.1 that:
The R&D tax concession could be improved by:
- *shifting the orientation of the concession towards its 175 per cent incremental component;*
- *relaxing the beneficial ownership requirement and the expenditure and turnover thresholds for the tax offset for the incremental scheme alone;*
- *changing the base on which the incremental subsidy is paid to a firm's ratio of R&D to sales at a given, fixed date; and*
- *allowing access to the incremental scheme to start-up firms.*

The ATN agrees with the recommendations to improve the R&D tax concession and would support any change in the tax regime which would make it more attractive for industry to invest in R&D. Balance is needed to achieve impact for the community. In many cases, free transfer of public good information is appropriate but if industry investment in R&D increases as a result of greater tax incentives then universities are best placed to deliver the R&D and partner with business and industry in commercialisation of the outcomes. Universities must be allowed and encouraged to diversify their income base.

There is a wide range of perceived obstacles to commercialisation by universities, but the Commission believes that only some of these warrant policy action. The report states that there may be a case for providing universities with some additional funding to demonstrate promising technologies so they can be more easily transferred to business, however there are several options for support such transfer that do not involve a new dedicated funding stream. The ATN, however, supports the provision of additional funding to assist in overcoming obstacles to commercialisation. We need to support the broader concept of technology transfer through routes other than direct commercialisation and additional funding is necessary to support these endeavours.

3.3 Cooperative Research Centres (CRCs)

In relation specifically to CRCs, the Productivity Commission's *Draft Finding 9.4* states:
The CRC program could be improved in several ways:
- *the original objectives of the program – the translation of research outputs into economic, social and environmental benefits – should be reinstated. This is likely to produce better outcomes than focusing*

public support on the commercialisation of industrial research alone; and

- *the share of public funding should be aligned to the level of social benefits provided by each CRC, thereby reducing some of the large rates of subsidy to business collaborators.*

The Commission believes that the objectives of CRCs should be re-aligned to the broad attainment of economic, social and environmental goals, not just commercial ones. The ATN agrees with this finding as the CRC program has been instrumental in encouraging university and industry partnerships on a national scale. The intangible benefits of these relationships are valued and important for the future.

However, the ATN continues to be concerned about the current trends in the way that CRCs operate. With a greater expectation that universities will input a considerable amount of funds into their operation, as well as research expertise, there is a danger that universities will shift from the role of research providers to that of investors/shareholders. This is neither tenable nor realistic. With no injection of funding to universities for core activities, the capacity to respond to schemes requiring matching funds is becoming almost impossible. Universities play an important role as research partners as they commit significant resources, both in cash and in kind, to CRCs that it is becoming no longer viable to join new ventures. There is a need to revise the expectations the Government has on the level of university contributions so that the CRC program can continue to grow.

4.0 CONCLUSION

As stated in the recent BCA report (2006, p. 23), the effectiveness and efficiency Australia's national innovation system is compromised by the lack of innovation policy alignment and "joined-up thinking" in government, public agencies, business and universities, as much as by funding deficiencies (OECD report on 'Governance of Innovation', 2005). There is therefore a need for a more strategic approach to emphasise and capitalise on Australia's role in the global innovation system.

The Productivity Commission's draft report is a step forward in hopefully refining the Australian science and innovation system. However, the ATN would recommend reconsideration of the issues presented in this submission, specifically:

- the need to increase the total level of public support for science and innovation to ensure global competitiveness into the future;
- redefining and supporting the diverse roles of universities in the system;
- acknowledging the full extent of the impact of research by incorporating the social and cultural benefits flowing from R&D via the use of a case study assessment approach;
- supporting university research collaboration with industry through improved R&D tax concessions to increase industry investment in research ;
- supporting the broader concept of technology transfer through routes other than direct commercialisation via additional funding;
- addressing CRC governance concerns and revising expectations on the level of university contributions to the CRC program.