AUSTRALIAN TECHNOLOGY NETWORK OF UNIVERSITIES

ATN SUBMISSION TO PRODUCTIVITY COMMISSION ISSUES PAPER: PUBLIC SUPPORT FOR SCIENCE & INNOVATION

The ATN welcomes the opportunity to comment on the Productivity Commission's issues paper: Public Support for Science and Innovation. The university sector is an important part of Australia's innovation system, not only educating the research workforce, but also engaging in extensive knowledge transfer and research activity. An examination and review of Australia's innovation framework is very timely; not least of all because of the relevance of research impact to the national discussion about the Research Quality Framework (RQF).

This submission will address some key issues surrounding public support for science and innovation that the ATN as a network would like to emphasise, noting that individual ATN members may make their own submissions to the discussion paper.

SCOPE OF THE STUDY

ATN universities, with their origins in former Institutes of Technology, are by nature focused on scientific and technical disciplines. We teach, for example, 21% of Australia's IT students, 26% of engineers and 42% of architects.

Nevertheless, we believe strongly that the social sciences are an important and intrinsic part of innovation. Australia needs to nurture a diverse knowledge and innovation agenda to ensure it is best placed to succeed in the global environment. We need research designed to impact in social, environmental and cultural ways as well as that providing direct economic benefit.

As well, the cost of *not* taking into account the social sciences in a research framework can be unexpected and significant, particularly when looking at its eventual impact. A scientific and technological focus alone can lead to oversight of the technology/community interface. The impact of a particular technology is often closely related to public attitudes and opinion.

To use an example, from a purely scientific standpoint, genetically modified food has the potential to revolutionise all aspects of agriculture. The technology has, however, been received with skepticism by the general public and is only gradually being introduced on a large scale. Incorporating a multidisciplinary approach to this issue, including involvement by the social sciences to gauge the likely public reaction, may have resulted in a much different outcome.

Science does not operate in a vacuum, and there is an increasing recognition by the global research community that multidisciplinary research is the way forward. The ATN would urge the Commission to consider and recognise that a multidisciplinary approach to Australia's innovation and funding outcomes is essential.

ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS

We welcome the recognition that it is important to take into account the broader impact that science and innovation have on Australia, as we believe it is vital that all research organisations make a significant, direct contribution to society. ATN universities operate strongly under this principle, with our members' research tending towards the R&D end of the continuum, focusing on application and knowledge transfer for innovation, wealth creation, and environmental and social sustainability. 70% of our collective research budget is focused in applied and impact-driven research.

Research at ATN universities is also very strongly geared towards third-party partnerships, as evidenced by the outcomes of ARC Discovery and Linkages grants. 43.4% of ATN funding received from the ARC in 2006 flowed from Linkage Project grants – a significantly higher percentage than most universities. 70% of our total research funding is sourced from partnerships with industry and government.

IMPACT VS KNOWLEDGE TRANSFER

It is important for the Commission to recognise that knowledge transfer and broader research impact are separate, although related, concepts. Both are important to Australia's innovation system and need to be supported separately.

Impact is exactly that – 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. This might include outcomes such as increased productivity, reduced costs, reduced water consumption or improved health.

Knowledge transfer, on the other hand, is a much broader concept. The most cited and accepted definition of activities encompassed by knowledge transfer is activity:

> *"concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments"*[1]

A critical element of the approach outlined within the SPRU Report is that it highlights the importance of the measurement of the *extent* of knowledge transfer activity, separately from the impact of any category of research activity.

The SPRU Report is also clear that whilst some metrics of knowledge transfer activities may be readily available, such as the metrics of commercialisation activity, it is important to focus on activity measures which may be more difficult to measure quantitatively but which may provide a better reflection of the overall economic and social benefits of knowledge transfer activities in the social sector. In this context it is important to note that the existing

[1] Molas-Gallart, J., Salter, A., Patel, P., Scott, A., Duran, X. *Measuring Third Stream Activities: Final Report to the Russell Group of Universities.* Science and Technology Policy Research, University of Sussex. April 2002

metrics of the volume or quality of commercialisation activity may not represent the most relevant or accurate basis for determining institutional performance[2].

Some of the examples of impact cited in the issues paper would, in fact, come under the category of knowledge transfer. Research leading to additional R&D, patents or adoption of new ideas and technology are all examples of knowledge transfer, rather than impact.

This is important in the context of the issues paper, dealing as it does with public support and funding. Clearly, knowledge transfer is a precursor to research impact in many cases and a direct relationship can be drawn between a particular piece of research, knowledge transfer from that research, and a positive impact. However, knowledge transfer activities also include such initiatives such as teaching programs, professional development activities, community outreach, policy development or the application of research undertaken by non academic partners.

While impact is an extremely important part of science and innovation activity, it is also important to recognise that knowledge transfer is also important and brings benefit to the nation.

The Commission should therefore not become focused on impact to the exclusion of 'third-stream' activity, particularly when taking into account the benefits that both bring to Australia and the need for ongoing support for both.

MEASUREMENT OF IMPACT

As the issues paper notes, the evaluation of impact can be quite difficult, especially when applied to social and environmental impact, where there are less modeling resources available than for economic impact. For that matter, even for economic impact there are increasing difficulties in drawing linkages to particular innovation initiatives as time passes.

The study should not allow these difficulties to affect its conclusions. While research that provides tangible commercial outcomes in the short term might be the easiest to quantify, it is important to recognise that research of this kind is not in any way intrinsically more valuable than other kinds. A wide exploration of research impact is essential.

Methodology

Beyond the metrics of commercialisation, there are relatively few existing metrics to help define short or longer-term impact. This will not only make it difficult for this study to reach solid conclusions about the extent of impact that science and innovation has on Australia, but also is important in the RQF context, where the government has stated very clearly that the measurement of impact will be an integral part of the assessment along with

[2] Howard, J. (Howard Partners). The Emerging Business of Knowledge Transfer: Creating value from intellectual products and services. Australian Government, Department of Education, Science and Training. March 2005.

quality.

The ATN is working closely with DEST to address the issue of impact measurement within the RQF and will be happy to share its conclusions with the Commission, as it relates closely to some of the questions raised in the issues paper. While ongoing work is still being done around the detail of impact measurement, we have reached a number of initial conclusions about the best ways to measure impact.

Case studies are integral to presenting evidence of impact for assessment and it is recognised that within those case studies both qualitative and quantitative measures can be used to support the case. 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. Work still needs to be done to improve our understanding of impact measures (both qualitative and quantitative) in the other areas of impact, and the ATN is progressing some of these issues.

The ATN strongly supports the view that assessment of impact should be based on a judgement of case studies and the extent to which the case study is supported by credible indicators (qualitative and quantitative).

This is particularly important when talking about social, cultural and environmental impacts.

While a case study approach would appear on the face to be only applicable when looking at specific research outcomes, if applied on a very wide scale (as the RQF proposes to do) it should be possible to get a solid, overall picture of the impact that science and innovation investment is having on Australia. Linking a significant portion of funding to impact measures would encourage a greater focus by researchers on incorporating impact outcomes into their research.

Historical surveys

The study raises the issue of time periods in the context of difficulty in measuring impact for innovation, as well as the possibility of using 'past performance' as a mechanism for allocation of funding.

The ATN would caution against the use of historical surveys as a mechanism for funding decisions. Australia must have a science and innovation sector based on a range of organisations that have different research foci, including which segments of the innovation 'chain' they target. By their very nature, some of these will be relatively mature in terms of research culture/mission/infrastructure and some will be relatively young and in phases of rapid growth.

Using a 6-year historical survey (as foreshadowed in the upcoming RQF exercise) as an instrument to determine any proportion of 'infrastructure support or block funding' could inadvertently result in a loss of innovation momentum across the national sector. Historical

surveys might provide an accurate measure of research quality and impact in established institutions, but they are inappropriate for those institutions which are developing a research profile and which are in establishment or growth phase.

Client surveys

Whilst the ATN attracts a large percentage of its research funding from industry sources we have also found it necessary to listen to what our clients tell us of our research services. To this end members of the ATN have conducted an annual survey of clients over several years which rates performance on client service quality attributes considered important in delivery of ongoing high quality service. These attributes include those relating to ease of contact with each ATN university, employee knowledge and experience, understanding of customer requirements and delivery of results.

Participating universities receive a customized report detailing their survey results and those of the combined ATN data set. The reports identify service quality strengths, areas for improvements and suggestions for the continuous improvement of research services provided by members of the ATN.

CURRENT IMPEDIMENTS TO AUSTRALIA'S INNOVATION SYSTEM

The ATN believes strongly that increased investment is needed for Australia's innovation system to be globally competitive. A greater investment in Australia's investment system to build the percentage of GDP invested into research and development to the level comparable with our OECD counterparts is clearly required if we are to compete effectively.

This will be addressed in detail in the final section, however there are other specific issues that the ATN considers are important for the science and innovation agenda. These include:

- Research workforce planning
- Future operation of CRC programmes

RESEARCH WORKFORCE PLANNING

A key issue for the future of Australia's science and innovation agenda is that of building our research workforce to meet the challenges of the future. It is critical that research workforce planning be taken into account when considering science and innovation productivity. While striving for innovation and investing significant funds into the innovation system is a worthy goal, there begins to be diminishing returns if the research workforce does not exist to drive that innovation. Attention must be given to the expansion of our research base from undergraduate to trained researcher.

There is currently a lack of interest in key disciplines for the science and innovation sector at a secondary school level. Physics, mathematics and chemistry, the traditional precursors for science and engineering studies at a university level, are suffering negative perceptions within schools and this affects the uptake of undergraduate students.

Domestic enrolments in science, engineering and technology (SET) courses as a proportion of total enrolments have declined from 15.8 per cent in 1989 to 14.0 per cent in 2004. Much of the decline occurred in engineering, agriculture, environment and related studies, while the proportion in natural and physical sciences has remained static.

Increasing the flow of students into SET courses within universities will be crucial if Australia is to build its research capacity for the future. Individual universities and networks are all struggling with these issues and attempting to address them. The ATN, for example, is currently looking to change the perception of careers in the sciences/engineering and examining alternate pathways into these degrees. However major attention at a national level needs to be focused to address these issues, as they are systemic and can only be addressed in a relatively minor way by individual institutions.

This, combined with the ageing workforce within universities has the potential to create significant shortages in these fields. Internationally, there has been strong growth in investment in science, engineering and technology. With this growth creating a greater demand for skilled researchers, Australia cannot simply rely on being an 'attractant' for overseas researchers. We need to develop these skills internally, understand the demographics for University appointments required over the next 20 years, and determine how the training base can be expanded.

CRC Programme

Cooperative research activities are an important part of any science and innovation system, allowing resources to be brought together to focus strongly on a particular issue. Australia's Cooperative Research Centres (CRCs) are an excellent example of this type of activity. CRCs support and encourage engagement between universities and industry, which is designed to increase both knowledge transfer and impact.

However there is increasing concern amongst the university sector about 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.

DECISION MAKING PRINCIPLES AND PROGRAM DESIGN

TOTAL LEVELS OF SUPPORT

Australian science is characterised by "islands of excellence", but is at present unable to match the high volume of excellence achieved by leading overseas institutions. Our lack of economies of scale in equipment and of the critical mass needed for interdisciplinary research is accompanied by a fragmented interface with industry.

Although some improvements have been made in response to Backing Australia's Ability (BAA), there has not been an increase in the overall level of Australian investment in research and innovation, with virtually no direct investment in universities' core research capacity. Without this research core there can be no linkages to industry, no commercialisation of research outcomes and no skilled research graduates.

BAA has had a modest, positive effect on investment levels, but it has not really advanced Australia's research efforts compared to international developments. It has reversed the downward trend in national investment in R&D. By the end of BAA (2006) - the net result of this additional investment will have been to return national expenditure on R&D to where it would have been without the slump of the late 1990s.

At the same time as Australia has been playing catch up - many of our major international trading partners, allies and competitors have made significant, increased and long-term commitments to R&D. We must do likewise.

For example, the increased investment by OECD countries in R&D represents a commitment 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. Flowing from these commitments is the recognition of the importance of investment by governments in research carried out in publicly funded research agencies.

Canada has set an innovative target - to become one of the top five Organisations for Economic Cooperation and Development (OECD) nations for investment in R&D by 2010. Achieving this goal requires the tripling of 1999 levels of investment, to around 3% of GDP. The commitment has been backed up by substantial increases in public funding of R&D.

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%.[3]

[3] Science and innovation investment framework 2004 - 2014. HM Treasury. July 2004

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.

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.[4]

The Working Group also highlights that, in terms of meeting the challenges laid down by China and India, the prognosis is 'alarming'. Significant skill shortages are occurring in the SET fields and are predicted to worsen in the face of declining or stagnant enrolments in SET, increased demand for skills in engineering and the enabling sciences resulting from economic development and increasing global demand for highly skilled labour.

Without a more aggressive national innovation strategy backed up by actual investment to retain and build research capacity Australia will soon be unable to even keep up with the accelerating pace of growth of new knowledge. Unless Australia demonstrates its commitment to such efforts by increasing its investment in research training, positions and granting opportunities, we will soon loose our place in the global knowledge economy.

We need to equip Australia with more world-class scientists and innovators able to take ideas through to successful application and commercialisation.

ALLOCATION TO AND WITHIN PROGRAMS

The issues paper raises the question of allocating public funding into areas where it will bring the 'highest net benefits'. The ATN would strongly oppose any model of allocation that would focus research funding narrowly, given the need to build and grow a broad research and innovation base.

Attempting to predict which institutions, or which particular piece of research, will generate a 'greater' public benefit is not only impossible, it can be quite dangerous for Australia's future innovation capacity.

Australia needs to invest in research strategically, and part of that strategy needs to take into account growth for the future. Restricting research funds to institutions that have, for example, built successful research on many years of public funding is not the way to build the momentum in Australia for increased science and innovation capacity.

If Australia wishes to invest wisely in growth, it is important to diversify the research base across a number of sectors with different 'types' of research missions, and who will be at

[4] Strengthening Australia's Position in the New World Order, Working Group on Asia report to PMSEIC, June 2006.

different stages in their development.

Take, for example, the University of New South Wales (UNSW). If UNSW's research performance had been evaluated in 1960, it would have fared very poorly. But by 1985, UNSW was the highest income-earner of any Australian university. With growth rates over our first 15 years that exceed UNSW's in its first 15 years, the ATN expects its growth to similarly register on the national scale.

Different institutions also have very different research missions. The ATN, as previously articulated, is strongly focused on engineering and the applied sciences and on applied research. Other institutions might have a strong focus on basic research, or medical research, etc.

All disciplines and types of research are important, and all have the capacity to bring a significant 'net benefit'. An argument could be made, for example, that a very strong funding focus for applied research would be more likely to produce measurable benefits, by its very nature. It would certainly not have a negative financial outcome for ATN universities. However a decline in basic research would decrease the stock of knowledge from which applied research builds.

It is important that public funding continue to support a range of research disciplines and research at all stages of the continuum.

PEER REVIEW

Finally, the ATN would like to state its support for peer review as an important methodology for funding allocation. Some questions in the issues paper have raised the question of alternate methods for funding distribution.

It is essential that the peer review process for research development and innovation be retained within Australia. This review is a hallmark of world-class science, ensures accountable allocation of funding based on cutting-edge research, allows a more responsive allocation of funding toward developing areas or research excellence and helps guard against the "halo effect" that can occur when block funding goes to institutions of good repute that may not be maintaining high research standards. Australian funding sources tend to make frequent use of international referees to ensure that proposals are assessed by international standards.

We would, in fact, like to raise concern with the apparent current move to non-external peer review by the National Health and Medical Research Council (NHMRC). Without external influence as part of the review process, peer review runs the danger of being dominated by conservatism - backing the established investigator, rather than the emerging and less well known investigator, and threatening the growth of innovation by not encouraging new researchers.

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A vibrant industry needs this type of continuous international review process and we should not short-change ourselves by changing the peer review process.

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