



**Submission to the Review of the National
Innovation System**

The Australian National University

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INTRODUCTION

Over the past twenty years, Australians have become better educated, more innovative, and more prosperous. Australia is thriving. Our economy has become more closely linked to global markets. Our nation has profited from an expanding global economy. We are building valuable trading partnerships, as well as stronger diplomatic, scientific and cultural relationships with fast-growing economies in our region. We benefit from strong public institutions and from an efficient private sector.

Australian society is, in many respects, well placed to sustain its prosperity and dynamism. But our future success is not guaranteed. Global economic expansion is leading to dramatic shifts in education and research investment in our region. Australian industry and our public institutions are confronting ongoing constraints in accessing educated human capital. There are challenges in ensuring that Australian organisations continue to become more productive, more internationally competitive, and more innovative.

At the same time, finding solutions to the problems faced by all Australians – relating to regional and global security, climate change, our ageing population, water scarcity, energy, financial regulation, the cost of healthcare, and social cohesion – depends increasingly upon the discovery and application of knowledge. Positioning Australia to deal with a changing and competitive world is inherently dependent upon sound innovation policy, and the challenges we face here are compelling. Australia strongly needs a transformation of its national innovation system.

The Australian National University (ANU) welcomes the opportunity to contribute to a review of the National Innovation System. The National Innovation System sustains and promotes Australia's place in the global economy. This submission discusses the issues faced by the Innovation System in Australia from the perspective of Australia's National University. In the final section we offer recommendations addressing the terms of reference and offering ways forward for innovation in Australia.

WHAT IS THE AUSTRALIAN INNOVATION CHALLENGE?

The Australian innovation system is almost invisible by global standards. Our distance from international markets restricts the abilities of Australian firms to access customers, suppliers and ideas. At the same time, the structure of our economy is changing in ways that are heightening the importance of human capital. These factors create key challenges for policy-makers.

We don't have the people – Economies throughout the world are restructuring in ways that emphasise the importance of university-

educated human capital. In many sectors, innovation is impossible without highly educated or highly trained personnel. But our educated population is trivial in world terms. There are less than 70,000 people with doctorates in Australia compared with almost 1.6 million in North America.¹ There are now almost 450,000 engineers being graduated each year from Chinese higher education institutions, compared with around 10,000 from Australian universities.² Indeed, in 2004 there were over 13 million students enrolled in Chinese higher education colleges and universities – a number roughly equivalent to the entire working-age population of Australia.

We don't have the scale – In excess of US\$770 billion was spent on R&D in the OECD in 2005. This was more than the entire Australian gross domestic product.³ Because Australia is a small and geographically distributed nation, we need to make a concerted effort to build high-scale institutions. No Australian university would currently be ranked among the top forty US universities by scale of its research expenditures. Yet Sweden (a country with a population almost a third that of Australia) has two universities that perform research on this scale.⁴ Australia has to invest with disproportionate intensity in education and science in order to maintain institutions of international standing.

We don't have the proximity – Although Australia's remoteness from the rest of the world's GDP has narrowed over the past 50 years, the impact of distance on trade may actually be increasing.⁵ There is evidence that knowledge spillovers also remain heavily impacted by geography.⁶ Australia is disadvantaged in many areas of innovation due to its remoteness. This is a drawback that seems likely to grow for the foreseeable future: in light of current growth in innovation activity occurring in emerging economies, Australia seems destined to account for an ever-decreasing share of global innovation in coming years.

How can Australia meet these challenges? It can sustain migration programmes to build its skilled workforce and its connectivity with the world. It can develop efficient tax arrangements to stimulate its businesses. It can foster clusters in particular regions and industries. Any serious response to the Australian innovation challenge however must above all involve universities, and must seek particularly to build up universities of international standing.

¹ OECD, *Labour Market Characteristics and International Mobility of Doctorate Holders: Results for Seven Countries*, STI Working Paper 2007/2.

² NSF, *Science and Engineering Indicators*, 2008.

³ OECD, *Main Science and Technology Indicators*, 2007.

⁴ Barlow Report, *The State of Research in Australian Universities*, 2007.

⁵ S. Redding & P.K. Schott, *Distance, Skill Deepening and Development: Will peripheral countries ever get rich*, NBER Working Paper, No. 9447, 2003.

⁶ G. Withers, *Can Distance be Defeated?*, CEDA Growth, No. 58, July 2007.

WHY ARE UNIVERSITIES IMPORTANT?

Universities create a significant share of Australia's innovative human capital. They help to position Australia as an innovative society that values knowledge. They provide important linkages to international knowledge networks. They develop knowledge-based solutions to Australian problems, and they act as a repository of knowledge so that Australians can solve a diversity of future problems.

Creating Australia's professional workforce – Each year, well over 200,000 students graduate from Australian universities. The vast majority of Australia's scientists, engineers and professionals have been educated at Australian universities. Those universities that offer the highest standards of education (particularly those that offer a research-intensive education) equip their graduates to work in knowledge-intensive environments for a lifetime.

Leaders in skilled migration – Over 70,000 international students enrol each year to study at Australian universities. Many of these students will subsequently remain in Australia to join our workforce. In 2004, 34% of international student graduates were approved for permanent residency under selected skilled categories⁷. The quality of student migrants (and arguably of the broader skilled migrant pool attracted to Australia) is directly determined by the international standing of our higher education system and by the existence within it of internationally prestigious institutions.

Building Australia's underlying knowledge base – In most developed societies university research has become the dominant mechanism for advancing knowledge. Universities perform 60% of all basic research carried out in Australia.⁸ In the US, the figure is actually slightly higher at 63%.⁹ Basic research only rarely provides direct inputs into technological innovation. It is instrumental however for building underlying capabilities, for providing access to global knowledge networks, and for enabling responsiveness within the Australian innovation system to future opportunities.

Leaders in international collaboration – Universities play an instrumental role in ensuring receptiveness to the global knowledge-base, and Australia's research-intensive universities especially are fundamental for connecting Australia to global innovation. In 2004, 36% of Australian research publications had an international co-author,

⁷ ABS, *Australian Social Trends: International Students in Australia*, 4102.0, 2007.

⁸ ABS, *Research and Experimental Development*, 8112.0, 2006.

⁹ NSF, *Science and Engineering Indicators*, 2008.

compared with just over 10% in 1980. This increase mirrors an important trend internationally, with 21% of scientific publications involving international co-authorship in 2005, up threefold from 7% in 1985.¹⁰

Solving problems for Australia – Universities are a critical source of direct advice for governments, communities, and businesses. It was an ANU academic, Professor Bruce Chapman, who devised and promoted HECS. Two other ANU economists, Professors Ross Garnaut and Warwick McKibbin, have played instrumental roles in developing Australia's policy response to climate change. Australian universities collectively provide around \$800 million in consultancies and contract services to other Australian organisations annually.¹¹ Businesses invested over \$240 million in Australian university research projects in 2004.¹² Australian universities provide unique and important problem-solving capabilities to the national innovation system.

Shapers of Australian culture – Finally, through teaching and through engagement in public debate, universities can (and have) had a powerful influence upon Australian culture. It was an ANU academic, Professor Peter Read, who coined the term "stolen generation". Through his writing on restorative justice, the ANU's Professor John Braithwaite has triggered a global social movement in re-integrative justice. The best universities teach their graduates how to negotiate and influence the cultures in which they subsequently live. Any society that aspires to foster a culture of innovation must begin by transforming the culture of Australian universities.

BUT ARE OUR INSTITUTIONS DEVELOPING IN APPROPRIATE WAYS?

No developed nation can aspire to have an innovative society without a dynamic university system. But scale constraints, policy settings, and workforce sustainability risks are currently hindering Australian universities from delivering the knowledge, the networks, the skills and the broader culture that Australia needs if it is to blossom as an innovative society.

Scale constraints – The standing and performance of Australia's higher education system (and indeed of Australia itself) is strongly influenced by the presence of internationally prestigious organisations, like the Australian National University. Yet current innovation policies are not ensuring that Australia has universities of the highest international standing. The National University of Singapore now has total assets

¹⁰ NISTEP, *Science and Technology Indicators*, 5th edition, June 2006.

¹¹ DEST, *Finance 2006: Financial Reports of Higher Education Providers*, September 2007.

¹² ABS, *Research and Experimental Development: Higher Education Organisations*, 8111.0, 2006.

considerably higher than those of any Australian university¹³. Federal research council funding for the University of Toronto is now roughly double that provided to even the most successful Australian institutions through national competitive grants.¹⁴ Australia needs to reassess its investment in research and the extent to which it concentrates resources around its highest-performing talent.

Policy inefficiencies – Compounding the impacts of our scale constraints, there has been confusion in Australia about what the goals of innovation policy should be, leading to inefficiencies in public programs designed to foster collaboration, critical mass, and commercial outcomes. Government policies are also imposing significant constraints upon universities' capacities to develop their own strategic directions. If Australian universities are to demonstrate strategic leadership in innovation on behalf of local communities and for wider Australian society, several elements of research policy will need to be refocused.

Workforce sustainability – The proportion of the Australian workforce with high-level skills in knowledge diffusion is low by international standards. Consequently, there are good arguments for enhancing government support for research-intensive education programs. Australian universities themselves face much more severe demographic challenges than is true of the Australian workforce as a whole. There is a risk that Australia will shortly find itself unable to sustain an adequate academic workforce to train our future innovators.

These themes, as we shall see in greater detail below, provide compelling justifications for including higher education and research at the heart of any government deliberations about innovation policy. In knowledge-intensive societies, universities create capacity for innovation. Australia's universities, however, are not currently operating to maximise this capacity.

ARE WE IDENTIFYING OPPORTUNITIES?

There is a logical relationship between the scale of a country's university system and a country's capacity for generating knowledge. It is perhaps unsurprising then Australia's capacity for generating new ideas and knowledge is not as well developed as is popularly imagined. A range of metrics indicate that Australia lags particularly among small-to-medium sized nations in its capacity to generate new opportunities based on new knowledge.

¹³ National University of Singapore, *Annual Report*, March 2007; DEST, *Finance 2006: Financial Reports of Higher Education Providers*, September 2007.

¹⁴ Office of the Vice-President, Research and Associate Provost, *Annual Report 2005-06*, University of Toronto; DEST, *Higher Education Research Data Collection*, 2005.

Investment in knowledge is weak – According to the OECD, Australian investment in knowledge (defined as the sum of expenditures on R&D, higher education, and software) is less than 4% of GDP. This figure is lower than the OECD average (4.9%) and considerably lower than in Denmark (5.1%), Japan (5.3%), Finland (5.9%), Sweden (6.4%), and the US (6.6%).¹⁵

Investment in university research is low – Australian investment in university research is also low compared with nations that operate with similar scale constraints. As already noted, smaller nations have to spend more as a proportion of their economy in order to achieve the same global impact for their institutions. The effect is compounded, moreover, for nations with highly distributed populations. Yet, as a share of its economy, Australia spends just 0.48% of GDP on R&D in higher education institutions, which compares poorly with other smaller OECD nations: Austria (0.59%), Canada (0.7%), Denmark (0.61%), Finland (0.68%), Sweden (0.85%), Switzerland (0.66%).

Australian universities are not focusing on long-term research – There has also been a marked trend over the past decade for researchers in Australian universities to shift focus away from exploring opportunities with long-term horizons. The combined share of strategic basic research and pure basic research dropped from 62% of Australian universities' R&D expenditures in 1995 to just 52% in 2004, ten years later.¹⁶ In the US, where university research has played an unparalleled role in the development of human capital as well as new technologies and new industries, 75% of university R&D expenditures are directed towards basic research.¹⁷

Total investment in basic research is low – Total Australian investment in basic research as a proportion of GDP also falls well behind that of many of our competitors. According to OECD data, Australian expenditure (at 0.42% of GDP) is equivalent to that of Singapore (0.42%) and lower than that of South Korea (0.44%), Denmark (0.46%), the US (0.50%), France (0.52%), Israel (0.75%) and Switzerland (0.84%). Interestingly, Switzerland, which invests disproportionately in basic research, also ranks first globally in per capita measures of publications, patents, citations and Nobel Prize winners.¹⁸

Production of knowledge outputs is limited – Australia boasts about its 2% share of the world's scientific publications, a share slightly lower than that of South Korea and roughly equivalent to that of the

¹⁵ OECD, Science, Technology and Industry Scoreboard, 2007.

¹⁶ ABS Research and Experimental Development Survey, 1995 & 2004.

¹⁷ Barlow Report, The State of Research in Australian Universities, 2006.

¹⁸ OECD, Science and Technology Indicators, 2007.

combined North African nations.¹⁹ Normalised for the size of our economy, our output is lower than that of Switzerland, Sweden, Denmark, Finland, the Netherlands, the United Kingdom and Canada²⁰ - and the quality of Australian publications (as measured by citations per paper) is lower than for the majority of OECD nations.²¹

Australia is not currently leading the world in knowledge production or in knowledge investment – even when normalised for the size of our economy or population. Australians could, however, aspire to be world leaders in both of these things. A society's investment in knowledge is a good indication of its future innovative capacity and of its cultural attitudes towards innovation. Knowledge investment, moreover, is increasingly pervasive in its impacts. In contemporary Australia especially there are now good reasons to believe that any national increase in knowledge production would be beneficially distributed.

ARE WE DISTRIBUTING KNOWLEDGE AND CAPABILITIES?

Given Australia's limited capacity for generating ideas, the national innovation system has proved more effective than is commonly supposed at mobilising and distributing knowledge. At the grassroots level, Australian researchers for example have shown enhanced abilities in recent years for working together and sharing their capabilities. One sees this, quite demonstrably, in co-authorship trends from scientific publications and also in the growing evidence of public-private collaboration.

University researcher collaborations – In 1980, less than 15% of Australian university research publications involved co-authorship with other institutions nationally. Twenty years later, the figure was around 30%.²² Significantly, this growth in co-authorships occurred at a steady rate, largely independent of changes in research policy over the period. It reflects a similar steady transformation in publishing patterns that has occurred internationally. There is also no sign that the trend towards increased collaboration at the grassroots level is slowing.

University and business collaboration – There has also been dramatic growth in business engagement with universities over the past fifteen years. In 1992, 2.5% of Australian university research was financed by industry, compared with 5.5% for the OECD as a whole in 1991. By contrast, in 2004, 5.7% of Australian university research was financed

¹⁹ National Science Foundation, Science and Engineering Indicators, 2008.

²⁰ OECD, Main Science and Technology Indicators, 2007.

²¹ Australian Science and Innovation System: A Statistical Snapshot, DEST, 2006.

²² L. Butler, *Monitoring Australia's Scientific Research: Partial Indicators of Australia's Research Performance*, Australian Academy of Science, Canberra, 2001.

by industry, compared with 6.1% for the OECD as a whole.²³ This reflects two important trends: (i) the overall growth in business R&D investment in Australia over the period; and (ii) the growth in co-funding opportunities made available to researchers through the Australian Research Council and the Cooperative Research Centres program.

These figures contradict perceptions that collaboration is stifled among Australian researchers by geographic constraints, by cultural issues, or by the peculiarities of the Australian industrial structure, which traditionally provided limited absorptive capacity for research in public institutions. Arguably, current policies have been at least moderately successful in fostering the distribution of knowledge and capabilities among university researchers and between university researchers and businesses.

However, these trends largely reflect the consequences of individual initiative – of researchers exploiting personal relationships, applying for ARC Linkage grants, working for the most part independently of their organisations via “bottom-up” processes. Where Australia struggles, by contrast, is at the level of the system and of the organisation.

CAN WE OVERCOME INEFFICIENCIES IN INNOVATION POLICY?

Although the Australian innovation system has many dynamic elements in the way it creates and distributes knowledge, much greater political will and strategic leadership could be applied in setting priorities and creating critical mass. This is apparent both in the way governments make decisions about public investment in research and in the nature of contemporary governance arrangements imposed upon organisations for large-scale collaborations.

1) Governments must re-invigorate their decision-making about public investment in large inter-organisational collaborative research centres or facilities.

Federal programs for funding centres and infrastructure facilities have provided important mechanisms for building scale and focus in Australian research in recent years. However, government agencies allocating resources to such initiatives could pay less consideration to political factors in order to make investments with a more strategic view of national interest.

Clear messages – In the case of ARC Centres of Excellence, CRCs, and the National Collaborative Research Infrastructure Strategy (NCRIS), the political imperative to share resources nationally has to some extent undermined the impact these programs could have had in

²³ OECD, Main Science and Technology Indicators, 2005 & 2007; ABS Research and Experimental Development Survey: Higher Education Organisations, 1992.

driving concentrations of capability. This has been an explicit feature particularly of CRCs, where a focus on research outcomes has sometimes been held subservient to the program's other objectives relating to cooperation (which, in turn, have arguably been superseded anyway by modern research practice).

Greater transparency – Ironically, the lack of national focus has been especially true of NCRIS, where the privately facilitated funding process tended to promote negotiation around personal, institutional and state interests rather than objective thinking about national interest. Facilitated schemes of this nature need to be conducted openly – through a transparent process where outcomes are also justified openly. The word 'investment' has been used repeatedly throughout the NCRIS process, though never in conjunction with any serious analysis of the microeconomic impacts (both favourable and unfavourable) of proposed funding arrangements. Where academic peer review is complemented or supplanted by other forms of assessment, justifications for public investment in research should be rational and public.

Influence of state governments – Although they are usually minor partners, by co-investing through NCRIS and competitive centre bids, state governments have exerted disproportionate influence in recent years in determining the location and the nature of major federal investments in research. Federal programs have failed to articulate the costs and benefits of allowing investment decisions to be influenced by state leveraging funds. This is an issue on which the Australian Government needs to develop an informed and rational position.

2) Federal policies for managing research ventures run by multiple partners could be simpler and more efficient.

Recent programs for funding centres and infrastructure facilities have also introduced serious inefficiencies into university research management. First, by encouraging the formation of incorporated research ventures, federal policy has inadvertently reduced institutions' capacity to control their own destiny. Second, by focusing on collaboration and cooperation rather than research outcomes, federal policy has led to the formation of inefficient research governance structures.

Avoiding fragmentation by incorporation – The creation of NICTA and many CRCs as autonomous entities has fostered unexpected fragmentation in the Australian research community. Where newly funded centres could have been used to build up established university brands, to support the strategic plans of parent organisations, and to bring researchers together across organisations and across the nation, they have in some instances eroded established university brands, operated in unconstructive ways with their parent organisations, and

created unnecessary barriers to collaboration between those who are inside such centres and those who are outside. Indeed, contrary to policy objectives, the implementation of some new research centres may actually have constrained the scale of national research activity in an area rather than expanding it.

Governance for managing cooperative research ventures – An additional problem for centres, such as CRCs, which have ‘cooperation’ as an objective in its own right is that they tend to be overburdened by their governance structures and by the need to manage the conflicting interests of multiple parties. A more efficient approach to governing outcomes-focused centres, such as CRCs, would be to distinguish more clearly between research users and research providers, and for the government to articulate separate governance models for funders, providers, and users.

DO OUR INSTITUTIONS SHOW STRATEGIC LEADERSHIP?

Leaving to one side the specific issues posed by government programs to support collaborative research centres and facilities in universities, there is an additional constraint on our universities’ capacity to set priorities, build collaborations, and create critical mass. To a surprising degree, universities in Australia currently lack the financial flexibility and the authority to set their own strategic directions in research.

Financially tied – Increases in funding for competitive grants have brought a welcome expansion to Australian university research in recent years, broadly in line with international trends. The federal government, however, does not fully fund the research infrastructure required to deliver on its project grants. This means that institutions themselves are now required to meet a funding gap, which has severely eroded their capacity to drive innovation directly from their own balance sheets. Despite intensive efforts to create capacity to pursue strategic opportunities, even the best run Australian institutions are unable to counter the effects of Government policy such as inadequate indexation, intense leverage, and fragmentation of funding programs.

Direction is imposed on universities – The lack of unconstrained research funds means, for the most part, that Australian universities’ research directions are determined either: randomly from below by the success of individual research staff in accessing external resources; or arbitrarily from above whenever there are changes in Commonwealth funding programs. Where leaders have minimal capacity for making important decisions on behalf of their organisations, it should not be surprising if organisations have only limited ability to act strategically.

Yet this is what is happening: Australian universities do not currently set their own research directions.

Perverse outcomes – The situation creates perverse outcomes. Despite ten years of rhetoric about diversity and the need for scale and concentration of effort in Australian universities, most institutions continue to offer only a veneer of research across a very wide range of disciplines. Universities that could be highly responsive to regional communities or local partners are constrained in their capacity to develop relevant research programs. At the same time, there are strong incentives in the current model for institutions to cross-subsidise research from other sources of revenue – largely at the expense of teaching quality, and in ways that can lead to confusion between an institution's teaching and research objectives.

Increases in funding for competitive grant schemes have raised the capacity for *individual* researchers in Australian universities to think and act strategically. This trend, however, has been contradicted by a gradual constriction in opportunity for organisational leaders and university administrators to act strategically in developing *organisational* research portfolios.

Australia would clearly benefit if research-intensive universities had greater discretion to set their own directions and to align the activities of their internal research communities with wider organisational, regional, and national objectives. The impacts could be particularly profound if universities had greater incentives to develop strategic and symbiotic associations between their teaching and research activities. This is especially important when one considers the role universities play in the diffusion of knowledge.

DO WE HAVE SKILLS TO DIFFUSE KNOWLEDGE FROM ANY SOURCE?

Formal education is a significant (perhaps the most important) mechanism for distributing knowledge and capabilities in Australian society. Universities play a fundamental role in this respect both in early post-school programs and through lifelong learning. Over a quarter of Australians in full-time employment and 30% of all Australians aged 25-34 now have a university degree.²⁴ Graduates convey a range of advanced capabilities into the Australian workforce. Far more important, though, is the knowledge they bring about knowledge itself.

At its best, a university education prepares individuals to involve themselves in the distribution of knowledge as creators, disseminators, and users; and equips them to do this for the rest of their lives. This is especially true for postgraduate students and for students with research experience, whose

²⁴ ABS, *Education and Work*, 6227.0, May 2007

training tends to make them particularly receptive to ideas, skilled in accessing advanced knowledge, and highly adaptive in modifying and using new knowledge. It is also true where traditional undergraduate programs can be closely linked to, and informed by, the latest advances in research.

Australia has good participation rates in university education, but it faces considerable hurdles in the short-term in ensuring equitable access to university for all members of society and in building high-level knowledge diffusion skills in its workforce.

Business enterprise researchers – Australia has just 3 business enterprise researchers per thousand people employed in industry. This compares with a figure of 7 for the OECD as a whole, and it compares very poorly with other developed nations such as Finland (14), Japan (13), the US (12), South Korea (8), Norway (7), and Canada (7).²⁵ The figure is lower than one expects, even accounting for the relatively modest investment in business R&D in Australia.

PhDs in the workforce – Australia has just under 8 doctorate holders per thousand in its labour force, compared with 28 for Switzerland, 20 for Germany and 11 for the US.²⁶ The comparison would be even starker if one looked at the private sector workforce. Private industry employs 44% of all science and engineering PhDs in the US²⁷. The proportion in Australia would be much lower.

International PhD Scholarships – The government's recent efforts to increase the number of domestic PhD students in Australia are excellent. But to grow the number of PhDs in the private sector workforce, in line with the education patterns in leading countries, Australia will also need to attract more international PhD students. This would have the additional benefit of not taking young Australians out of the workforce at a time of widespread skills shortages.

Lack of research training opportunities at all levels – Existing support for research training through the Research Training Scheme operates according to a generic model of education based on the traditional PhD. In a climate of low unemployment and immediate private-sector demand for bright graduates, broader support could be provided for related initiatives. Few universities nationally provide a truly research-intensive approach to education at the undergraduate as well as at the postgraduate level. Yet this is the model for education that will inculcate the deepest skills in knowledge diffusion.

²⁵ OECD, Main Science and Technology Indicators, 2007.

²⁶ OECD, *Labour Market Characteristics and International Mobility of Doctorate Holders: Results for Seven Countries*, STI Working Paper, 2007.

²⁷ L. Thurgood, M.J. Golladay, and S.T. Hill, *US Doctorates in the 20th Century*, NSF, June 2006.

To build a workforce with high levels of advanced education and high familiarity with research practice is a major undertaking for Australia. It will require a strong, lasting government commitment to research-intensive education at all levels. It must be matched in addition, though, by increased responsiveness to universities' own emerging demographic challenges.

ARE WE MANAGING RISK AND UNCERTAINTY?

In the long-run, the capacity to sustain a high standard of Australian higher education and to train future innovators is constrained by demographic effects. At its simplest, the quality and quantity of education and research that our universities can provide will increasingly depend in coming decades upon the extent to which universities can recruit outstanding staff. Australia faces significant uncertainties in this respect.

Demographic bottleneck – Staff in Australian universities have a much older age structure than is true for the rest of Australia's workforce. In 2001, 45% of academics were 45 years and over, compared with 36% of professionals in the Australian workforce as a whole. This indicates that nearly 15,000 academics will be retiring over the next fifteen years. As these staff members retire, universities will face a major recruitment challenge.²⁸

Inadequacy of domestic supply – The evidence suggests that current flow-through of existing resident academics will fail to meet the demand for high quality staff in Australian universities. Between 1996 and 2006, the number of teaching staff in Australian universities has stagnated, leading to a pronounced deficiency in appointments at the mid-career stage. The Australian Government's mid-career fellowship program will assist in this respect, but it will probably need to be supplemented from 2010.

Inadequacy of supply through immigration – Australia, like many other developed countries, will intensify its recruiting overseas. It is doubtful however that Australia will be able to meet its needs for talented academics through immigration. Over the decade from 1993 to 2003, Australian universities gained in net terms just 5,000 staff from overseas (with just under 15,000 academics migrating to Australia and with just under 10,000 departing). There is no guarantee of a similar gain over the coming decade – at least not without a concerted effort to lift the international profile of Australian universities. Nearly half of our arriving academics come from Asian countries, which are now beginning to build up their own higher education institutions.

²⁸ G. Hugo, *The Demography of Australia's Academic Workforce: Patterns, Problems and Policy Implications*, Monash Seminars on Higher Education, September 2004.

Quality of PhDs becomes critical – In this context, initiatives to increase the number of local PhD students will be invaluable. But demographic effects mean that current PhD students may need to be promoted extremely rapidly. Australia's future innovative, knowledge-savvy workforce may find itself being trained by a very young academic community. With this in mind, the quality of PhD training that students receive in Australia has never been more crucial. Government programs may also need to give greater attention to the wider institutional research environment in which PhD research is carried out.

Obviously the human resources challenge for universities is, to a large degree, tied up with other constraints faced by Australia's higher education system. It is closely associated, for instance, with international perceptions about the scale of the university sector in Australia and the perceived level of policy support from government.

HOW CAN WE BUILD ON OUR NATIONAL 'CAN DO' CULTURE?

Universities shape a nation's culture. We educate the nation's opinion-leaders as they form their higher intellectual skills. Our research influences public debate and government policy on all the key issues that shape Australian society. Perhaps most importantly, and to a degree that is unique among all educational organisations, universities educate their students by providing an environment in which there is considerable freedom to innovate and to explore ideas – something our graduates carry with them for life.

Universities could do more to instil a 'can do' culture across Australian society. But they will need new forms of support, new freedoms, and a new confidence if they are to transform the extent to which they enable innovation in Australian society.

1) Universities must be empowered with their own 'can do' culture.

If Australian society is to increase the value it accords to knowledge and innovation, and if it is to be seen internationally to value knowledge and innovation, it will be essential to empower our universities with major changes in government policy. Transforming the national culture and Australia's international standing as a knowledge economy, above all will require:

- investment – substantial increases in Australia's overall investment in knowledge;
- focus – recognition that there are special reputational benefits in strengthening the research performance of institutions with high prestige internationally;

- efficiency – full federal funding for the costs of research in order to curtail the running down of Australian knowledge assets;
- leadership – research funding policies that empower institutions with the strategic capacity to determine their own destiny; and
- simpler governance – new models of governance for government programs that are clear about their objectives and that prioritise transparency and administrative simplicity.

2) Universities must also be better supported for conveying deep knowledge diffusion skills

If Australians aspire to build an innovative society with deep access to global knowledge and with an inquisitive population, they will need to populate their universities with the most outstanding educators and researchers in the world. This will require:

- workforce sustainability – a concerted government push to build human capital for Australian universities at the mid-career and at the PhD level;
- international focus – a vigorous endorsement of the importance of international reputation and international linkages in university research programs; and
- graduate education – a fresh focus on PhD programs to fund more international students and to distribute funding with greater consideration of the standard of the overall research environment.

In addition, if Australia is to foster a deeper cultural capacity for discovering, sharing and exploiting knowledge, governments will need to provide explicit mechanisms for nurturing universities' other research-intensive education programs. Helping Australia's future workforce to learn independence and confidence in using and adapting knowledge, and in linking to knowledge networks, will require:

- research-intensive education – new policy support for research-intensive educational initiatives at both the graduate and the undergraduate level; and
- networks – a new awareness of the impact that universities have in generating and sustaining professional networks both among staff and graduates.

HOW DO WE BALANCE OUR PRIORITIES FOR INNOVATION?

There are many actions the Australian Government could take to build a more innovative culture in Australia. In developing a new innovation policy for Australia, the broad challenge for government is to provide ongoing momentum for Australian education, to nurture an environment in which innovative institutions and firms will thrive, and to invigorate a 'can do' culture across Australian society. Universities already provide a powerful (and essential) mechanism for meeting these challenges. Their impact, however, will be maximised if the government can respond to the issues raised in this document by making specific changes as outlined below.

1. Principles for Public Sector

Recommendation 1a – Public policy should drive the nation's total investment in knowledge towards ambitious targets.

Recommendation 1b – The Australian Government should fund the full costs of the research it commissions of universities through national competitive grant schemes.

Recommendation 1c – Decisions for public investment in research about funding centres or facilities should be made in the national interest and on merit, not for political reasons, nor to encourage leverage, nor to distribute spoils, nor to force collaborations.

Recommendation 1d – Sound economic concepts rather than superficial considerations should apply when assessing the costs and benefits of allowing state governments to leverage decisions about the awarding of research facilities and centres.

Recommendation 1e – Facilitated decision-making about research investment (such as that provided through NCRIS) should be managed in a transparent way, and in a way that avoids conflicts of interest.

Recommendation 1f – The Excellent Research for Australia (ERA) initiative should exclusively emphasise the quality of research to ensure that Australian research institutions build scale around the nation's best research.

Recommendation 1g – Australian Government innovation policies should establish, fund, and regulate a vibrant marketplace for ideas in Australia, and they should avoid interference in the affairs of organisations operating within this marketplace.

2. National Innovation Priorities

Recommendation 2a – The Australian Government should provide enhanced investment for generating new ideas and knowledge, and particularly for basic research, within Australia's excellent universities.

Recommendation 2b – While supporting a broad and diverse higher education sector, the Australian Government should be mindful of the value of sustaining the growth and international prestige of its unique educationally intensive research institute (the Australian National University).

Recommendation 2c – The government should increase national and international PhD studentships for institutions able to demonstrate the quality of their research and the quality of their PhD programs.

Recommendation 2d – Consideration of the stocks and flows of mid-career researchers suggests the government should plan to increase the scale of its new mid-career research fellowship scheme from 2010, in order to assist universities to manage human capital requirements to replace retirements.

Recommendation 2e – As part of its resourcing for research training, the Australian Government should provide new support for initiatives aimed at creating professional networks linking students, graduates, staff, and communities.

3. Barriers to Innovation

Recommendation 3a – Australia's knowledge infrastructure must be kept competitive in an international context. This is an important reason for the government to fund the full costs of the research it commissions of universities.

Recommendation 3b – The deficit in research infrastructure funding provided to universities severely restricts organisational capacity to act strategically. Government policy needs to complement existing top-down and bottom-up funding schemes with schemes directed at the organisational level.

Recommendation 3c – The Australian Research Council (ARC) should complement its project funding to individual researchers with block grants to institutions that display a capacity to sustain large scale, long term and high quality research.

Recommendation 3d – ARC block grants should be awarded on the basis of institutional research plans and on evidence of institutional research outcomes. They should be provided to enable greater strategic leadership at the organisational level.

Recommendation 3e – The gravest emerging barrier to innovation in the Australian higher education sector relates to the challenge in recruiting and retaining internationally outstanding academic staff. The government should work with research intensive universities to develop a comprehensive strategy for addressing this challenge.

4. Program Efficiency

Recommendation 4a – All research centre programs and large infrastructure funding programs focus strongly on generating research outcomes of international quality and benefits.

Recommendation 4b – Innovation and research program managers within relevant government departments should make administrative simplicity a priority. Funding allocation and administration processes should be managed in a transparent manner.

Recommendation 4d – The Research Infrastructure Block Grants and the Institutional Grants Scheme should be combined and annual funding for the combined scheme increased to provide for the full cost of research.

Recommendation 4e – Funding for the Research Training Scheme should be raised in line with the government's aspirations for increasing Australia's total number of PhD graduates, and to reflect the full cost of research training.

Recommendation 4f – Some component of research training funds should account for the wider institutional research environment in which PhD research is carried out, while additional research training funding should be accessible for use within research-intensive undergraduate programs.

5. R&D Tax Concession

Recommendation 5a – National expenditure on knowledge is a more valuable metric than the national expenditure on R&D (which it encompasses).

Recommendation 5b – The government's commitment to raise private sector R&D investment in Australia through tax concessions must be complemented by investment in public sector higher education.

Recommendation 5c – Instead of further enhancing tax concessions for businesses to collaborate with universities, the Australian Government should consider policies such as the ‘innovation vouchers’ being implemented in the UK to enable small and medium-sized enterprises to work with universities.²⁹

6. Better Governance

Recommendation 6a – Government should create new research centres and facilities within existing university governance structures, not peripheral to them, in order to strengthen the National Innovation System, not to fragment it.

Recommendation 6b – In developing governance arrangements for university innovation initiatives, the Australian Government must allow for flexibility and responsiveness so that organisations can pursue unforeseen opportunities.

Recommendation 6c – The Excellence in Research for Australia (ERA) initiative must remain focused on reporting the quality of Australian Research within a framework that is internationally credible.

Recommendation 6d – Governments should remain aware of the risks that arise when ‘relevance’ and other instrumentalist notions of research drive decisions relating to university R&D investment.

7. CRC Program

Recommendation 7a – The CRC program should be renovated with an increased emphasis on ends and outcomes rather than means and cooperation.

Recommendation 7b – Governance arrangements for the CRC program should be simplified to avoid the problems that arise where multiple organisations with multiple objectives attempt to control a research portfolio.

Recommendation 7c – The CRC program should be managed by the ARC in order to coordinate funding in conjunction with the ARC Linkage program.

Recommendation 7d – CRC funding should be distributed to universities and other publicly funded research performers via industry associations, government agencies, or other community groups interested in large

²⁹ Department for Innovation, Universities and Skills, *Innovation Nation*, March 2008.

scale, highly significant pre-competitive research. AMIRA may provide a good model.

Recommendation 7e – The split between ‘commercial’ and ‘public good’ CRCs is artificial. All CRCs should be distinctive for their focus on strategic and basic research outcomes that are useful to society at large. Research outcomes of commercial value should be properly funded by the beneficiaries.