INNOVATE AND PROSPER

Ensuring Australia's Future Competitiveness through University-Industry Collaboration

AUSTRALIAN TECHNOLOGY NETWORK OF UNIVERSITIES

Ai GROUP

TABLE OF CONTENTS

FOREWORD

Foreword from Philip Marcus Clark AM

Industry-university collaboration is not one of Australia's strengths. We sit 29 out of 30 in OECD rankings for collaboration between the university sector and industry on innovation.

I appreciate that this is just one of the significant challenges facing the university sector, but it is important. It is also a matter which should be higher on industry's agenda.

Closer industry-university collaboration can be achieved without compromising the independence of universities or the important role they play in Australian society. It can also be achieved without distracting industry from their primary goals, indeed it will help achieve those goals.

Strong collaborative relationships don't just happen. They depend on commitment from all stakeholders. There is a role here for industry and universities and there is an important leadership role for Government.

In this context, industry is not just big business. SMEs must be encouraged and brought into the tent. The UK has managed to do this. We can too.

This report is a call to action for all stakeholders. I believe it will be an important catalyst in stimulating a discussion and debate of national significance.

On behalf of the ATN Research and Industry Advisory (ARIA) Board, I commend ATN universities on their initiative and I thank PricewaterhouseCoopers (PwC) for their work.

The next few years represent a watershed moment for our nation; over the past two decades, Australia has seen a marked and sustained deterioration in productivity. Falling productivity, in all sectors of the economy, will place a huge amount of pressure on Government and the taxpayer. By our own estimates, the combined annual deficits of Australian Governments will rise from 1.9 per cent of gross domestic product (GDP) in 2011-12 to 5.9 per cent by 2049-50, meaning that Government debt levels as a proportion of GDP will rise from 12.1 per cent to 77.9 per cent in the same period.[1] Two decades of consistent growth may have deferred some of the choices we now have in front of us as a nation.

This report is by no means the first to call this issue out, nor suggest that better collaboration in innovation is one of the surest ways to improve productivity. Yet we feel that across Government, universities and business, bold action is required in the next 12 months to set a platform for the transformation that we need. This report is a call to arms, offering practical steps that should be discussed by the three parties to spur action from each.

Fundamentally, this report seeks a clearer strategy for innovation to be set out by Government, with policy modifications that will support collaborative engagement. Simultaneously, universities and businesses must show vision and leadership to take up the challenge set out by Government. Higher education is becoming more competitive and those universities which can best demonstrate their value to students and business will benefit in financial and reputational terms. Likewise, in a globalised marketplace with increased disruption from more numerous and agile competitors, Australian businesses need to focus on their comparative advantages, working together to tackle more complex problems. Each group faces different challenges and has specific agendas relating to innovation, but there will need to be a shared and agreed approach to address the issues. They must take collective responsibility and be prepared to make difficult decisions together. Innovation, and therefore collaboration, will be vital to their long-term success but will require a degree of cultural change for industry and research alike.

PwC looks to support individuals and organisations from all three groups who have the resolution and foresight to act strategically and show leadership in collaborative innovation. We were delighted to be asked by the ATN to support the preparation of this report and we would like to thank those stakeholders who have helped inform the discussion on barriers and recommendations.

Manoj Santiago & Philip Le Feuvre, PwC

[1] PwC, Protecting Prosperity: Why we need to talk about Tax, 2014

EXECUTIVE SUMMARY

The continuation of Australia's economic growth is under threat. In order to sustain the levels of prosperity we have previously experienced, we have to build on our competitive edge in key industries to remain globally competitive. Alongside these developments, Australia's higher education system is under increased pressure to become more productive and develop courses that address employability.

Innovation represents the most reliable and sustainable solution to transition into a high value, high wage economy. Yet Australia ranks 29th out of 30 in the Organisation for Economic Co-operation and Development (OECD) in terms of the proportion of large businesses and small to medium enterprises (SMEs) collaborating with higher education and public research institutions on innovation[2].

[2] OECD, Science, Technology and Innovation Scoreboard, 2013

This report acts as the next level of detail to publications such as the Department of Industry's Boosting the Commercial Returns from Research report[3] and the Business Council of Australia's Building Australia's Comparative Advantages[4], which have highlighted Australia's poor performance in collaborative innovation. We present five recommendations that are a call to action to universities, industry and Government to take the necessary steps to build an innovation economy. They are not a call for additional funding from Government, rather a more effective way of using our existing resources.

PricewaterhouseCoopers (PwC) have engaged with leading figures from industry, including the Australian Industry Group (Ai Group), and partnered with the ATN to develop this five point action plan for Government, the university sector and industry[5] that will provide incentives and impetus for collaboration. Our recommendations include:

1 REBALANCE THE NATIONAL RESEARCH AGENDA TO UNDERPIN AUSTRALIA'S ECONOMY AND FUTURE PROSPERITY

2 CREATE INCENTIVES FOR UNIVERSITY-INDUSTRY COLLABORATION:

i) Reform the allocation of Research Block Grant funding to incentivise industry collaboration;

ii) Incentivise greater private investment in industry-engaged research, particularly via an R&D tax premium for expenditure on research in collaboration with universities; and

iii) Continue reforms to intellectual property that will enable Australian companies to access and commercialise the outcomes of research

3 TRAIN RESEARCHERS FOR DIVERSE CAREERS:

i) Integrate industry experience into the training of research students;

ii) Incentivise businesses to offer internships and employment to researchers; and

iii) Promote industry-focused PhD projects via co-creation of projects with end-users

4 ENHANCE CAREER MOBILITY BETWEEN INDUSTRY, ACADEMIA AND GOVERNMENT

5 PROVIDE INCENTIVES FOR CO-INVESTMENT IN RESEARCH INFRASTRUCTURE BETWEEN UNIVERSITIES, INDUSTRY AND STATE AND FEDERAL GOVERNMENT

Each recommendation contains a number of practical strategies for consideration by Government, universities and industry. The hope is that the report will encourage dialogue between the three groups and prompt bold policy changes in the coming 12 months and beyond.

[3] Department of Education and Department of Industry, Boosting the commercial returns from research, 2014
[4] Business Council of Australia, Building Australia's Comparative Advantages, 2014
[5] Industry in this report is broadly defined to include 'end-users' such as NGOs, public services, state-owned enterprises, and private entities.

1 INTRODUCTION AND OBJECTIVES

"Like almost every other advanced nation, Australia is experiencing a transition from a traditional base of heavy manufacturing towards the development of professional services, advanced manufacturing and high valued added production that reaches a global market."

Ian Macfarlane – Addressing the Sydney Institute

1.1. Why focus on collaboration?

Australia has enjoyed 23 consecutive years of growth and has developed a highly skilled and resilient economy. The need for diversification remains despite significant changes in the composition of Australia's industries during this period of growth. Since 1993, gross value added by industry has shifted, leaving a smaller manufacturing sector and larger business services industry.[6]

At the same time, the world is undergoing structural change as emerging countries industrialise and urbanise. The speed of technological advancement and globalisation has reduced trade barriers and increased competition from low cost economies.

Likewise the significance and composition of our trading partners has changed dramatically. While Europe remains Australia's largest two-way trading partner, China is now Australia's largest destination for exports.

Innovation provides Australia with a pathway to a competitive, high wage, high growth economy. Yet by most metrics, Australia ranks poorly in comparison to its counterparts in the Organisation for Economic Co-operation and Development (OECD) in terms of innovation. It is even more surprising given Australia's high quality and well regarded research sector, where it ranks ninth in research output per capita amongst OECD nations.[7] By not collaborating, public expenditure may be prioritised by the research sector in areas that are detached from the innovation needs of end users in industry and the community.

Innovation with partners is becoming increasingly important given the changes in the external environment. In the globalised economy it is difficult for individual businesses to achieve excellence and competitive advantage across a wide range of disciplines. As a result, there is an increasing shift from proprietary models of knowledge creation to an open source model that emphasises collaboration and sharing.[8]

[6] Office of the Chief Economist, Australian Industry Report, 2014

[7] Department of Education and Department of Industry, Boosting the commercial returns from research, 2014

[8] NSWBC, Industry-Research Collaboration Discussion Paper, 2014

"Technological improvements are changing how and where products are produced, and in doing so are forcing Australian firms to reassess their position along the global value chain."

Office of the Chief Economist – Australian Industry Report 2014

A number of high profile publications have sought to address the difficulties in converting research into commercial outcomes. Of the different factors at play, collaboration between the industry and research sector has consistently been raised as the 'Achilles heel' holding back Australia's innovation achievements. The figures available on researcher employment underline the issue: 60 per cent of Australia's researchers are employed within the boundaries of universities and public research institutes.[9] In comparison, Germany, Canada and Sweden have half that proportion, with business enterprise being the main employer of researchers.

The disconnection between the research agendas of industry and the university sector is acute. In 2010, businesses spent 52 per cent of their R&D outlay on engineering and 28 per cent on ICT. Correspondingly, universities spent 9 per cent on engineering and only 4 per cent on ICT. On the other hand, while universities spent 38 per cent of their research expenditure on medical and health sciences and biological sciences, the comparable figure for business is 6 per cent.

This lack of alignment is not conducive to the support of innovation and knowledge co-creation between industry and universities.

The evidence indicates that, when collaboration works, it has led to great results and successful innovations. The publication of 50 Solutions That Count[10] by the Australian Technology Network of Universities (ATN) has highlighted some of the instances where industry and research co-creation has produced a demonstrable return on public investment, positive outcomes for communities and sustainable commercial success. Further to this, the National Collaborative Research Infrastructure Strategy (NCRIS) has demonstrated that successful industry collaboration with researchers can be achieved. A collation of collaboration case studies are provided in the later sections of this report. While examples of successful, innovative collaboration between industry and universities can be found across Australia, taken as a whole, Australia underperforms in this space. As Professor Ian Chubb stated, "An issue for us is not effort, but scale."[11]

1.2 Objectives of the report

Our intention is not to duplicate the efforts of previous reviews by Government. This report accepts the barriers to collaboration and offers advice on action to break through these in the knowledge that further analysis and ratification by Government will precede policy decisions. The report's primary focus is on providing a set of practical and achievable recommendations which can be applied by Government, higher education and industry. Each recommendation has a set of actions. These actions offer the next steps for improvements in this area.

The mark of success for this report, therefore, will be the extent to which it:

- Challenges and offers methods for businesses to become more engaged with higher education research;
- Supports, informs and spurs Government policy changes related to research and development;
- Provides a voice to the ATN's member universities on a key topic that is in alignment with the group's mission; and
- Encourages higher education establishments to review their current practices and implement a range of practical steps to achieve greater collaboration.

[9] OECD, Science, Technology and Innovation Scoreboard, 2013

[10] http://www.atn.edu.au/Documents/Publications/ATN-web-LR.pdf

[11] Professor Ian Chubb, Top Breakthrough Actions for Innovation, 2012

1.3 Our approach

The evidence collected to inform the findings of this report comes from both desktop and primary research with key stakeholders. Our focus has been on engaging with a wide range of stakeholders to provide a representative overview of the issues, and responses to them, from the perspective of Government, higher education and industry. It is important to highlight that whilst we wanted a representative group, we targeted stakeholders within the key industries in which Australia has a comparative advantage. While there are a number of factors that contribute to innovation performance, this report specifically focuses on policy measures and actions that would lead to improvements in collaboration between industry and research stakeholders.

Recommendations have been co-developed with stakeholders, with significant consultation. They have also been prioritised according to their perceived impact. We have consciously avoided assessing the impact and potential costs and benefits of recommendations in quantitative terms – this report offers steps forwards for all parties which must be considered carefully before being acted upon.

We would like to thank the following organisations for their input and support:

Ai Group
Bayer CropScience
HealthEngine
GE
UTS: RESEARCH
Northrop Grumman
Carlton Connect Initiative
Bendigo and Adelaide Bank
KEECH
Australian Government Australian Research Council
Microsoft
Grattan Institute
Institute for Large Scale Innovation
Brandon Capital Partners
ceda
ACCI Australian Chamber of Commerce and Industry
BioPower Systems
UNSW NewSouth Innovations
Australian Government Department of Industry and Science
Australian Government Department of Education and Training

2

FINDINGS

"If there is a failing in Australia that is graphic, it is the lack of collaboration"

Ian Macfarlane, Minister for Industry, The AFR, 29 November 2013.

2.1 The benefits of collaborative innovation to our nation's competitiveness

Given the quality of research in Australia, even a small increase in our efficiency at converting research into innovation could produce substantial results. A report commissioned by Google indicates the value of the collaborative economy in Australia is worth $46bn.[12]

The benefits of collaboration are multi-faceted and different types of collaboration provide correspondingly differing benefits to stakeholders, such as:

- Collaborative research engagements can lead to new knowledge and product development;
- Student engagement with industry and presence in the workplace can lead to work integrated learning opportunities to improve the work readiness and employability of our graduates;
- Companies can create partnerships to help develop curriculum that is tailored to their future strategy;
- Companies gain early access to the best and brightest students; and
- Teachers can gain exposure to industry environments that improve the real life application of their work and therefore the quality and relevance of their teaching.

These are just some of the more obvious benefits of a more collaborative research system.

BENEFITS OF COLLABORATIVE INNOVATION: MINERALS FLOTATION CASE STUDY

The Ian Wark Research Institute (The Wark) is an international leader in minerals processing and surface chemistry research. As lead partner for the Australian Mineral Science Research Institute (AMSRI), The Wark developed a flotation model that increased the recovery and quality of minerals from fine and coarse particles.

Flotation is the most extensively used method worldwide to separate minerals from mineral resources. Increased efficiency to the flotation process, even small improvements of one to two per cent, can equate to millions of dollars in savings, depending on the size of the operation and the value of the mineral recovered.

In 2013, an independent report had found that the Wark has added $436 million value to the minerals industry. Previous reports have suggested that there is a further $118 million in expected value, and $412 million in future opportunity value, equating to almost $1 billion total industry benefit derived from the research.

The AMSRI is the largest single research grant ever awarded by the Australian Research Council and is supported by $26 million from industry, State and Federal governments and four participating universities. AMSRI also has 24 international collaborating partners.

[12] Deloitte, The Collaborative Economy, 2014

2.2 Factors driving our underwhelming collaboration performance

Misaligned incentives

The reward structure of our higher education system acts as a barrier to collaboration with industry. University promotion policies and other strategies such as the Excellence in Research for Australia (ERA) initiative are largely focused on the volume and quality of publications rather than industry engagement. Research excellence, as recognised by journal publications and citations, is the criteria on which universities are ranked amongst their international peers. High performing basic research amongst Australian universities has built our international reputation which has in turn contributed to international education being Australia's third biggest export earner. As such, universities place a high value on publications as a measure of research quality and impact. Yet there is little incentive and no imperative for these publications to focus on collaborative research; there is no weighting to industry-research engagement or even research outcomes such as job creation, patents and product income. While much of this research is doubtless excellent, with clear benefits for society, more research and publications should be geared towards positive outcomes from industry collaboration, which would demonstrate clearer returns on public investment.

The focus on publications also filters through to many of the funding bodies. Without a track record of publications in high ranking journals, it can be challenging for researchers and industry to secure much needed investment from funding bodies. This puts SMEs and universities who focus on industry experience over publications at a financial disadvantage.

Another more subtle factor is the application process for companies. It is generally academics, who may have little prior experience of commercialising research or comprehend the commercial application, who determine the fate of company applications. The Australian Research Council has offered further guidance and support in this area through Linkage Projects[13], but researchers' lack of experience in dealing with industry is clearly a systemic issue.

Finally, the R&D tax incentives remain general rather than targeted instruments to support investment in innovation. It does not specifically encourage collaboration and it is clear that only a small proportion of the claimed tax benefits relates to investment by companies in university research.

Differing priorities between university and industry

A common misconception is that the differing missions of universities and companies prevent them from engaging and working together. The reasoning stands, that any policy initiatives to improve collaboration will be fruitless due to the mind-sets of the parties involved.

All of our engagement with stakeholders and much of the literature consulted refutes this myth. Our stakeholders indicated that it is not the willingness that holds them back, but a number of impediments that require policy solutions to be addressed. Further, the GE Global Innovation Barometer shows a strong intention to carry out innovation through partnership.[14]

While the myth of a lack of appetite for collaboration should firmly be dispelled, it is important to consider the cultural differences which can affect collaboration. Universities are increasingly conscious of their economic role, yet they are rightly cognisant of their traditional core functions. Basic and strategic research should always remain a key part of university activity. Nevertheless, over time we have seen some universities extend their missions from teaching and research to include a third mission – driving external engagement, such as regional economic development.

It is also often stated, perhaps overstated, by companies that universities are not 'business-ready'. Additionally, the long-term time horizons often accepted in academia sit uncomfortably with an increasing focus on immediacy of results for business. Universities are often seen as overly bureaucratic by industry, while industry has been culpable in regarding collaboration as discounted R&D.

Many of these cultural differences are qualitative and subjective; nonetheless these perceptions have a serious and often negative impact on industry and academic relations which can suppress collaboration.

IP ownership and commercialisation issues

Universities have been criticised for being too protective of intellectual property attached to research carried out within the walls of the university. The argument stands that as research is predominately publicly funded it therefore should be owned by the university, for the benefit of the wider community. It is also justified that, in an environment where universities are relying more and more on varied revenue sources, they seek to protect the potential future income stream.

However, industry has claimed that universities do not have the capabilities or resources to commercialise research and therefore should not be the owners of this IP. A fairer assessment would be that many universities have taken too long to appreciate where they are unable to commercialise a product and thus relinquish ownership. Some universities are very capable and successful at commercialising research, but a universal assessment shows that unless this diffusion process happens, much of the knowledge created does not find its way into real market applications.

A number of universities are currently leading the way in research commercialisation partnerships. UNSW was the first university in Australia, and a very early adopter worldwide, in providing certain IP to companies free of charge under its Easy Access IP program.[15] This initiative has been replicated by others including the Queensland University of Technology (QUT), the University of Technology, Sydney (UTS), and Curtin University. While not necessarily the direction of travel for all universities, both higher education and business would benefit from clearer nationwide guidelines to ensure that IP ownership is in the hands of the party best qualified to develop the research, regardless of whether that represents shared or single ownership.

Issues of scale and size

Australia has over 2 million SMEs, accounting for slightly less than one-half of private sector industry employment and contributing approximately one-third of private sector industry value added.[16] SMEs also find barriers to innovation more challenging than larger companies; 65.8 per cent of micro businesses, 58.8 per cent of other small businesses and 63.1 per cent of medium businesses experienced barriers to innovation, while only 50.3 per cent of large businesses reported experiencing barriers to innovation.[17] SMEs often do not have the basic foundation of knowledge internally or the economies of scale that allow for successful engagement with research intensive universities. This is an access issue, but also one of 'innovation literacy', where research is not communicated in a practical and accessible format.

While the size of the average Australian business presents a barrier, so does the size of the industries. There is simply not sufficient scale and size in many industries to justify significant investment in innovation, which suggests the need for a more targeted approach. This is compounded by the fact that it is often the small and medium sized (SME) businesses in Australia, particularly those that cannot fund internal investment in innovation, that are paying the highest price for a lack of action on industry-university collaboration.

[13] http://www.arc.gov.au/ncgp/lp/lp_default.htm

[14] General Electric – Global Innovation Barometer, 2014

[15] http://www.nsinnovations.com.au/easy-access-ip

[16] DoI, Australian Small Business Key Statistics And Analysis, 2012

[17] DoI, Australian Small Business Key Statistics And Analysis, 2012

2.3 What is being done from a policy perspective to improve industry-research collaboration

Australia has already taken significant steps to develop a more collaborative environment and address these barriers to collaboration. These activities should be reviewed and replicated where applicable. Likewise, internationally we have much to learn from countries that have spearheaded collaboration for, in some cases, the past decade. We have chosen to share some of the responses to collaboration barriers that have been successfully deployed. These case studies have helped inform our own recommendations.

2.4 What role do Government, Industry and Higher Education take in facilitating collaborative innovation?

This report seeks a response from all three parties of the 'triple-helix'. It is necessary that their roles are outlined in broad terms before apportioning responsibilities.

Government

It is the role of Government to target public research funding on areas of National and industry research priorities, create the optimal policy conditions for collaboration and foster private sector investment in R&D. In broad terms, this means developing policy that can bring about systemic changes to the culture and research focus of public universities. Encouraging R&D in Australia through tax incentives that are well targeted and generated for meaningful research in partnership with universities and PhD graduates is a core role.

Universities

Universities have a significant role in achieving social objectives and public good through teaching and research as well as being drivers of economic growth. In the context of the Government's innovation and competitiveness agenda, universities have a responsibility to diffuse and develop excellent research into outputs which are beneficial for industry. In more practical terms the role of universities is to:

- Push the boundaries of research in areas relevant to the needs of the nation and where Australian industry is experienced and well-positioned to develop ideas;
- Disseminate and make available research that could have a commercial application for industry; and,
- Encourage collaboration and remain flexible and agile when working with industry.

Industry

Business is focused on creating value. It is here that commercialisation of research is vital. To become a world leader in collaborative innovation, industry must become more aware that investment in R&D in partnership with universities is not philanthropy, but a commercial opportunity. To allow for collaboration industry must consider:

- Seeking out long-term relationships with universities and remain open to co-creation;
- The role large business plays in supporting and growing its supply chain of SMEs;
- Supporting activities which attempt to increase researchers' time spent in industry; and
- Engaging fully in the debate and remaining informed about incremental changes that may offer opportunities for collaboration.

2.3.1 Domestic policy initiatives

Industry growth centres

Building on the work of the previous Government's Innovation Precincts, the Industry Growth Centres Initiative, due to be rolled out from 2015, aims to increase competitiveness and productivity by focusing on areas of competitive strength. The Initiative is ongoing with $188.5 million in Government funding over the first four years.

Crucially, the Initiative is focussing on five growth sectors outlined by Government as areas of comparative advantage; Food and Agribusiness, Mining Equipment, Technology and Services, Medical Technologies and Pharmaceuticals, Advanced Manufacturing and Oil, Gas and Energy Resources. As Growth Centres will be not-for-profit organisations led by industry leaders, they are designed to respond to regional and industry specific gaps and initiatives. Their boards will also include researchers and representatives from SMEs.

The Growth Centres therefore address a number of the barriers to collaboration as they represent;

- *Targeted activity and funding in sectors where Australia holds a comparative advantage*
- *A structure for engagement, as well as strategic support, of SMEs, large businesses and research to enhance collaboration*

ATN Industry Doctoral Training Centre in Mathematics and Statistics (IDTC)

The IDTC is an innovative four year doctoral training program in mathematics, which places industry experience and business skills for future employment at the forefront of the qualification. It is the only centre of its kind in Australia and has a national footprint, operating across all five ATN universities. The IDTC trains graduates in applied mathematical or statistical techniques, modelling methodologies and communication skills.

Industry based research projects are central to the IDTC, with doctoral candidates able to undertake a PhD level research project of critical importance to an industry partner, supported by academic supervisors and potentially with additional supervision from partner organisations.

This demonstrates how universities can take a leading and proactive role in the collaboration agenda.

China-Australia Free Trade Agreement (ChAFTA)

The conclusion of negotiations in the long-awaited trade agreement with China represents a significant move forward for Australian import and export prospects. ChAFTA will unlock major opportunities for Australia as China is Australia's largest export market for both goods and services, accounting for nearly a third of total exports, and a growing source of foreign investment.

Coupled with bold policy incentives to encourage foreign investment it could afford Australian companies and universities access to much needed capital that will support early stage innovation.

2.3.2 International policy initiatives

Defence Advanced Research Projects Agency (DARPA)

DARPA was created in 1958 in the United States as the Advanced Research Projects Agency (ARPA), a Government backed response to the Soviet Union's launch of Sputnik. The political and defence communities recognized the need for a high-level defence collaboration to spur world leading innovation.

Since its inception over 50 years ago, DARPA's list of achievements is unrivalled. DARPA is credited with being highly influential in the development of the Internet, which started with an idea to link time-sharing computers into a national system. Other outputs of the program include the Air Force F-117 tactical fighter (Stealth Fighter) and a significant role in the adoption of the M16 rifle as the U.S military's preferred individual weapon.

DARPA has a long history of industry collaboration and though the U.S. military was the original customer for DARPA's applications, the agency has been instrumental in creating a host of multibillion-dollar industries. Particularly impressive is the fact that DARPA doesn't have any laboratories of its own. Researchers and staff work at their respective organisations and meet at least twice a year to review progress and objectives. In addition, DARPA demonstrates a rapid 'return on investment' – projects are set with a 5 year upper limit, meaning companies and universities have short term horizons for their investment.

DARPA represents an impressive example of Government, industry and university collaboration with relatively small investment from companies and universities in projects with short timescales.

Innovate UK's Catapult initiative

In 2010 Innovate UK, Britain's flagship Technology Strategy Board, set out its Catapult program, designed to encourage economic growth. A Catapult is a technology and innovation centre where the best of UK businesses, scientists and engineers can work together on research and development. There are currently 7 Catapults and the most recent review of the program has called for expansion of the program.

The intention is that Catapults will be funded by;

- Business-funded R&D contracts, won competitively
- Collaborative applied R&D projects, funded jointly by the public and private sectors, also won competitively
- Core public funding for long-term investment in infrastructure, expertise and skills development.

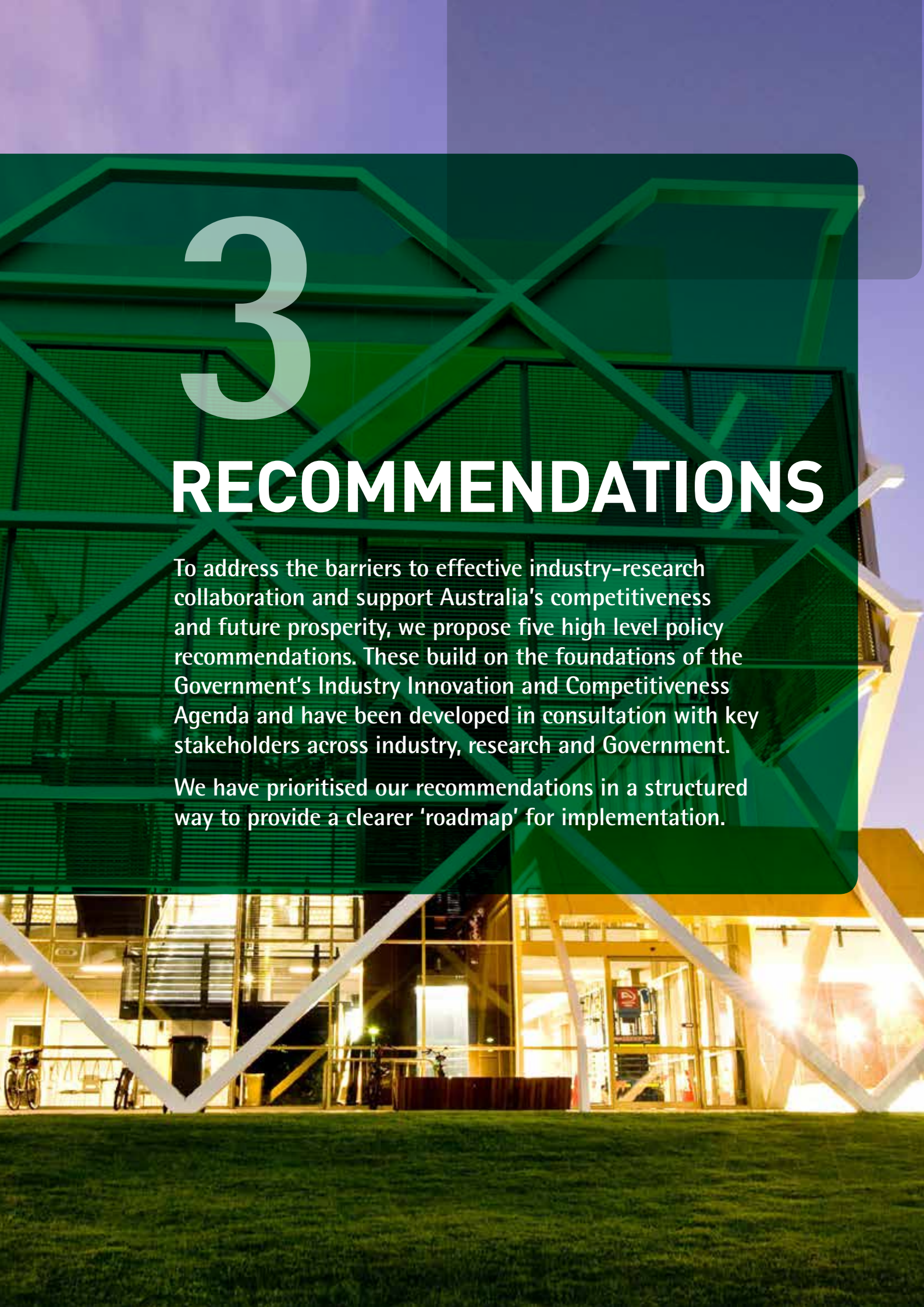
The Catapult program demonstrates the UK Government's enabling role in facilitating collaboration and commercialising of innovation – each centre, once established, will need to attract around £10m to £15m per annum from business to be viable, leveraging private sector investment to match state spending.

The Netherlands's Top Sectors and Tax incentives

In 2011 the Netherlands launched its Top Sectors program, targeting 9 areas in which that country excels globally. For each of these sectors, considerable effort and investment was made to create the right environment for innovation to flourish. This meant altering regulation and making policy adjustments to encourage international trade.

The initiative included amendments to the tax credit system to support companies engaged in innovation in these sectors. Practically it involved a fiscal incentive by the Dutch Government to compensate part of a company's labor costs, essentially a wage tax credit.

The Top Sectors policy exemplifies Government's influential role in maximising private sector investment through legislation. Relatively low active input from government has yielded significant returns.



3 RECOMMENDATIONS

To address the barriers to effective industry-research collaboration and support Australia's competitiveness and future prosperity, we propose five high level policy recommendations. These build on the foundations of the Government's Industry Innovation and Competitiveness Agenda and have been developed in consultation with key stakeholders across industry, research and Government.

We have prioritised our recommendations in a structured way to provide a clearer 'roadmap' for implementation.

1

REBALANCE THE NATIONAL RESEARCH AGENDA TO UNDERPIN AUSTRALIA'S ECONOMY AND FUTURE PROSPERITY

The imminent release of the National Research Priorities[18] by the Australian Government is highly anticipated by the university sector. The proposed priorities are intended to align areas of research excellence with Australia's industrial strengths, comparative economic advantages, social interests and global trends[19]. Both the National Research Priorities and Industry Growth Centres[20] are starting points for providing context and focus to ensure that the appropriate level of funding is directed into areas of critical importance.

The Government seeks to maximise outcomes from public research investment by concentrating funding in industry sectors that have a current economic strength or the potential to develop a globally competitive economic advantage. Industry and its peak body organisations must take leadership in consulting with the Government to identify key research and innovation challenges. Industry should be empowered by Government to approach universities and the research community to tender for industry-engaged research that is supported by public funding. The Industry Growth Centres, in particular, represent a good opportunity for business and research to request action from Government and hold them to account.

Public funding should flow to collaborative research partnerships between the university sector and industry that address the interconnected research priorities of both Government and industry. Industry, particularly SMEs, need not duplicate the investment in R&D resources and infrastructure to undertake research that already exists in the university sector. Targeting industries most likely to benefit from investment would increase support and incentives for private investors to engage in R&D. Universities and businesses could then align their short and long term strategies to respond to these opportunities. This would encourage new businesses and higher education providers to enter the marketplace, creating increased competition and productivity. Government policy should prioritise market centric innovation, supporting collaboration that involves the customer viewpoint in its approach as far as possible. In this way, innovation will be focused on tangible outcomes for the public good. For effective co-creation to occur, any policy initiative, such as the Industry Growth Centres, must be a three-way collaboration between Government, industry and universities.

There are two levels of imbalance in the current system of research and research funding in Australia. Firstly, Australia's industry profile is not reflected in our research, with an imbalance between our industry strengths and our research focus. For example, almost one third of all R&D expenditure in higher education institutions has been in medical and health research[21], while the number of Australian companies who can take medical innovations to market globally is relatively limited. It is clear that medical and health research has been underpinned by significant investment by Government, and has led to many beneficial outcomes for Australia. However, there needs to be similar levels of investment into industries where Australia has competitive advantage and economic strength. Targeted levels of investment would create opportunities for industry-university research collaboration outside of the medical sector.

Secondly, there is misalignment in the research agendas of industry and the university sector. In 2010, businesses spent 52 per cent of their R&D outlay on engineering and 28 per cent on ICT. Correspondingly, universities spent 9 per cent on engineering and only 4 per cent on ICT. On the other hand, while universities spent 38 per cent of their research expenditure on medical and health sciences and biological sciences, the comparable figure for business is 6 per cent. This lack of alignment is not conducive to the support of innovation and knowledge co-creation between industry and universities. The Australian Government currently spends $9.2billion pa including the R&D tax concession. Businesses spend between $18-19 billion per annum on R&D. Yet only $700 – 800m is spent on university research, when more than 60 per cent of researchers are located in universities. This is a missed opportunity and incentives need to be realigned to ensure better balance.

It is essential that the National Research Priorities are detailed, measurable and have clear timescales associated with them. We recommend that each research priority have a 5, 10 and 20 year set of sub-targets to allow periodic assessment. We also note that there needs to be consistency in National Research Priorities over a long period of time, to ensure certainty for those wishing to invest and engage with them.

[18] http://www.chiefscientist.gov.au/2014/11/commonwealth-science-council/

[19] http://www.chiefscientist.gov.au/wp-content/uploads/STRATEGIC-SCIENCE-AND-RESEARCH-PRIORITIES_181214web.pdf

[20] http://www.business.gov.au/advice-and-support/IndustryGrowthCentres/Pages/default.aspx

[21] http://www.abs.gov.au/ausstats/abs@.nsf/mf/8111.0/

2

CREATE INCENTIVES FOR UNIVERSITY-INDUSTRY COLLABORATION

Along with the prioritisation of key industries, we recommend reform to the ways in which collaborative innovation is funded and financed. These recommendations are intended to encourage greater levels of research collaboration between publicly funded research organisations and industry. Further, we support the continuation of existing funding mechanisms such as the Commercialisation Fund, albeit with funding realigned to the National Research Priorities. Our recommendations seek to increase and maximise private investment, including foreign capital investment. In particular, we see the benefit of encouraging investment in innovation at its earliest stages. Therefore our recommendations are:

i. Reform the allocation of Research Block Grant funding to incentivise industry collaboration

In 2015, the Commonwealth Government will distribute approximately $1.8bn in Research Block Grants (RBGs) to Australian universities – with $786m to support research and $980m to support the research training of Master and PhD students. Master and PhD students make an enormous contribution to the research effort of the Australian Higher Education sector and increasing the industry engagement in their training is the focus of Recommendation 3.

At present the over three-quarters of a billion dollars in RBG committed to support research is allocated via a series of complex formulae, which rewards universities with a strong performance in traditional measures of research 'excellence' such as publications and income derived from competitive research grants. Funding is divided between a number of schemes and programs which provides research training for Higher Degree Research students and supports basic, fundamental research (research excellence).

Data used in the Research Block Grant funding model which recognises 'industry engaged' research (supported by non-Australian CompetitiveGrants) is less significant than the component recognising research excellence. To create a better balance between academic excellence and industry engagement – and realising that good commercial outcomes arise from quality research – we recommend that the Government rebalance the RBG to provide more incentives for industry engaged research.

It is acknowledged that basic research is essential to the long term success of innovation and has wider societal benefits; therefore its funding should be protected. We also propose no changes to research-training related block grants and scholarships such as the Research Training Scheme (RTS), the Australian Postgraduate Awards (APA) and International Postgraduate Research Scholarships (IPRS). These grants are important to ensure continued support for the training of research students. However, we recommend the strategic realignment of the RBG incentives to a balance of 50:50 between excellence and (industry) engagement. This maintains support for Australia's world leading academic research effort, increases incentives for university researchers to undertake research directly with industry and, importantly, provides incentives for the spectrum of research activity in between. To implement this strategic realignment will require further, detailed, work which should have at its heart a drive to simplify the allocation formulae to increase both transparency and the

effectiveness of the incentives. We believe that such changes to the RBG system will increase industry – university collaboration and also ensure that the Australian community gets the right return on its collective investment in research through the RBGs.

This report also recommends the adoption of an industry engagement metric that highlights effective R&D collaboration between universities and industries. This would encourage researchers and universities to engage in industry research. The independent ATN Research Industry Advisory (ARIA) Board has been developing a broad suite of metrics to facilitate this process and the Academy of Technological Sciences and Engineering (ATSE) have also been working to progress an industry engagement metric that can be applied to currently available data.

ii. Incentivise greater private investment in industry-engaged research, particularly via an R&D tax premium for expenditure on research in collaboration with universities

The Government is presently implementing legislative change to the R&D tax incentive ahead of the taxation white paper process that promises to reform the taxation system in Australia. We would encourage the Government and the Department of Treasury to analyse the costs and benefits of an R&D tax incentive premium for companies that collaborate with universities in their research and development.

We believe that there are savings for industry and Government in utilising the existing resources and infrastructure across the university sector. Access to university skills and infrastructure presents increased options for companies in terms of research and development opportunities. Duplication and reimbursement of investment by individual firms may not be in the best interests of the taxpayer or the company if there is a commercially viable alternative possible through collaboration with universities. We recommend that companies be reimbursed at a higher rate for R&D expenditure that involves partnership with universities than for research that is undertaken internally.

Acknowledging that this could be a complex process to manage, we encourage a strengthening of the R&D tax incentive for work undertaken by a PhD graduate for a period of three years post-graduation. PhD students should be encouraged to work closely with their university and with the broader research community to help disseminate and create new and innovative ideas in industry and to strengthen links between these communities.

The long term sustainability of innovation can best be ensured if private investment accounts for a growing proportion of its financing. Private investment will naturally have a high demand for outcomes and results deriving from their investment. As a result we recommend a series of policy adjustments to foster investment from the private sector and individuals. This paper is not seeking a net increase in financial support from Government, yet a number of the recommendations will incur significant costs. These can only be balanced out if private sector investment is increased and used in a more targeted way. Options could include:

- *Review of the R&D Tax Incentives in the next Tax White Paper to make sure they promote the desired behaviours – previous incentives increased research, which has been successful and positive. Future policy intent should be to increase collaboration. Some of the existing rules dictating taxes in R&D mean that ventures which have 39 per cent ownership by universities may not benefit from tax relief and are therefore working as a disincentive to collaborate. Government should consult with industry and higher education to make sure the tax system facilitates collaboration. In addition, new tax incentives could be introduced to encourage university-industry collaboration;*
- *Explore the introduction of lower interest rate loans for SMEs who are collaborating with higher education within the national research priorities. Alternatively a lower regulatory burden for partnering with publicly funded research organisations (PFRO);*
- *Consider altering the significant investor visa system in order to attract investment from high net worth individuals from abroad. A key step in making it easier for wealthy foreigners to invest in the early stages of R&D and innovation is by allowing them simple and dependable entry rights;*

SUGGESTED ITEMS FOR THE WHITE PAPER ON TAX REFORM

The upcoming White Paper represents an opportunity to optimise the current environment for private sector investment in R&D and warrants further exploration. We recommend that government considers;

- Increasing the rate of the refundable R&D Tax Incentive for SMEs to provide a greater incentive for small companies to undertake technologically challenging developments and offset the high cost/unavailability of capital for these companies.
- Extending the availability of the refundable R&D Tax Incentive to firms with turnover up to $50m and less than 10 years since incorporation. These early-stage companies have significantly more capacity to invest in R&D than smaller firms (due to cash flow and overall cost of capital) yet may not be in a position to realise the benefits of the non-refundable R&D Tax Incentive due to substantial tax losses incurred in the start-up phase.
- Allowing the R&D Tax Incentive benefit concessionary franking treatment. Under the current program, companies are unable to provide a franked return of the R&D benefit to shareholders, leaving the shareholders liable for personal income tax that effectively recoups the entire R&D Incentive. As a result, the market discourages companies from investing in R&D in favour of less risky investments with more tax effective returns. To improve engagement in R&D, the R&D Tax Incentive should attract concessionary treatment that allows the benefit to be distributed either fully franked or partly franked to shareholders.
- Using average turnover over a number of years to determine eligibility for the refundable R&D Tax Incentive rather than turnover in the income year to ensure that SMEs transition smoothly to the non-refundable R&D Tax Incentive rather than disrupting cash flow as soon as their turnover is over $20m.

[22] http://www.atse.org.au/atse/content/activity/innovation-content/developing-impact-engagement-australia-metric.aspx

[23] http://www.business.gov.au/grants-and-assistance/closed-programs/iif/Pages/IIF-VentureCapitalInAustralia.aspx

- *Review whether the environment for venture capitalist investment can be improved. Many of the necessary steps have already been taken to encourage venture capitalism in innovation. The Innovation Investment Fund[23], which supported companies through the high risk process, made good progress in this area. Emerging venture capital firms require policies that will provide for improved returns and signal to others that the benefits outweigh the risks to encourage more investment in future. Organisations such as AVCAL should be consulted in advance of the next Tax White Paper;*
- *Explore the introduction of Self-managed Super Fund investment in early stage R&D. Much like tax incentives and loans above, SMSFs should receive incentives for investing in collaborative innovation linked National Research Priorities. This could be extended to the creation of a venture capital fund supported by retail superannuation funds under similar circumstances; and*
- *Scope the introduction of 'research/commercialisation' bonds. New and innovative funding mechanisms for innovation should be sought. While they would require significant analysis and testing, we recommend broadening the base of private investment. One idea worth considering is that of 'research bonds' with 10 and 20 year maturities, set at a compelling, below market interest rate, which could convert into a standard 10 year Federal Government bond upon maturity. Australia would be the first to introduce something like this, but it presents an inventive way to microfinance innovation.*
- *Future budget considerations permitting, we argue for a single research fund across all priority areas with a charter that can be reviewed regularly and directed at areas in line with the greatest national need, rather than one focused solely on medical research. The Research future fund would have a set of strategic imperatives and would provide long term support for innovation. To ensure viability of this fund, significant private investment could also be leveraged to deliver our national priorities.*

iii. Continue reforms to intellectual property that will enable Australian companies to access and commercialise the outcomes of research

Businesses and universities need a more solid foundation from which to build agreements on, as the application of the current IP framework presents issues. A decade ago the UK introduced a set of 5 standard university and business IP agreements, dubbed the Lambert Toolkit. While in many cases the agreements were tweaked to suit the specifics of the case, the Toolkit provided a reference point for both parties to help frame the negotiations. We recommend a similar framework be agreed and diffused across Australia.

Universities and businesses also need to be able to select the right way forward for their particular case – licensing will be more appropriate in some instances, equity in others. However, best practice should be shared and the case should be made for the benefits of licensing as well as equity.

3 TRAIN RESEARCHERS FOR DIVERSE CAREERS

Australia is unusual amongst high performing OECD counterparts in having a low proportion of university researchers, including PhDs employed in industry. Industry experience fosters commerciality amongst researchers, builds relationships and understanding between business and universities, leads to long-term employability and ultimately increases innovation efficiency. It should, therefore, be central to all appropriate courses. Therefore, our recommendations are to:

i. Integrate industry experience into the training of research students

We recommend that an industry experience component is incorporated into the training of students at all levels, including a percentage of research students and PhDs. In relation to PhDs, programs such as the ATN's Industry Doctoral Training Centre (IDTC) provide a blueprint for how such qualifications can be constructed and delivered in the future. Given the changes afoot in higher education, there is an opportunity to create courses that have clear employment pathways at the forefront of their value proposition. For undergraduate courses, the Chief Scientist's call for "at least 50 per cent of STEM undergraduate students completing a work-related placement or project" should be adopted.

Australia needs to embed industry experience in research related courses. Universities can take the lead in developing such courses and placement opportunities, supported by both Government and industry. While we have called on universities to take a leading role in this, we also recommend Government create opportunities for work experience. The Government's New Colombo Plan, which aims to lift knowledge of the Indo Pacific in Australia by supporting Australian undergraduates to study and undertake internships in the region, provides a good model on which a National Internship in Industry program could be formed. Such an internship program should be linked to a wider skills plan set out by the Industry Growth Centres. Furthermore, if the Research Training Scheme is reviewed, Government should look at ways to encourage supervisors from industry as well as traditional academic supervisors to better address national research and industry needs.

ii. Incentivise businesses to offer work experience and employment to researchers

From an industry perspective, more needs to be done to encourage the employment and engagement of researchers. Currently there is a lack of incentives to attract businesses to employ PhDs and graduates, even on a part time basis. Although our goal is to increase participation of researchers in industry in any capacity, it is noted that greater success will be achieved if it is via paid employment. A practical example to review and perhaps replicate can be found in Canada, where regional Government has implemented a Co-operative Education Tax Credit (CETC). For each qualifying work placement ending in the taxation year, an eligible employer may claim a refundable tax credit for eligible expenditures incurred. More generally, many of our stakeholders called for a review of employment regulations to reduce the cumbersome red tape that exists around employing individuals for internships and part-time work in industry.

Employers of PhD students should be rewarded via an R&D tax incentive, as was highlighted in the previous recommendation. Tax incentives should assist Australia's SMEs and acknowledge the resource intensiveness of supporting the training of students in an industry setting. Based on the findings of past research, SMEs generally find barriers to innovation more challenging to overcome than larger companies. Access to publicly funded research and university researchers should be an area of focus going forward. Initiatives such as the 'STEM flying squad' proposed by the Chief Scientist should be piloted. This would see recent PhD graduates placed in an SME for no longer than a month to identify where the SME could improve their products or services. It may also encourage researchers to seek employment in fledgling companies, which require the best talent to become world beating start-ups.

Other support initiatives that will further SMEs interaction with university researchers relate to co-location, which will be addressed in recommendations four and five.

iii. Promote industry-focused PhD projects via co-creation of projects with end-users

To ensure we are training researchers for diverse careers, developing PhD topics with end users provides those students with research that is valuable to industry and a partner that is engaged throughout the duration of their degree. It will likely lead to enhanced job opportunities as they will have skills valuable to both a career in industry and academia at the completion of their degree.

The ATN currently operates this model through its Industry Doctoral Training Centre, where each PhD student develops their topic in consultation with both industry and their academic supervisor.

This report recommends that this approach be adopted at scale, noting that this would require investment from both universities and industry.

4

ENHANCE CAREER MOBILITY BETWEEN INDUSTRY, ACADEMIA AND GOVERNMENT

Currently success for academics is largely measured by the quality and quantity of publications and other metrics that capture research excellence. Industry experience for academics is less prolific in Australia relative to other OECD nations despite it being needed in order to build a workforce capable of identifying and addressing industry research challenges and commercialising innovation. Changes to the research block grants, as proposed in recommendation 2, will enable universities to place a greater focus on industry engagement without suffering financial consequences.

We recommend that much greater opportunities are provided for academics to work within industry and Government and vice-versa. The benefits of enhancing the mobility between employees in industry, universities and Government include:

- A better understanding and knowledge of each sector;
- Improving links and working relationships; and
- Reforming career opportunities and pathways.

A number of Congressional Fellowship opportunities are available in the US, which expands public knowledge of Congress and its related legislative processes. For example, the Congressional Fellowship programs run by the American Political Science Association (APSA) offers political scientists, journalists, federal executives and international scholars a nine-month work placement on congressional staffs. Teaching political process through practical experience means that when fellows return to their jobs, they are better equipped to engage with public policy and improve interaction with Government in their respective disciplines.

Within Australia, secondment agreements between universities, industry and Government could be utilised to build career mobility between sectors as a first step. Universities could look to industry more often when recruiting. Further, by using university researchers rather than in-house researchers, industry will better be able to utilise the broad multi-disciplinary expertise found in a university setting which drives innovation and presents complex solutions. From a government perspective, secondment agreements mean that researchers and industry would be better informed about policy formulation and the drivers of the national agenda.

Given the lack of incentive for university-industry collaboration (as highlighted in previous recommendations), it is important that researchers undertaking industry placements are acknowledged in areas such as promotion procedures and applications to funding boards. Recognition for mobility should be valued and considered in addition to more tangible outcomes such as publications and meeting funding targets.

5

PROVIDE INCENTIVES FOR CO-INVESTMENT IN RESEARCH INFRASTRUCTURE BETWEEN UNIVERSITIES, INDUSTRY AND STATE AND FEDERAL GOVERNMENT

We believe that world-class research infrastructure is essential to underpin innovation and commercialisation in Australia in the years ahead. This was supported in the findings of the Commission of Audit[24] released in early 2014 that recognised 'quality research infrastructure is a critical component of Australia's research and development system.'

Universities are not only home to human capital, but also world-class research infrastructure that represents billions of dollars in collective investment by successive Governments. Additionally, most Australian universities have facilities in prime areas, often surrounded by their current and potential industry stakeholders.

These world-class facilities promote collaboration. SMEs should be allowed to invest in this type of infrastructure to promote collaboration and foster innovation. It should also be noted that this investment does not have to be financial, but could be in-kind contributions. We should be endeavouring to increase the level of industry engagement using these research facilities to drive innovation, particularly in areas of national interest. It could also provide a strong three-way partnership between industry, universities and government – recognising that there are many beneficiaries of world-class research and collaboration. A number of case studies of successful industry collaboration in NCRIS are provided as an appendix to this report.

Voucher systems provide funding to help industry gain access to research infrastructure, services and knowledge they may otherwise not have the necessary resources to access. Technology based voucher systems such as the Victorian Government's Technology Development Voucher and the South Australian Government's Innovation Voucher Program provide start-up funding for SMEs to translate inventions into commercial products. Vouchers support a transaction between a company and a supplier with money directed at the supplier, rather than the company[25]. There have been varying degrees of success in the use of generic voucher systems to allow industry access to world-class infrastructure. However, targeted voucher systems have been more successful. We recommend that these schemes are continued and targeted in areas where investments are being made in university-industry collaboration.

Universities and large companies in Australia not only have extensive knowledge banks and infrastructure that can be leveraged, they also have well developed international networks that could be utilised in the co-creation of innovative research and assist smaller companies to grow and to move up the value chain. It should be recognised by SMEs and Government that innovation increasingly requires global collaboration and networks that local industry can access via a university partner.

A large, tangible framework of infrastructure in both CBD and regional settings provides opportunities for co-location and integration of industry and researchers, as is more common in the business parks of North America and Europe. A similarly expansive network of international partnership agreements means that Australia's SMEs and start-up enterprises have access to resources and technology that would be otherwise inaccessible.

The diversity of the location of public universities, including those in regional centres of Australia, means that a large spectrum of different sectors can have access to relevant infrastructure. Within CBD location, vibrant innovation 'villages' in which students, researchers and industry work in close proximity, will also be advantageous for collaboration.

The authors of this report are cognisant that a review of higher education infrastructure is currently underway. Building and maintaining world-class infrastructure is expensive but vital. It is crucial that private sector financing is considered in this review, particularly if the use of such infrastructure by industry is to grow in future through the implementation of these recommendations.

[24] http://www.ncoa.gov.au/

[25] http://www.vipac.com.au/edm/seminar-downloads/r-and-d-seminar_roland-diggens.pdf

4

ACKNOWLEDGEMENTS

We would like to extend our thanks to the ATN DVCR Working Group and the ATN Research and Industry Advisory (ARIA) Board for their input:

ATN DVCR Working Group Members

Professor Tanya Monro (Deputy Vice Chancellor, Research and Innovation, University of South Australia, UniSA)

Professor Arun Sharma (Deputy Vice Chancellor, Research and Commercialisation, Queensland University of Technology, QUT)

Professor Graeme Wright (Deputy Vice-Chancellor, Research and Development, Curtin University)

Professor Glenn Wightwick (Deputy Vice-Chancellor and Vice-President Research, University of Technology, Sydney, UTS)

Professor Calum Drummond (Deputy Vice Chancellor, Research and Innovation and Vice-President, RMIT)

ATN Research and Industry Advisory (ARIA) Board Members

Philip Marcus Clark AM ((Member of the J P Morgan Advisory Council and Chair of the ARIA Board)

Dr Peter Burn (Director-Public Policy, Ai Group)

Greg Stone (Chief Technology Officer, Microsoft Australia)

Dr Laurie Hammond (Board Member Innovation Australia)

Sally Coutts (Manager Research – Crisis Services, Salvation Army)

Professor David Parry (Principal Advisor – Environment, Rio Tinto)

Dr Paul Vogel (Chair of WA EPA)

Dr Bronwyn Evans (CEO Standards Australia)

Chris Leptos AM (Non-Executive Director)

Colin Beckett (Chancellor Curtin University)

Professor John Dewar (Vice-Chancellor, La Trobe University and Chair of the IRU)

We would also like to thank all participating universities, Government agencies, peak bodies and companies who generously gave up their time to contribute to this report:

Innes Willox (Chief Executive, Australian Industry Group)

Aidan Byrne (Chief Executive Officer, Australian Research Council)

Kate Carnell AO (Chief Executive Officer, Australian Chamber of Commerce and Industry)

Professor Ian Chubb AC (Chief Scientist for Australia)

Dr Kevin Cullen (Chief Executive Officer, New South Innovations)

Geoff Culbert (President and CEO, General Electric)

Dr Timothy Finnigan (Chief Executive Officer, BioPower Systems)

Herbert Hermens (Chief Executive Officer, Keech Australia)

Mike Hirst (Chief Executive Officer, Bendigo Bank)

Ian Irving (Chief Executive, Northrop Grumman)

Professor the Hon. Stephen Martin (CEO, Committee for the Economic Development of Australia)

Dr Jim Minfie (Grattan Institute)

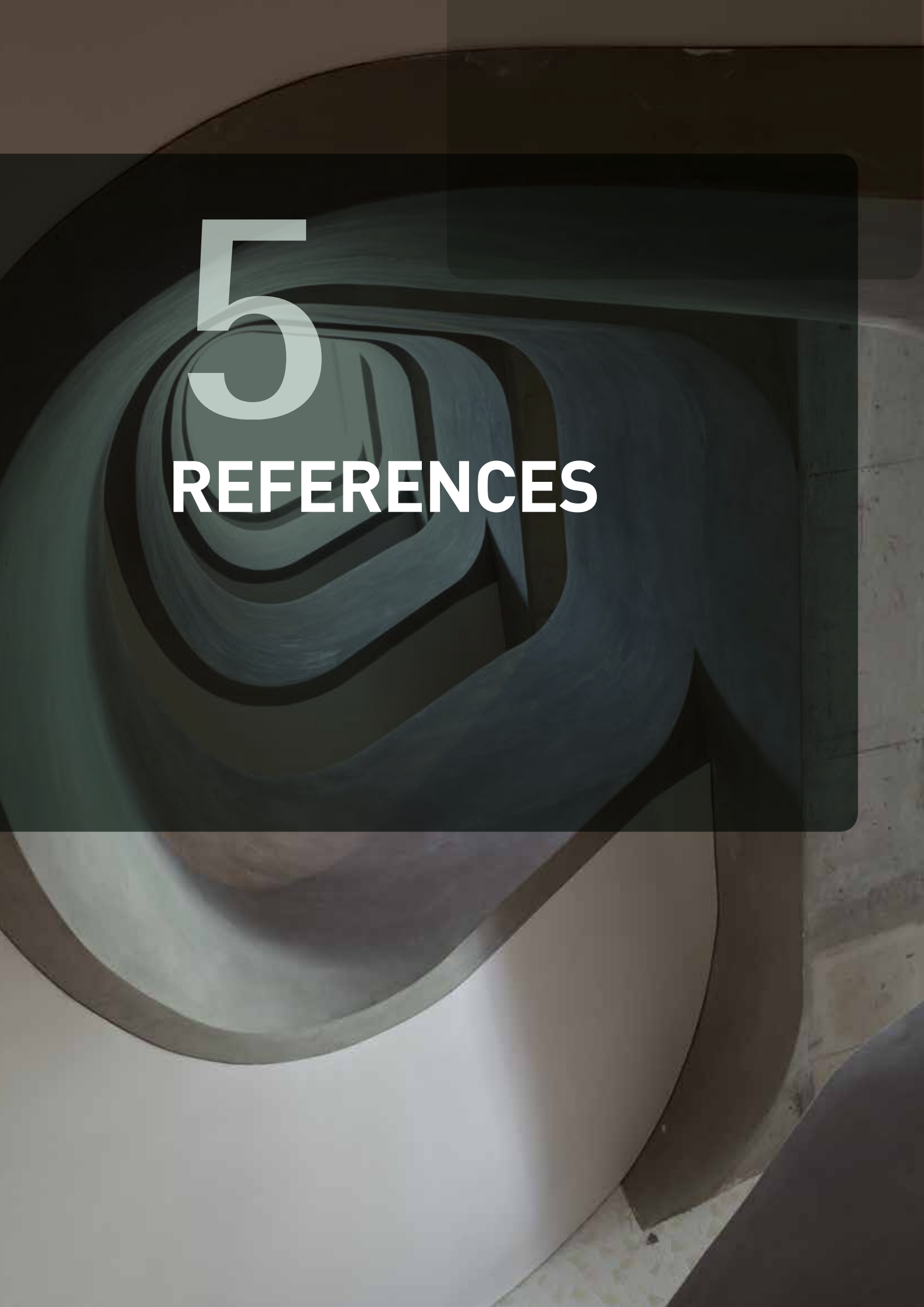
Eric Ruggirello (Chief Financial Officer, Bayer Cropscience)

Lisa Schofield (Department of Industry and Science)

Dr Marcus Tan (CEO and Medical Director, HealthEngine)

Stephen Thompson (Managing Director, Brandon Capital)

Dr Charlie Day (The Carlton Connect Initiative)



5 REFERENCES

ABS 2013, Research and Experimental Development: business, Australia, 2011–12, Cat. no. 8104.0, Australian Bureau of Statistics.

ABS 2014a, Research and Experimental Development: government and private non-profit organisations, Australia, 2012–13, Cat. no. 8109.0, Australian Bureau of Statistics

ABS 2014b, Research and Experimental Development: higher education organisations, Australia, 2012, Cat. no. 8110.0, Australian Bureau of Statistics.

Australian Government 2014a, Industry Innovation and Competitiveness Agenda: An action plan for a stronger Australia, Commonwealth of Australia. **http://www.dpmc.gov.au/publications/Industry_Innovation_and_Competitiveness_Agenda/index.cfm**.

Australian Government 2014b, Science, Research and Innovation Budget Tables 2014–15, Commonwealth of Australia. **http://www.industry.gov.au/AboutUs/Budget/Documents/SRIBudgetTables2014-15.pdf**.

BCA 2013, Action Plan for Enduring Prosperity, Business Council of Australia. http://www.bca.com.au/publications/action-plan-for-enduring-prosperity-full-report.

BCA 2014, Building Australia's Comparative Advantages, Business Council of Australia. **http://www.bca.com.au/publications/building-australias-comparative-advantages**.

BCG. (2014). The Shifting Economics of Global Manufacturing: An Analysis of the Changing Cost Competitiveness of the World's Top 25 Export Economies. Retrieved from **http://www.slideshare.net/TheBostonConsultingGroup/bcgglobal-mfg-cost-competitivenessindex-final**.

Committee for Economic Development of Australia (CEDA) 2014, Advanced Manufacturing: Beyond the Production Line. Sydney, Australia: Author. Cornell University, INSEAD & WIPO 2014,

The Global Innovation Index 2014: the Human Factor in innovation, Fontainebleau, Ithaca and Geneva. **https://www.globalinnovationindex.org/content.aspx?page=GII-Home**.

Department of Education and Department of Industry 2014, Boosting the commercial returns from research, Commonwealth of Australia. **http://www.education.gov.au/news/discussion-paperboosting-commercial-returns-research-released**.

Department of Industry 2013, Australian Innovation System Report 2013, Department of Industry.**http://www.industry.gov.au/science/policy/AustralianInnovationSystemReport/AISR2013/wpcontent/uploads/2013/11/AIS-Innovation-Systems-Report-2013-v3.pdf.**

General Electric 2013, Global Innovation Barometer – Focus Australia. Retrieved from **http://files.publicaffairs.geblogs.com/files/2013/01/Australia_IBReport1.pdf**.

General Electric 2014, Global Innovation Barometer: Retrieved from **http://www.ideaslaboratory.com/projects/innovation-barometer-2014/**

National Commission of Audit 2014, Towards Responsible Government: The Report of the National Commission of Audit (Phase One). Retrieved from **http://www.ncoa.gov.au/report/docs/phase_one_report.pdf**.

NSW Business Chamber 2014, Industry Research Collaboration Discussion Paper. Sydney, Australia: Author.

OECD 2013, OECD Science, Technology and Industry Scoreboard 2013: innovation for growth, OECD Publishing. **http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-andindustry-scoreboard-2013_sti_scoreboard-2013-en**.

OECD 2014, OECD Science, Technology and Industry Outlook 2014. **http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-outlook-2014_sti_outlook-2014-en**.

Office of the Chief Scientist 2014, Science, Technology, Engineering and Mathematics: Australia's future, Office of the Chief Scientist. **http://www.chiefscientist.gov.au/wp-content/uploads/FINAL_STEMAUSTRALIASFUTURE_WEB.pdf**.

Piacentini, A. 2013, A New Format to Promote Innovation: The University Industry Partnership. Adelaide, Australia: Department of Premier and Cabinet South Australia.

Sharma, A. 2013, Universities Need to Address Disconnect Between Research and Industry Needs. Australian Financial Review, 16 September 2013.

Universities Australia 2014, University Research: Policy Considerations to Drive Australia's Competitiveness. Canberra, Australia: Author.

World Economic Forum 2014, The Global Competitiveness Report 2014-2015. Geneva, Switzerland: Author.

Hauser, H. 2014, Review of the Catapult network. London, United Kingdom: Department for Business, Innovation and Skills

Mazzarol, T. 2014, Commercialising university research: a good but costly move. The Conversation, 25 August 2014. Retrieved from **http://theconversation.com/commercialising-university-research-a-good-but-costly-move-30453**

The Australian Government Competition Policy Review, 2014, Competition Policy Review – Draft Report. Canberra, Australia: Author.

The Australian Government Cooperative Research Centres, 2014, Program Review Discussion Paper. Canberra, Australia: Author.

Deloitte Access Economics 2014, Australia's Innovation Imperative – Business Council of Australia. Sydney, Australia: Author.

Deloitte Access Economics 2014, Get out of your own way – Unleashing Productivity. Sydney, Australia: Author.

Bucolo, S and King, P. 2014, Design for manufacturing competitiveness. Australian Design Integration Network (ADIN).

General Electric 2014, Australian Mid-Market Report 2014. Retrieved from **http://www.gecapital.com.au/knowledge-hub/2014/mid-market-report.html**

The Group of Eight (G08) 2012, The University-innovation nexus in Singapore. Canberra, Australia: Author.

Esposito, M. 2014, Microeconomics of Competitiveness. Harvard Business School.

Innovative Research Universities, 5 Supporting Materials: Innovation and Economic Transformation: The Role of Universities. Retrieved from **http://iru.edu.au/media/50682/5%20economic%20transformation%20-%20collated.pdf**

Office of the Chief Scientist 2012, Top Breakthrough Actions for Innovation, Office of the Chief Scientist. **http://www.chiefscientist.gov.au/wp-content/uploads/Item_3-Breakthrough-Actions.pdf**

Minerals Council of Australia 2011, Minerals Council of Australia – Submission to the Australian Governments Consultation Paper, Minerals Council of Australia. **http://www.mineralscouncil.com.au/file_upload/files/submissions/MCA_Higher_Edcuation_Base_Funding_Review_Submission_300411.pdf**

Lydon, J., Dyer, D., Bradley, C. 2014, Compete to Prosper: Improving Australia's global competitiveness. McKinsey and Company.

Carr, K. 2014, National innovation agenda essential for manufacturing to flourish. The Australian, 17 September 2014.

PhilipsKPA. 2014, Engaging employers in work integrated learning: Current state and future priorities. Richmond, Australia. Department of Industry.

PwC Australia 2014, Rethinking innovation in industrial manufacturing – are you up for the challenge?. Sydney, Australia: Author.

Parker, R. 2014, Submission to inquiry into the Australian innovation system. Brisbane, Australia: Queensland University of Technology

Morgan Jones, M., et. al. 2014, Assessing Research Impact: An international review of the Excellence in Innovation for Australia Trial. RAND Europe

Australian Government 2014, Competition Policy Review, Commonwealth of Australia. **http://competitionpolicyreview.gov.au/files/2014/09/Competition-policy-review-draft-report.pdf**.

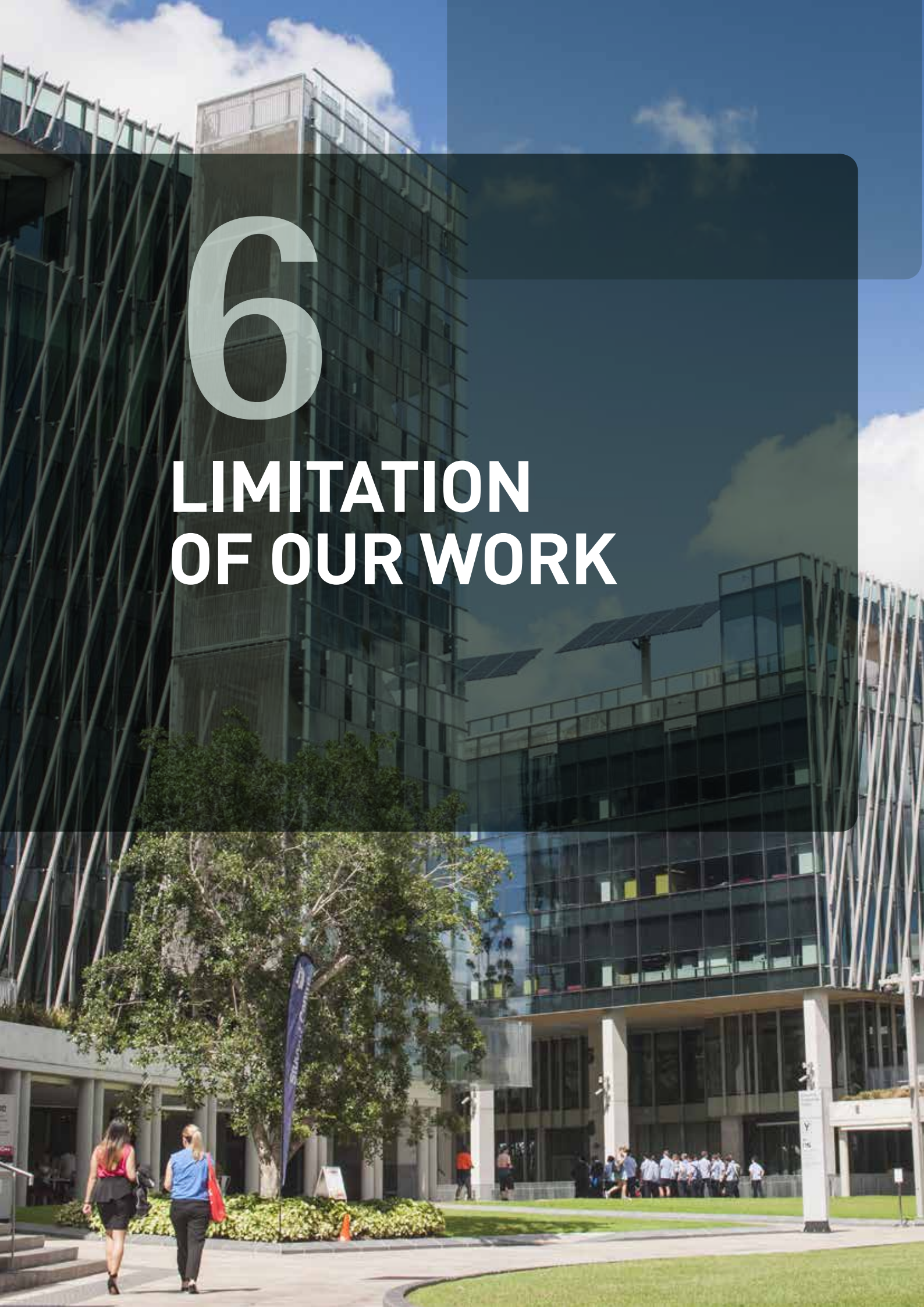
Smith, P. 2014, Review lacks pathway for changes. Australian Financial Review, 23 September 2014.

Business SA 2014. Senate Innovation Inquiry Submission. Adelaide, Australia: Author.

Goldsworthy, C. 2014, The alchemy of connecting between business, industry and higher education, Skilling Australia Summit, at Melbourne, 30 June.

Human Capital Australia Magazine 2014, 'The power of collaboration', Human Capital Australia Magazine, September, p. 4-8.

Witty, A.. 2013, Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth; Author.



6

LIMITATION OF OUR WORK

General use restriction

This publication has been prepared for general guidance on matters of interest only, and does not constitute professional advice. You should not act upon the information contained in this publication without obtaining specific professional advice. No representation or warranty (express or implied) is given as to the accuracy or completeness of the information contained in this publication, and to the extent permitted by law. PwC, its members, employees and agents do not accept or assume any liability, responsibility or duty of care for any consequences of you or anyone else acting, or refraining to act, in reliance on the information contained in this publication.

Contact us

PwC Sydney
Darling Park Tower 2
201 Sussex Street
Sydney NSW 2000
Australia

GPO Box 2650
Sydney NSW 1171
Australia

Tel: +61 (2) 8266 0000
Fax: +61 (2) 8266 9999

www.pwc.com.au

About PwC Australia

PwC Australia helps organisations and individuals create the value they are looking for. We are a member firm of the PwC network, made up of 161,000 people who are committed to delivering quality in assurance, advisory, tax & legal and private clients' services.

PwC is one of Australia's leading professional services firms, bringing the power of our global network of firms to help Australian businesses, not-for-profit organisations and governments assess their performance and improve the way they work. Having grown from a one man Melbourne accountancy practice in 1874 to the worldwide merger of PriceWaterhouse and Coopers & Lybrand in 1998, PwC Australia now employs more than 6,000 people.

Liability limited by a scheme approved under Professional Standards Legislation.

7

CASE STUDIES

Examples of successful industry research collaborations

GE Open Innovation Challenge

GE's Open Innovation Challenges aim to develop critical technologies and partner with start-ups. In 2012, it launched its first local 'ecomagination' challenge which sought out disruptive technologies for a low carbon future. The challenge attracted 191 entries from across Australia and NZ. In 2013, a jet engine bracket designed by an engineer from Salatiga in Central Java, Indonesia, came in first place in a global 3D printing challenge held by GE and the open engineering community GrabCAD. Participants from 56 countries submitted nearly 700 bracket designs. The winning design will now be used to further advance GE jet engines.

This represents large business engaging with SMEs and researchers to develop future products and tackle significant issues – more companies should adopt this cost-effective model of problem solving.

Converting agricultural waste into biofuels

QUT's Mackay Renewable Biocommodities Pilot Plant is home to leading research in the conversion of biomass including sugarcane, sweet sorghum, eucalypt wood chips, sunn hemp, elephant grass and banana fibre into renewable transport fuels such as ethanol and valuable by-products such as lignin. Using waste fibres to produce ethanol has environmental benefits over using food sources such as sugar or corn.

The 10 million dollar Mackay Pilot Plant is hosted at one of Australia's leading sugar manufacturers and is an initiative of the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS). The Mackay Pilot Plant has also received funding from the Queensland Government Department of Employment, Economic Development and Innovation and QUT. A recent report has suggested that sugarcane biomass could fuel a multi-billion dollar bio refinery industry and support up to 7,000 jobs.

Members of the public and private sector are able to apply for access to the facilities for biomass harvesting, transportation, storage, and processing, in addition to analytical expertise available through QUT. Companies are able to use the facilities to test different types of biomass and pre-treatment processes, and keep the products produced.

The facility showcases how investment in research infrastructure can result in innovative solutions that have the potential to contribute significantly to Australia's economy.

Energy efficient steel production

Supported by the Government's NCRIS program, the Australian Microscopy and Microanalysis Research Facility (AMMRF) in conjunction with BlueScope Steel Ltd have developed a process to produce thin, strip-cast steel, using 70 per cent less greenhouse gas emissions and requiring less than 10 per cent of the floor space of conventional steel mills.

BlueScope approached the AMMRF because of their world-leading expertise and technical ability in the application of atom probe tomography (APT) to alloy development and analysis.

A collaboration of eight major university-based microscopy centres led by the University of Sydney, and including the University of Adelaide and University of South Australia, AMMRF supports 3000 researchers each year and comprises nearly 300 instruments run by almost 120 expert staff, supporting over 60 different microscopy techniques.

The collaboration of universities in a Government supported facility demonstrates the innovation capability achieved when high-end technical skills are made available to industry.

Computing technology to develop clinical trials

As an SME, Madeleine Pharmaceuticals is reliant on being able to access the expertise of innovative service providers in the drug development supply chain. The Australian Centre for Pharmacometrics (ACP) at the University of South Australia worked with Madeleine Pharmaceuticals, who are developing a cardiac peptide for the treatment of congestive heart failure through clinical trials.

Madeleine Pharmaceuticals enlisted the help of ACP's high-end computing facilities and expertise in pharmacometric modelling and simulation to create a population pharmacokinetic model of their trial subject data. This approach ensured that Madeleine Pharmaceuticals was able to plan the dosing for their clinical trial, ensuring a meaningful trial outcome that is cost-effective.

The ACP is an example of world-class facilities being made available to business, giving access to resources and technology to enable the process of innovation.

Biofortification of bananas

Supported by a $10 million grant from the Bill and Melinda Gates Foundation, QUT biotechnology research has worked to increase the nutritional content of bananas to improve the health of East African nations. These countries rely on cooked bananas as a staple food, with Ugandans each consuming an average of one kilogram of bananas a day. In 2013, 30 million people relied on bananas to stay alive. The technique, called 'biofortification', analyses the banana's DNA structure to maximise nutritional content, and enhances the iron, vitamin E and pro-vitamin A levels in the banana. The research has now expanded its footprint to India, in a $2.8 million partnership with the Indian Government's Department of Biotechnology. This project aims to stamp out iron-deficiency anaemia in India where bananas are also a staple food, particularly in the south of the country. Iron-deficiency anaemia in India is a major cause of maternal death during childbirth. The research is aimed at developing a widely available iron-rich variety of banana for the Indian market.

The project demonstrates the co-investment of public and private sources to fund, develop and maximise the reach of research applications in areas of need.

Improving the accuracy of weather forecasting

In collaboration between RMIT and the Bureau of Meteorology (BOM), significant gains have been achieved in Australia's capacity to predict, analyse and investigate severe weather events and natural disasters.

The research was the first to introduce the use of data for weather forecasting and climate monitoring from Global Positioning Systems (GPS) and the next generation Global Navigation Satellite Systems (GNSS). This GPS data was assimilated into the BOM's operational forecasting system in 2012 and technology developed through the research project now underpins the BOM's forecasting and modelling. RMIT and the BOM since have worked together to develop practical applications for the GPS and GNSS data.

The BOM is the Australian body responsible for providing national warnings on fires, heatwaves, floods, cyclones and severe storm activity. Its ability to deliver this information with advanced warning and greater accuracy benefits the industry, tourism, mining, agriculture, emergency services and transport sectors. More than 22 million people working and living in the Australian region have benefited from weather forecasting's accuracy threshold being improved by up to 10 hours.

Over the past 10 years, research has been supported through several funding initiatives including the Bureau of Meteorology's Strategic Investment Fund, Australian Research Council's Linkage grant (ARC-L), Department of Industry, Innovation, Science and Research (DIISR)'s Australian Space Research Program (ASRP) and the DIISR International Science Linkage (ISL) funding scheme.

The latest research project has received funding from the European Cooperation in Science and Technology (COST) Action ES1206 and looks at knowledge transfer and data sharing throughout Europe to improve short-range weather forecasts and climate predictions.

This demonstrates how long-term and continued investment in joint research ventures can result in tangible outcomes on 'real'-world issues on a global scale.

A world first plastic automotive mirror

As part of collaboration between UniSA, industry partner SMR Automotive (one of the largest manufacturers of rear-view mirrors for passenger cars in the world) and the CRC for Advanced Automotive Technology, the world's first light-weight, plastic automotive mirror was developed.

The process involves an engineered multi-layered thin film coating system resulting in an abrasion resistant and durable alternative to glass. The reflective element of the mirror is reduced in weight by 50% from the switch from glass to plastic. The entire mirror assembly, encompassing the mirror housing, actuator and reflective element is reduced in mass by around 15% by switching to plastic. This reduction in weight has a positive impact on driving efficiency, equating up to 16,864 litres of fuel saving per annum per 100,000 vehicles.

The mirrors took three years to develop and involved the secondment of two SMR engineers to the UniSA research team to help develop the product. By accessing the University's coating expertise and facilities, SMR took advantage of not having to source in-house coating equipment for the project, and gained two employees skilled in new technical expertise.

In 2012, SMR Automotive invested in a multi million dollar, full scale manufacturing facility able to produce in excess of 3 million coated mirror parts per annum as a result of the successful collaboration. The manufacturing plant, located in Lonsdale, South Australia, employs over 500 staff and produces 50,000 thin film plastic mirrors a month.

The collaboration between UniSA and SMR Automotive demonstrates a long-term research partnership, supported by Government funding. It has achieved innovation from concept to production and a commitment to knowledge transfer between industry and universities.

Advanced technology to develop new seafood products

Research biologists at Curtin University have been collaborating with Japanese company Kingsun Bioscience to develop dried seafood products for Asian markets. Dried seafood products are highly valued in Asian markets but not widely produced within Australia, opening up market opportunities to dry undervalued or underused local seafood stock. The research has been supported by the WA government and seafood industry partners to undertake research to improve outcomes for the local seafood industry.

The advanced food-drying technology uses a machine that takes only four hours to dry seafood, compared with the traditional four weeks of drying by sun. The research involves determining which drying 'profile' ensures the optimum quality of the product, and also whether it can enable an extended shelf life.

More recently, the research has led to the development of Blue Swimmer Crab Cakes from waste products of crustacean shells. Currently, 50-70 per cent of caught weight goes to waste. The project has been successfully commercialised, selling more than 1.1 million units and is being supported by a number of industry partners, the Australian Seafood Cooperative Research Centre and the Fisheries Research and Development Corporation.

The example showcases how research opportunities can improve processes and value-add to the Australian seafood industry via the support of a number of contributing partners.

Assistive robotics for physical disabilities

Greystanes Disability has been working with the University of Technology, Sydney (UTS) to define the needs and practical considerations of people with a variety of physical disabilities. Individuals with severe physical disabilities resulting from spinal cord injuries, stroke, traumatic brain injuries, spina bifida, muscular dystrophy cerebral palsy and balance disorders are set to benefit from breakthroughs in autonomous technologies. Among these is an intelligent wheelchair that can be controlled by the user's brainwaves rather than physical inputs. Based on the UTS-developed Aviator technology, the wheelchair's thought navigation system circumvents the physical and psychological barriers of similar systems currently on the market.

The partnership will use their findings to further expand the range of technologies available to the disabilities sector.

This demonstrates how a collaborative partnership can help define specific user needs and practical considerations to improve quality of life and well-being of those living with disabilities.

For further cases studies, please visit: http://www.atn.edu.au/Documents/Publications/ATN-web-LR.pdf