



Australian Government

Department of Education and Training

Inquiry into Australia's Future in Research and Innovation

**Submission from the Department of Education and Training to the
Joint Select Committee on Trade and Investment Growth**

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Table of Contents

Terms of reference	3
Summary of key points.....	4
Introduction.....	5
Driving innovation	5
Productivity: building human capital.....	5
Australia's research sector	6
Collaboration and commercialisation	7
Australian Research Council funding and Research Block Grants	8
National Collaborative Research Infrastructure Strategy	9
Further opportunities.....	10
Overcoming geographic, economic and labour challenges.....	11
International education.....	11
Australia's Global Innovation Strategy	12
Conclusion	12

Terms of reference

The Joint Select Committee on Trade and Investment Growth was established to inquire into and report on any measures to further boost Australia's trade and investment performance, including, but not limited to, barriers to trade; reduction of red tape and structural challenges and opportunities for the Australian community.

As part of its remit, the Committee will investigate how the research and innovation sector can better assist in overcoming Australia's geographic, economic and labour challenges, with a focus on commercialisation including, how technology imports and exports could be further facilitated.

Summary of key points

- Australia produces a large amount of research, relative to its size; however, collaboration between the research and industry sectors is relatively low.
- Greater collaboration between the research and innovation sector and industry is critical if the research and innovation taking place in Australia are to yield commercial outcomes. This is an essential step in ensuring that research and innovation support Australia to meet its current and future geographic, economic and labour challenges.
- While there are some strong examples of where collaboration has been successful in yielding outcomes, Australia could improve on this front.
- In December 2015, the Prime Minister announced the National Innovation and Science Agenda which is delivering a range of new initiatives to support research, incentivise innovation and entrepreneurship, reward risk taking and promote science, maths and computing in schools.
- The department aims to develop Australia's human capital through education and training, which is a driver of innovation. It is also responsible for funding research and development in the higher education sector.
- The department is also leading the development of the National Strategy for International Education, which, among other things, aims to encourage new and innovative approaches to providing education services internationally.

Introduction

The Department of Education and Training is the Australian Government agency responsible for national policies and programmes relating to quality and affordable child care, early childhood education, school education, post-school education and training, international education and academic research.

This submission looks at the role of education and research in fostering innovation. It further examines how the research and industry sectors can collaborate to achieve commercial outcomes through innovation. For example, while Australia does undertake a significant amount of research, it does not have high levels of collaboration between the sectors.

It is imperative that the research and innovation and industry sectors continue to build stronger ties to ensure that Australia is well-equipped to meet its future geographical, economic and labour challenges. In this regard, the department's role is two-fold. First, as the national agency responsible for education funding, policy and programmes, the department aims to build human capital to ensure that Australia has a mass pool of highly-skilled labour. Increasing human capital will not only drive productivity (and therefore economic growth), but also lead to further innovation in the future.

The other element which is of paramount importance to the department is the research agenda, particularly in relation to higher education research. In that context, the department provides funding and support to universities to undertake research activities as well as form collaborative relationships with business and industry to ensure that research leads to innovation and productivity gains. Through its support for a national research infrastructure network, funded through the National Collaborative Research Infrastructure Strategy (NCRIS), the department further boosts the quality of research and research-industry links.

Driving innovation

Productivity: building human capital

Australia has enjoyed strong and uninterrupted economic growth since the early 1990s. In recent years, Australia's growth has been fuelled by an unprecedented resource boom, driven by growing demand from emerging Asian economies. This strong growth has been underpinned by increasing human capital and significant gains to labour productivity. During this period the proportion of working age adults who hold a non-school qualification has increased from 41 to 60 per cent. Even more telling; the proportion of 20-64 year olds who hold a bachelor level qualification (or higher) increased three-fold, from around 10 per cent to 29 per cent¹.

A highly-skilled workforce creates greater opportunities for labour mobility and collaboration. Human capital is also a critical element in fostering and driving innovation, as the skills acquired

¹ Australian Bureau of Statistics, *Education and Work* (cat 6227.0), 1991-2015

by these workers enable greater transferability across sectors and therefore encourages greater collaboration and diffusion of ideas and practices. In turn, the development and diffusion of these ideas increases productivity and drives economic growth.

This has been evident in Australia since the last recession, where at the same time as the adult working age population increased its level of qualifications, labour productivity has increased by more than 60 per cent². While this is not the only factor which has resulted in higher productivity, it is correlated.

Australia must continue to improve upon its stock of human capital. The department aims to – through its funding of education providers and administration of national education and training policy and programmes – better equip the Australian workforce with the skills and knowledge it requires to adapt to the upcoming challenges in the labour market and to remain internationally competitive. Structural change, a changing Chinese economy and slower international growth present significant challenges going forward. If Australia is to continue to enjoy strong economic growth, it must continue to invest in human capital to drive productivity.

Australia's research sector

Research is another significant driver of innovation which leads to productivity and economic growth. It is no coincidence that countries which invest more heavily in research and development tend to have higher productivity. It is estimated that from the period 1993-2012, a sustained one per cent increase in research and development expenditure would have increased Australia's multi-factor productivity by nearly half a per cent³.

Overall, Australia has a relatively high level of research output, ranking 7th in the OECD in 2015⁴. However, the OECD Global Innovation Index Innovation Efficiency Ratio ranks Australia 72nd out of 141 countries when comparing innovation inputs (including research) to outputs⁵. In other words, Australia has an opportunity to capitalise on the level of research by boosting commercial uptake of research and innovation.

However, one of the key barriers faced by Australia is relatively low levels of collaboration between researchers and businesses. As illustrated by the OECD, Australia ranks last out of 26 countries⁶ for its level of collaboration between businesses and higher education and public research institutions on innovation. Similarly, Australia ranks only 23rd out of 32 countries on the proportion of research which is co-authored by researchers and industry sector⁷.

One of the contributing factors to this level of collaboration is the higher proportion of our researchers working outside of business than in comparable countries. In fact, 60 per cent of Australian researchers are employed by the higher education sector, compared to around

² Australian Bureau of Statistics, *Estimates of Industry Multifactor Productivity* (cat 5260.0), 2014-2015

³ Fox and Elnasri, *The Contribution of Research and Innovation to Productivity and Economic Growth*, 2014

⁴ Thompson Reuters, *Incites*, Jan 2016

⁵ OECD, *Global Innovation Index*, 2015

⁶ Office of the Chief Economist, *Australian Innovation System Report*, 2015

⁷ OECD, *Commercialising Public Research: New Trends and Strategies*, 2013

30 per cent in Germany, Canada and Sweden⁸, all of whom score higher on the Innovation Efficiency Index.

Nonetheless, there are some good examples of research-industry collaboration in Australia, particularly where there has been dedicated investment in organisations that have an industry or collaboration focus. For example, as at October 2014, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) worked with around 3,000 clients each year, including more than 20 per cent of the ASX top 200 companies and 1,300 SMEs, through programmes such as the Cooperative Research Centres⁹, which linked researchers with business and other end users across a range of sectors.

National Health and Medical Research Council Development Grants encourage specific collaboration between universities and industry in the health and medical research sector. For example, the University of Queensland's work in developing Gardasil (the human papillomavirus vaccine) and the George Institute's collaboration with the University of NSW which led to changes in fluid replacement treatments for critically ill patients around the world.¹⁰

Despite such examples, the evidence suggests that both Australian industry and the research sector could do better. On the business side, there are low levels of industry collaboration with the research sector by firms of all sizes, relative to other developed economies¹¹. For example, only 3 per cent of Australian businesses involved with innovation activity sourced their ideas from universities or higher education institutions compared to 59 per cent who sourced their ideas for innovation from within the business or company¹². Similarly, only 9.7 per cent of innovative businesses had collaborative arrangements with universities and higher education institutions¹³.

Collaboration and commercialisation

A lack of research and industry links can prevent knowledge, skills, and resources from being shared. Organisations with the specific purpose of translating and transferring technological development into industry practice can help establish these links, and this activity can be encouraged by government. At present, outside of a few sectors—such as mining and agriculture—Australia does not have organisations of this type at the scale of more highly ranked innovating countries including the UK, the Netherlands and Germany¹⁴.

⁸ OECD, *Science Technology and Innovation Scoreboard*, 2013

⁹ Department of Education and Department of Industry, *Boosting commercial returns from research*, 2014

¹⁰ SAFE study investigators, *A Comparison of Albumin and Saline for Fluid Resuscitation in the Intensive Care Unit*, New England Journal of Medicine, 2004

¹¹ OECD, *Science, Technology and Innovation Scoreboard*, 2013

¹² Australian Bureau of Statistics, *Innovation in Australian Business*, (cat. 8158.0), 2012-2013: This percentage reflects only direct knowledge transfer from higher education institutions. It is not possible to identify indirect flows of knowledge between the research sector and business, although it should be noted that 29.6% of Australian businesses reported sourcing ideas from 'websites, journals, research papers or publications'.

¹³ Australian Bureau of Statistics, *Innovation in Australian Business*, (cat. 8158.0), 2012-2013

¹⁴ Department of Education and Department of Industry, *Boosting commercial returns from research*, 2014

This is why the Government continues to provide funding and support to ensure that the research and innovation sector has greater access and mechanisms by which to collaborate with industry, and conversely that industry has access to researchers. Two Australian Government programmes – managed by the department – aim to provide this mechanism to the research sector and industry; Research Block Grants and the National Collaborative Research Infrastructure Strategy. Similarly, the Australian Research Council (ARC) manages programmes also designed to support research and innovation.

Australian Research Council funding and Research Block Grants

Funding provided by the Australian Government for university research and research training is provided through a mix of specific project and block grant funding. ARC supports excellent research and research training through the National Competitive Grants Programme (NCGP), which supports both basic (or fundamental) research as well as applied research. The NCGP comprises two programmes—Discovery and Linkage, which seek to maintain a balance between supporting research to find the big discoveries of today that will help to make our industries innovative and more competitive now but also research which will benefit our community, environment and industries in the years to come.

Funding awarded under the NCGP is allocated on the basis of a competitive peer review process involving national and international assessors. Funding is available to Australian universities under all programmes in the NCGP.

The Department of Education and Training is responsible for funding the systemic capacity of the university system to undertake high quality research across a broad spectrum of university research and to develop the next generation of researchers undertaking research degrees.

This funding is distributed through block grants that are not tied to specific funded projects, allowing universities to make strategic decisions on their research investments and to respond to government priorities and funding investments elsewhere in the research and innovations system. These Research Block Grants will provide \$1.8 billion, or around 20 per cent, of government support for research and innovation in 2015-16.

Similarly, the department is driving greater research-industry collaboration by introducing new Research Block Grant funding arrangements for universities from 2017. These changes will boost reward for industry and other end-user engagement, giving it equal emphasis to research quality. Additional funding of \$127 million has been added to the Research Block Grants over four years to boost support for engagement success. The new arrangements will also boost reward for international engagement with industry as measured by research funding received from overseas sources.

It is also envisaged that these arrangements will drive more flexible delivery of research training to students, including enhanced opportunities to gain exposure to industry experience and the

commercialisation process. Over time, this will drive cultural change as better prepared graduates take their place in the innovation system and begin to influence its direction.

As part of its National Innovation and Science Agenda (NISA), the Australian Government has sought to streamline and accelerate access to industry-focussed research project funding. The Australian Research Council's Linkage Projects scheme will open continuous applications for funding. These Linkage Projects bring together researchers, business, industry and other end-users to solve problems that help generate more products and services for Australia's economic, commercial and social benefit.

National Collaborative Research Infrastructure Strategy (NCRIS)

Between 2004-05 and 2016-17, \$2.8 billion has been invested under NCRIS to support a research infrastructure network, established in close consultation with the research sector, which provides openly accessible research infrastructure in Australia. Access to infrastructure is provided, on a merit-basis, to approximately 35,000 Australian and international researchers each year. There are currently 27 projects which cut across the research and industry sectors.

In December 2015, the Prime Minister, announced NISA, which is delivering a range of new initiatives to support research, incentivise innovation and entrepreneurship, reward risk taking and promote science, maths and computing in schools. NISA also provides ongoing funding for the operating expenses of NCRIS projects, commencing in 2017-18 at \$153.5 million.

NCRIS facilities broadly divide into three types of infrastructure, which serve researchers and industry in both different and complementary ways. Some facilities may fall into two or more of these categories:

- Networked infrastructure, which provide support and facilitate connections between other research infrastructure, institutions, researchers and industry. For example, the Therapeutic Innovation Australia (TIA) led project, Translating Health Discovery into Clinical Applications has supported the introduction of 19 products, processes or services into the market, as well as the improvement of 11 products, processes or services already in the market. TIA's consortium is currently participating in 169 clinical trials, an indication of its critical importance to Australia's medical research and health innovation system. Forty of these trials are conducted in collaboration with major international pharmaceutical companies.
- Laboratories and manufactories, which support innovation by directly translating fundamental research and design into potential prototypes. For example, the Australian National Fabrication Facility (ANFF) supports industry by both providing companies access to its facility portfolio, and also complementing their R&D with expertise from the ANFF network of researchers. Industry accounts for almost one third of ANFF's instrument time.

- Data intensive infrastructure, including a range of facilities, equipment and tools, which serve research through data generation, collection, manipulation, storage and access. This helps to support industry both directly and indirectly, through providing effective and efficient access to data and collections to researchers across all sectors, and providing researchers and industry with the data management skills to collaborate more effectively. For example, projects like the Integrated Marine Observing System, Terrestrial Ecosystem Research Network, and Atlas of Living Australia provide tools and environmental data that can be used by industry to discover, visualise and analyse.

This variety of infrastructures, with a diversity of purpose and design, means that there will be no standard approach to engagement; rather NCRIS actively provides an array of opportunities for industry-research engagement. Development and implementation of industry engagement plans was required of the existing NCRIS projects for 2015 funding. These plans indicate that NCRIS projects are already significantly involved in facilitating industry-research engagement, as well as engaging directly with businesses, contributing to boosting commercial returns from research. There does, however, remain an ongoing drive to improve industry use of and benefit from research infrastructure.

In some cases, the link between industry and research infrastructure may be established but not easily visible. It is especially difficult to find consistent data on indirect engagement, for instance when industry benefits through downstream services or intellectual property. In other cases, it may be that industry and research facility managers are not communicating as well as they might, and industry representatives may not be aware of the potential of the research infrastructure.

Nevertheless, these are critical projects in improving the level of collaboration between research and industry and with ongoing funding; NCRIS will continue to improve these links.

Further opportunities

Getting the right incentives in place to encourage collaboration will set a long-term direction for the research sector that will deliver greater commercial returns, noting that interactions between research and industry are complicated. Industry uses research in a range of ways according to market conditions, regulatory arrangements, skills and a host of other factors that influence the decisions of individual firms. Similarly, research institutions and individual researchers have a range of motivations influencing where they target their effort.

To boost the commercial outcomes from publicly funded research, the underlying incentives must be right. The settings that underpin incentives for research-industry collaboration, such as grant mechanisms, must be tailored to ensure that businesses view this investment as an efficient allocation of resources, while researchers recognise that opportunities exist beyond simply undertaking and publishing research. Regulatory settings can play a key part in shifting these perceived incentives and help to influence entrepreneurship. The NISA seeks to establish these incentives and ensure the regulatory environment is conducive to collaboration.

Overcoming geographic, economic and labour challenges

Innovation helps drive productivity and ultimately economic growth. It benefits workers by providing advancements in technologies and processes, which coupled with a highly-skilled workforce, promulgates further innovation. In this way it stimulates a positive cycle whereby skills beget innovation and innovation begets skills.

In this context, education plays a pivotal role. Put simply, the better equipped the pool of skilled labour, the more it is able to adapt to changing economic conditions, structural reform and technological change and drive innovation and productivity growth. The department's ongoing commitment to provide high-quality, mass education is an essential element to creating the high-skilled workforce required to meet Australia's future economic and labour challenges.

Notwithstanding the need for a highly skilled labour force, Australia faces further challenges which arise from geographical factors. Programmes such as the Innovative Connections programme seek to address some of these challenges through the provision of facilitators to assist businesses to access innovation infrastructure, particularly in regional Australia. However, our geographic challenges extend beyond our national borders.

Technological change over the past few generations has seen rise to a truly integrated global economy. Innovative ways of doing business have markedly improved the productivity of industry and economies as a whole. For example, improvements in digital mediums have enabled near instantaneous communication from anywhere in the world and have fundamentally changed the way that people access information, knowledge and expertise.

There also exist significant opportunities to enhance Australia's international competitiveness through research, innovation and international collaboration. In this space, the department is committed to improving our international competitiveness and developing new markets for our education and training, which is our most significant service export.

International education

International education is Australia's largest services export and third largest export overall valued at \$18.8 billion in 2014-15¹⁵. International education is central to Australia's transition to a services-based knowledge nation and is a key enabler of productivity and growth across the Australian economy¹⁶.

To support this aim, the department is leading the development of Australia's first National Strategy for International Education. The Strategy has been developed in consultation with education and training providers, business and industry, governments and the broader

¹⁵ Australian Bureau of Statistics, *International Trade in Services, by Country, by State and by Detailed Services Category, Financial Year, 2014-15* (cat. 5368.0.55.003)

¹⁶ M Baghai, D Redhill, C Richardson and G Vorster, *Positioning for prosperity? Catching the next wave*, 2014

Australian community. The Strategy provides a framework of priorities for all stakeholders to ensure the sustainable growth of international education over the next decade and beyond. This includes encouraging new and innovative approaches to diversifying services and markets, and engaging with industry and global partners.

Technology offers institutions, students and researchers flexible opportunities for teaching, learning and collaboration, irrespective of physical location. The two-way movement of students, researchers, academics and professionals generate new ideas, collaborations and partnerships. International research collaborations and partnerships with industry help Australia to access the new knowledge that exists beyond our shores and keep Australian researchers and institutions at the cutting-edge of discovery and application. The emergence of borderless education presents enormous opportunities for Australian providers to access and expand the range and reach of their services into new markets and models beyond the traditional onshore classroom model of delivery.

Australia's Global Innovation Strategy

As part of the NISA, the Australian Government announced Australia's Global Innovation Strategy. The Strategy will advance Australia's international collaboration performance and encourage Australians to leverage entrepreneurial expertise found in key locations overseas. It will also enable Australian businesses and researchers to collaborate with global innovation and science leaders as well as access international expertise and global markets.

Currently, only 6 per cent of Australian businesses engage in international innovation, compared to the OECD average of 18 per cent¹⁷. Accordingly, the Australian Government will invest \$36 million over five years to improve Australia's international innovation collaboration. This includes establishing 'landing-pads' in overseas locations to support entrepreneurial Australians, provision of seed funding to assist with international industry and research collaboration and investing in reducing barriers to regional collaboration.

Conclusion

There is a diverse range of activities in place by governments, industry and education providers to foster research and innovation in the Australian economy. However, as this submission demonstrates, a lack of collaboration between research and industry sectors could be an impediment to that research driving innovation and commercial outcomes. Despite a range of measures in place to encourage better collaboration, more can still be done. As the Australian economy transitions from its reliance of the resources sector and a range of other 'traditional' jobs, it will require not only the right skills in its workforce to adapt and innovate, but also the right technology and infrastructure in place.

¹⁷ Australian Government, *National Innovation and Science Agenda*, 2015

The department continues to work with the sectors to better facilitate collaboration, build infrastructure and foster the right skills in the economy to remain affluent and internationally competitive. NISA identified a number of areas where Australia can improve, including through better collaboration between research and industry sectors and developing the right skills for driving innovation in future generations. As outlined by NISA, innovation remains a priority for Government. Through the continued funding and support of innovation activities, Australia has the opportunity to embrace the challenges of the future with a highly-skilled workforce and resilient and adaptable economy.