

ENHANCING THE VALUE OF PhDs TO AUSTRALIAN INDUSTRY



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EXECUTIVE SUMMARY

This report informs policy debate in the area of PhD and industry engagement and collaboration

This report provides an overview of how PhD candidates and holders (PhDs) are currently delivering value to industry, and explores opportunities to further enhance this value. It is based on work undertaken by the Nous Group in late 2016 on behalf of the Australian Technology Network of Universities (ATN).

The content draws on previous Australian and international reviews, coupled with interviews and working sessions with university leaders and industry experts, and a survey of industry and business leaders from across a diverse range of organisations.

The findings and recommendations inform policy debate regarding PhDs and industry engagement and collaboration while also investigating the role that PhDs play in driving Australia's innovation ecosystem. This is timely given the Australian Government's focus on industry and university collaboration.

The findings of the report are:

Finding 1:

PhDs are important to enable industry innovation and economic growth

Finding 2:

Industry is already benefiting from PhD collaboration

Finding 3:

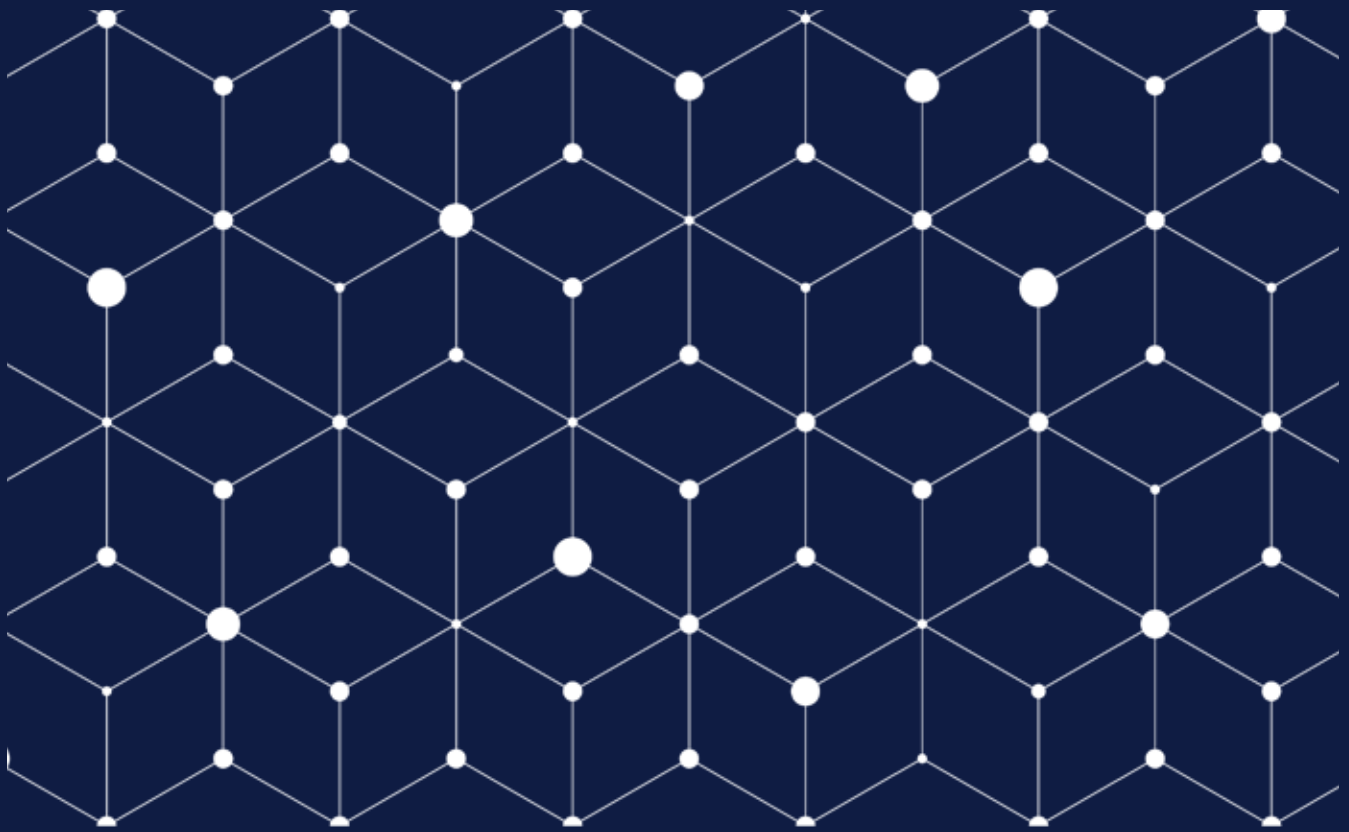
Barriers exist which prevent optimal PhD industry collaboration and integration

Finding 4:

Universities are actively engaged in equipping PhDs with skills that increase employability

Finding 5:

Scaling up and improving visibility of existing mechanisms has shown to help industry and PhDs engage with each other



RECOMMENDATIONS

- 1.** Expand in place supporting structures to deepen PhD and university collaboration with industry
- 2.** Ensure initiatives targeting PhD employability have broad scale
- 3.** Link a portion of PhD scholarships to industry collaboration
- 4.** Implement a national communication strategy to improve awareness and develop a deeper understanding in industry of the PhD
- 5.** Introduce tax incentives to encourage businesses to engage with PhDs





GLOSSARY OF KEY TERMS

3 Minute Thesis (3MT) competition

A transnational competition that requires participants to synthesise their research topic into a succinct three minute presentation that can be understood by non-academics.

ATN

The Australian Technology Network of Universities (ATN) brings together five of the most innovative and enterprising universities in Australia: Queensland University of Technology (QUT), University of Technology Sydney, RMIT University, University of South Australia and Curtin University.

ATN Industry Doctoral Training Centre

The ATN's Industry Doctoral Training Centre (IDTC) is an innovative Australia-wide industry research training program focused on providing solutions to real industry challenges.

Australian Council of Learned Academies

An independent, not-for-profit organisation that supports evidence-based interdisciplinary research.

GCA:

Graduate Careers Australia (GCA) is one of the leading authorities on graduate employment issues in Australia.

HDR

Higher Degree Research (HDR) students/candidates are those who are enrolled in research courses including PhDs and Masters by Research.

Industry

Industry encompasses industry, business, Government, the not-for-profit sector and the professions, excluding higher education providers for the purposes of this report.

Knowledge-based economy

An economy based on creating and trading ideas and information.

PhDs

A doctorate usually based on at least 3 years graduate study and a dissertation; the highest degree awarded for postgraduate study.

Transferrable career skills

Broad portable skills that extend beyond industry specific knowledge which can be applied to a variety of situations. Examples include communication skills, interpersonal skills, critical thinking, and analytical skills.

Structured programs

Strategic initiatives that aim to increase industry engagement of PhD candidates, and are usually time-bound with clearly defined objectives.



INTRODUCTION

The Australian Technology Network of Universities (ATN) commissioned Nous Group (Nous) in late 2016 to undertake analysis and consultations, and develop recommendations aimed at enhancing the value of PhDs to industry.

The ATN is a national collaborative group of five major universities including QUT, University of Technology Sydney, RMIT University, University of South Australia and Curtin University. ATN Universities all have genuine linkages to industry as an inherent part of both their teaching and research.

Why industry engagement with universities is important

Innovation across industry will be critical for Australia's future economic prosperity. Australia is continuing to transition from a commodities and manufacturing based economy to a services and knowledge-based economy. The increased reliance on knowledge as the driver of economic performance has substantial implications for industry. The ability to innovate and develop new knowledge that can translate to value generation, goods and services, and employment will be critical to future business and industry success. Despite the importance of industry and university engagement and collaboration, Australia has underperformed in this area, regardless of increasing business investment in R&D¹.

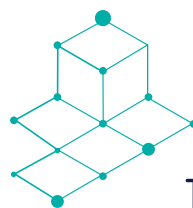
PhD candidates and graduates can play a major role in enabling innovation within individual firms and across industries. As trained problem-solvers and critical thinkers, they can accelerate innovation and translate research to address business challenges and enable new products and services.

PhD candidature provides a range of skills that are relevant and valuable to industry in addition to high level technical and research skills. Skills such as creativity, critical thinking and problem solving, as well as creating and integrating new knowledge, are developed through a PhD's candidature. The value of these skills is increasingly being recognised across industry and by PhD holders. The growth in PhD completions means there may be opportunity for industry to further leverage these capabilities to enable innovation.

The aims of this report

This report presents findings and recommendations to inform policy debate among Government, industry and higher education in the area of PhD and industry engagement and collaboration. It provides an overview of how PhD candidates and holders (PhDs) are currently delivering value to industry, and explores opportunities to further enhance this value. This is intended to inform debate as part of ongoing consideration of Australian higher education, industry and innovation policy development.

It is timely given the Government's current focus on improving industry and university collaboration, outlined in both the National Innovation & Science Agenda and the 2015 Review of Australia's Research Training System by the Australian Council of Learned Academies². Given that PhDs work across all industries, it is vital that they are trained for diverse and varied careers.



**This report presents findings
and recommendations to inform
policy debate among Government,
industry and higher education
in the area of PhD and industry
engagement and collaboration.**

Our methodology

This report is based on desktop research, interviews and working sessions with university leaders and industry experts, and a survey of industry leaders.



Desktop research:

Desktop research included reviews of previous reports developed in Australia and internationally regarding engagement and collaboration between PhDs and industry. It also considered a range of initiatives aimed at enhancing the value of engagement and collaboration being progressed by Governments, industry and universities in Australia and internationally.



Consultations and working sessions:

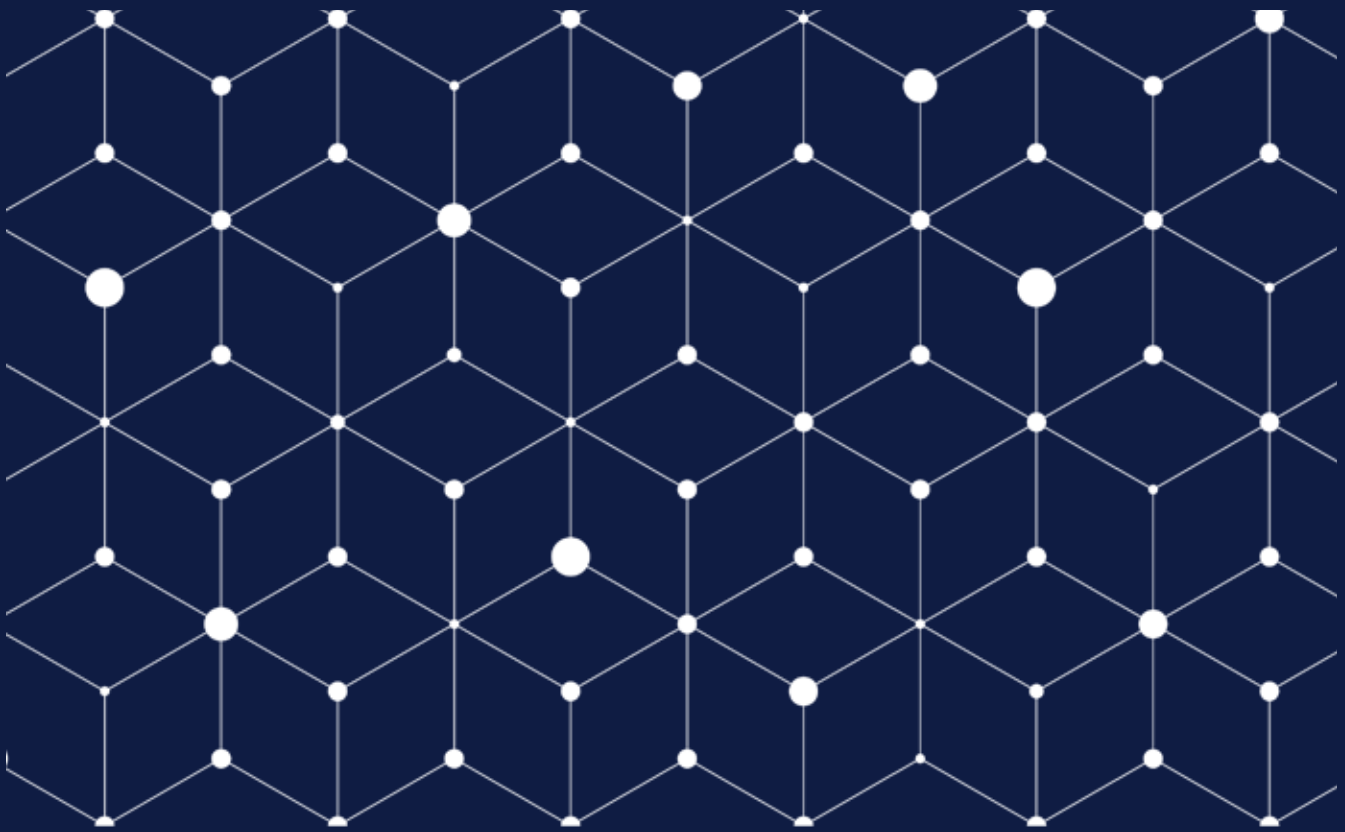
A range of stakeholders were consulted and participated in working sessions to explore the opportunities and challenges in enhancing engagement and collaboration. They included both experts and leaders from universities, and from a diverse set of industries. Industry groups consulted were from a range of geographies and sectors, and organisations of different scales and maturity. Stakeholder quotes from these sessions have been included throughout this report to illustrate key points raised as part of these discussions. Appendix A provides a list of the stakeholders engaged.



Survey of industry leaders:

A survey of senior executives was conducted to supplement and expand on the findings from research and consultations. A total of 69 senior executives from a broad range of organisations and sectors completed the survey. This included representatives from professional scientific and technical services, financial and insurance services, and manufacturing sectors. The organisations involved ranged in size from micro enterprises through to large scale businesses, and represented most Australian states and territories. Quantitative findings from the survey have been included throughout the report where relevant to help illustrate key points.

The questionnaire used for this survey can be found on the
ATN website at www.atn.edu.au/publications.



FINDINGS

PHDS ARE IMPORTANT TO ENABLE INDUSTRY INNOVATION AND ECONOMIC GROWTH

Australia is transitioning towards a knowledge-based economy, making PhD skills increasingly important

The downturn in Australia's mining and resource sector has created an imperative for Australia to transition towards becoming a knowledge-based economy³. This transition is not limited to Australia, with similar trends towards knowledge-based economies reflected across other countries⁴. Knowledge-based economies rely on innovation to help drive productivity improvements, and innovation will be of substantial importance to sustain Australia's high-wages and low-inflation environment.

A key element of a knowledge-based economy is a strong base of researchers and research capacity, and the ability to apply research to generate economic value^{5,6,7}. Universities are a critical hub for research, in particular through undertaking research themselves, partnering with industry and developing individual researchers. PhD candidates and graduates are a critical link between academia and industry, both in terms of their individual research and the skills and expertise they can bring to organisations in diverse sectors during and post their candidatures.

More broadly, workers with greater levels of human capital (in terms of total skills, competencies and social attributes) will be pivotal in driving future knowledge-based economic growth^{8,9}. The next five to ten years are expected to see changes in the skills required in the workforce, with a greater emphasis on critical thinking, creative problem solving and complex problem solving¹⁰, which are core skills developed during a PhD candidature¹¹.

PhD holders have been identified as key initiators of the movement towards the knowledge economy¹². They are well placed to translate research into business applications and can be an inexpensive way for businesses to deliver outcome-driven initiatives¹³.

PhD graduates are trained problem-solvers and critical thinkers; qualities which are fundamental for innovation. The research training experience develops the skills necessary for productive, insightful exploration and development. The length and independence required of research training are key variables which differentiate it from other forms of postgraduate education. The individualistic nature of each PhD project is another key characteristic that differentiates research training from coursework programs, as candidates have scope to work on the design, development, management and review of their research project. Together, these elements improve the initiative and resilience of students, which are necessary capabilities for driving change and solutions-based work in industry environments. Additionally, many PhDs have work experience prior to joining the program, further adding to the skills and capabilities they are able to leverage¹⁴.

PhD candidates can help industry transition to the knowledge economy

The innovative and analytical capacity of PhD graduates have already begun to successfully help in this transition.

CASE STUDY:

THE PWC CHAIR IN DIGITAL ECONOMY WAS SELECTED PREDOMINANTLY DUE TO HIS DEEP INTERNATIONAL RESEARCH EXPERIENCE AND WILL GUIDE QUEENSLAND'S TRANSITION TO THE KNOWLEDGE AND DIGITAL-AGE ECONOMY

Key Learning: The deep research knowledge that PhD candidates obtain, along with the skill sets that they develop, will be crucial to help Australia transition to the knowledge and digital-age economy.

QUT, PwC, Brisbane Marketing and the Queensland Department of Science, IT and Innovation have created the PwC Chair in Digital Economy role. The role, the first of its type in Australia, crosses the divide of academia, business and government and seeks to shape digital transformation in Queensland through research, innovation and instilling digital capabilities in graduates at the university^{15,16}.

Dr Marek Kowalkiewicz, a former Silicon Valley Senior Director, was chosen for the role from a formidable field of candidates. His deep international research experience coupled with his impressive record of publishing over 60 papers and having 12 patents to his name were key factors in him being selected for the role. Dr Kowalkiewicz's role as Chair is to engage heavily with both industry and Government to help foster creativity and innovation within business.

The importance of the skills, knowledge and capabilities of individuals such as Dr Kowalkiewicz will become increasingly important as the digital economy further develops. This particularly relates to the ability to manage a research portfolio that has clear links to industry-driven opportunities.

Increasing PhD-industry collaboration will be critical as the economy transitions

The level of collaboration in Australia between PhD holders and industry is lower than in other OECD countries. In comparison to OECD nations, Australia ranks last in terms of industry-university collaboration for large businesses, and second last for industry-university collaboration for small and medium enterprises (SMEs)¹⁷. Despite ranking last in terms of industry-university collaboration, Australia ranks 11 out of 34 for population per thousand aged 25-64 with a doctorate qualification and 8 out of 36 for highly cited (top 1% in the world, all disciplines) publications per million population¹⁸.

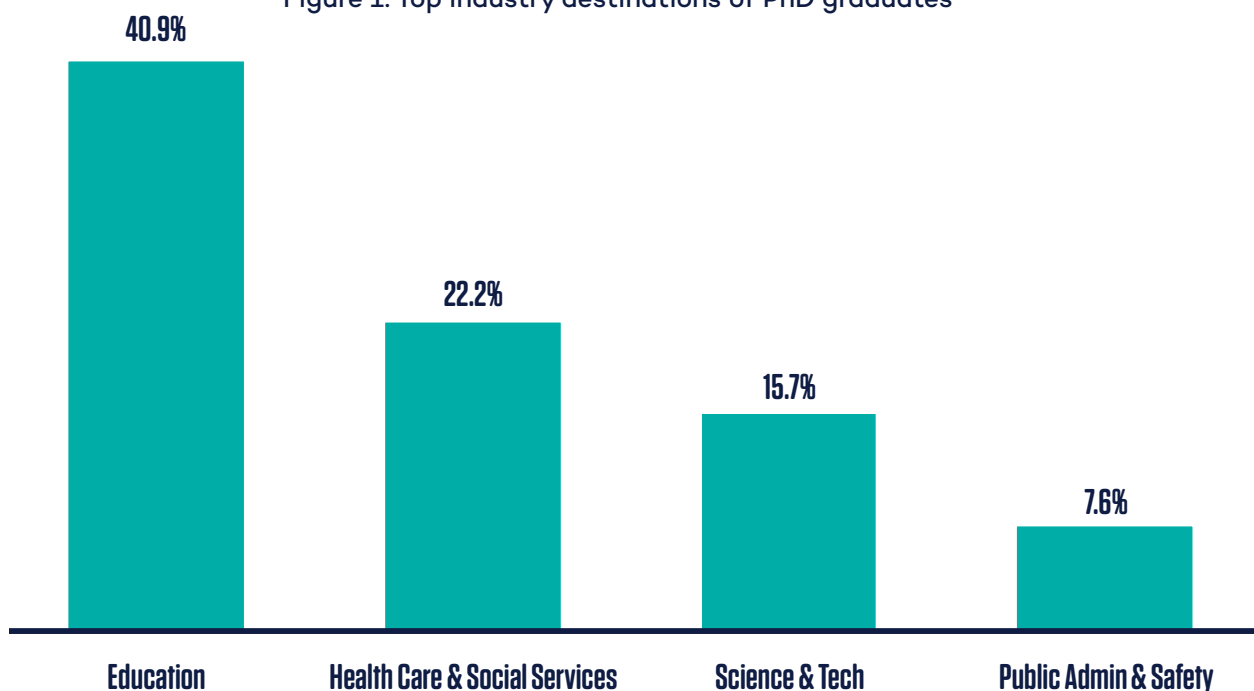
In part this reflects differences in Australia's economy. Australia's industry structure is characterised by over 2 million micro (0 – 4 FTE) and small (5 –19 FTE) businesses, accounting for approximately 97% of Australia's total industry. Australian firms employing between 1-9 employees make up 95.3% of all firms (by number), which is higher than the median of 92.1% for OECD countries¹⁹. Medium business (20 – 199 FTE) and large business (200+ FTE) account for less than 3% of Australia's industry make-up²⁰. By comparison, 92% of businesses are small in Germany, and approximately 8% are medium or large businesses²¹.

The relative size of firms has implications for their engagement with PhDs and research more broadly. Large companies with separate R&D functions are more likely than SMEs to target doctoral graduates as employees, as larger companies may be in a position to divide activities and make use of specialist skills²².

Additionally, from the perspective of smaller firms, a person with a first degree may be seen as less costly, less specialised and easier to train as they develop experience within the company²³, which can overlook the substantial return that individuals with broader problem-solving skillsets can provide.

There is some evidence that in knowledge-based economies, doctorates are more commonly recognised as having relevance to industry and business. For example, in Germany it is common for doctoral graduates to have a career outside of academia, and many company directors and managers have doctorates²⁴. This is partly due to the mindset regarding PhDs in Germany, where the qualification is marketed more as an advanced training degree instead of a pathway to academia²⁵. This environment is commonly found in Australia, where PhD graduates are employed across a range of sectors and perform a wide variety of roles. According to ABS 2011 Census of Population and Housing, PhD graduates are predominately concentrated within the education, health care, science and public administration sectors, as illustrated in Figure 1. As such, it is also increasingly important that PhD students are prepared for diverse graduate destinations, and that the doctorate program is recognised as having relevance to industry and business in Australia.

Figure 1: Top industry destinations of PhD graduates²⁶



Conversely, in countries with largely industrial economies such as Italy, the traditional view of a doctorate as pre-academic training is typically more widespread²⁷. Employers might see a doctoral graduate as coming from a 'different world', as 'speaking a different language' and as having too narrow a focus and might not appreciate the potential contribution to industry or business²⁸.

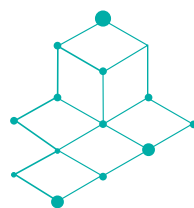
As a country with a significant proportion of micro SMEs, Australia may need to take steps to encourage and enable uptake of PhDs by industry to achieve comparable levels of innovation. This is likely to emerge gradually, and will require time and investment²⁹. Maximising the value of links between industry and PhDs will become even more important over the next decade as demand for research qualified workers and population ageing impact workforce availability. Estimates suggest 1.3 million graduates with postgraduate qualifications will need to enter Australia's knowledge workforce from 2015-2025 to drive the future economy³⁰. It has been predicted that the demand for individuals with research qualifications will surpass the supply available for employment in this time frame^{31,32}. This presents opportunity and need for new graduates to contribute to the steady growth of researchers in business. Additionally, many researchers are set to retire over the next decade, further emphasising the need for new PhD graduates³³.

The university sector will be an important player in the knowledge-based economy and will continue to need PhDs

The university sector is one of Australia's largest export industries³⁴ and there remains a need for a steady pipeline of PhD graduates to sustain the sector. The education sector remains a relevant destination for PhD graduates, with 25% of doctorate holders being tertiary education teachers³⁵. The movement of PhD graduates into academia also helps to further stimulate Australia's knowledge-base and ensure the quality of academia across all fields.

The contributions of the university sector to the knowledge-based economy can be further enhanced if connections and flows between academia and industry are enhanced³⁶. A more flexible trajectory with greater movement between industry and academia is mutually beneficial. The transition of PhD graduates into and from academia, at any point, has the potential to enrich the environment and stimulate Australia's knowledge-base³⁷. As the flow of knowledge and skill becomes more mobile, there is potential for greater development of ideas and an enhanced capacity to tackle new problems.

It should also be noted that a significant market for the Australian PhD would be university sectors of developing countries in the region and beyond. For some candidates and their sponsors, there is a need to emphasise the traditional academic values of the PhD, given their desire to contribute to their local university sectors. It is in Australia's interest to continue to train these academics who intend to work offshore, as it is an extension of Australia's soft diplomacy agenda, connected to foreign and developmental objectives³⁸.



Estimates suggest 1.3 million graduates with postgraduate qualifications will need to enter Australia's knowledge workforce from 2015-2025 to drive the future economy.

INDUSTRY IS ALREADY BENEFITING FROM PhD COLLABORATION

PhDs are collaborating with industry in a variety of sectors, and delivering substantial value. The existing collaboration is a solid base that can be leveraged for future at scale collaboration. While quantitative data, particularly longitudinal data, has yet to be developed, there are numerous examples of collaboration that highlight the benefits being delivered. This qualitative evidence also suggests there is potential to extend and deepen the level of engagement that industry has with PhDs.

The survey of industry stakeholders highlighted this value. Overall, 46% of respondents indicated that PhDs are extremely or somewhat valuable to their business. A further 36% indicated that PhDs are of value when they have industry experience. This highlights the importance of early collaboration with industry during PhD candidature to enable industry knowledge to develop concurrently with other skills, particularly for candidates who have no previous work experience in industry.

One of the primary benefits that PhD graduates provide is to develop an organisation's analytical and innovative capacity. The deep content knowledge they provide and problem solving capabilities are also highly valued.

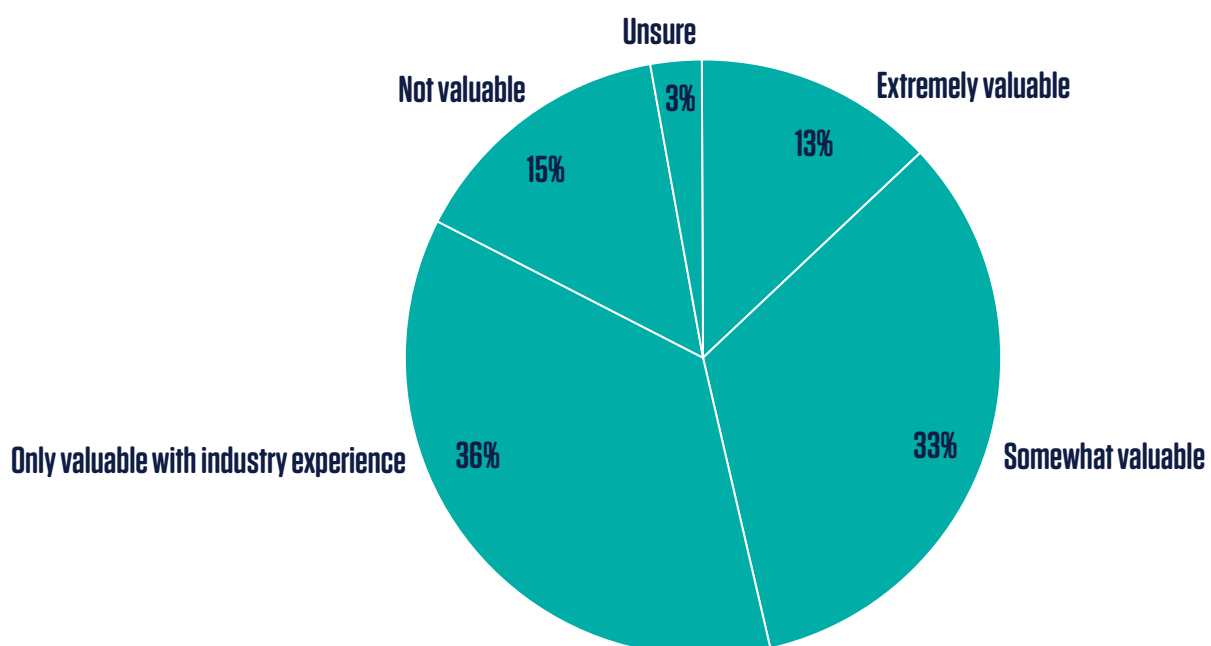
PhD candidates can increase the level of innovation in industry

Through their training, PhD candidates often work at the cutting edge of innovation and develop skill sets that suit exploration of new knowledge. This positions PhD graduates well to help industry develop new and innovative products and services.

PhD graduates provide deep expertise that can result in substantive benefit

The content knowledge and analytical skills that PhD graduates develop can be substantially leveraged for industry purposes. This expertise can allow PhD holders to assist in deeper thinking around industry needs and provide perspectives grounded in sound analysis.

Figure 2: Online survey results on question:
"Overall, how valuable do you think PhDs are to your business?"
(Survey conducted with industry stakeholders)³⁹





“We have a diverse portfolio, both in engineering and science and also clinical. It’s critical we have the right skill set in business and a PhD is the essential training that delivers that outcome.”

— Industry stakeholder

CASE STUDY:

AUSTRALIAN RED CROSS BLOOD SERVICE DEVELOP INNOVATIVE WAYS TO FREEZE BLOOD FOR DEFENCE FORCES

Key learning: PhD graduates are valued for their ability to work independently and think critically in developing innovative solutions.

The Australian Red Cross Blood Service uses research to develop processes and products to ensure sustainable, safe, secure and cost-effective supplies of quality blood products for Australians^{40,41}. The research team has over 60 members across the country that conduct cutting-edge translational research. PhD graduates both in specific scientific fields and broader fields such as psychology, economics, statistics and engineering collaborate to ensure research conducted is able to have a positive impact on the blood and broader health care sector. The Red Cross also collaborates extensively with universities in conducting their research.

One key innovation that Red Cross researchers have been able to produce has been in the field of frozen blood products. Frozen blood is necessary in combat situations and can help to save the lives of defence personnel. Previously, frozen blood had a short shelf life which made it difficult to supply blood to soldiers. However, after five years of dedicated research, the Australian Red Cross Blood Service research team developed a new process for preparing deep-frozen blood components that can extend the shelf life up to 10 years. The research team worked closely with the organisation’s manufacturing division to translate the research into practice. Dr Lacey Johnson, principal research fellow, was awarded The University of Technology Sydney’s Alumni Award for Excellence for her work on the project.

Consultation with a senior staff member of the Australian Red Cross Blood Service identified the importance that PhD graduates play in the innovative and translational research of the research team. PhD students and graduates were stated as being “highly motivated, independent thinkers who [were] keen to learn and want to develop their skills”. PhDs are seen as a key enabler of innovation, and they also make an important contribution to sharing knowledge through the publications they contribute to.

“As needs of the sector grows, we need some smart brains [PhDs] out there to devise plans, service models, and look after dollars. We need skills and expertise about how to deal with these problems.”
– Industry stakeholder

CASE STUDY:

SYDNEY WATER PARTNERS WITH PhD CANDIDATES TO PRODUCE INNOVATIVE RESEARCH

Key learning: Collaboration between PhDs and industry allows for deep research which can lead to innovative solutions.

Sydney Water has partnered with both the University of New South Wales and the University of South Australia to conduct a project on the beneficial re-use of bio-solids⁴². This project focusses on carbon footprint reduction, energy efficiency, odour emission management and other improvement opportunities.

A PhD candidate working on minimising odour emissions from bio-solids has been involved with this project. The candidate's project has a real world focus, working with data gathered from the wastewater treatment plants managed by Sydney Water to integrate and analyse relationships with bio-solids across sites. One particular case study conducted has shown positive findings that can demonstrate that a specific method can achieve lower odour emissions and higher bio-solids content.

Linkages between research and academia were crucial to ensuring that positive results were identified. Linkages have brought in necessary talent to develop example projects to conduct deeper investigations. The collaboration between academia and industry meant better access to data and laboratory equipment, and also resulted in better relationships between the two parties.

CASE STUDY:

TRAJAN SPECIFICALLY HIRING PHD STUDENTS DUE TO THE EXPERTISE THEY BRING

Key learning: PhDs are highly valued in the scientific and medical industry, and some firms are playing active roles in the PhD training process to develop and secure talent

Trajan works in the scientific and medical industry with a focus on developing and commercialising technologies. Trajan works closely with a number of universities to employ PhD students into their organisation, in particular the University of Tasmania and the University of South Australia⁴³.

Trajan seeks to offer PhD candidates a true alternative to the regular academic PhD route. One university based stakeholder who engages with Trajan noted that students receive the “best of both worlds” through this model, given that they received both academic input and the daily experience of working in industry. A senior employee at Trajan indicated that PhDs provided the essential training that was required in the organisation, demonstrating why Trajan is excited to develop even closer relationships with teaching institutes in Australia.

PhD candidates bring a deep level of expertise to their work and have contributed strongly to Trajan. A senior employee at Trajan noted that PhD candidates were all “contributing sensationally” and that “it [was] hard to think where they [were] not having a positive impact”. To ensure candidature success, Trajan is proactive in being a true partner to the research sector through playing an active role throughout all stages of the PhD. Trajan works with universities to structure PhD programs to align to both industry and PhD needs. On top of an industry supervisor, Trajan invests in PhD candidates by providing a mentor to ensure that they have the best chance of success in industry.



“We really value the specialised expertise PhD graduates provide - we hire them for specialist knowledge in their field.” – Industry stakeholder

BARRIERS EXIST WHICH PREVENT OPTIMAL PhD INDUSTRY COLLABORATION AND INTEGRATION

There are a range of barriers preventing more engagement between industry and PhDs in Australia. These include information asymmetry, views within industry that PhD training can be too narrow, and a lack of financial capacity within industry to recruit PhDs. Cultural and perception biases, which exist both in Australia and a range of other countries, also need to be addressed.

According to the Chief Scientist, reasons PhD graduates are not hired in industry include the qualification not being required, limited practical experience, limited business knowledge, unrealistic wage expectations, and not being pragmatic⁴⁴. PhD graduates are also sometimes not hired as they are said to be lacking transferrable career skills⁴⁵.

Information asymmetry is a key barrier and leads to cultural and perception bias

Some businesses have highlighted a disjunction between the skills gained in PhD training and those needed by the business as the key inhibitor of their recruitment^{46,47}. However, this is not consistent across all industries, as demonstrated by those firms showing a greater want and need for PhD graduates. This suggests that there is an information asymmetry problem, as it appears that both industry and PhDs may not have sufficient information about their own value to, and the value of, the other party. Information asymmetry similarly is prevalent among PhD candidates who lack critical information about their options and expected outcomes in relation to PhD training. Initiatives that can help address information asymmetry have been provided as part of Recommendations in Section 3.

Industry does not have sufficient awareness of the potential value of PhDs.

The 2012 Business/Higher Education Round Table, which involved employers of PhDs from across a wide range of businesses, revealed a limited understanding and appreciation of the Higher Degree Research (HDR) training experience and skill sets. It also highlighted a limited understanding of how HDR graduates could contribute to a firm's innovation capacity, business productivity and more broadly to an innovative economy⁴⁸.

Nous' consultations with education professionals support the findings. Academics interviewed have found there to be significant negative stigma associated with doctoral degrees. There is a widely held view that undertaking a PhD is associated with a significant opportunity cost, as graduates miss out on potential work experience. Consultations have noted that this is something inherent in Australian cultural attitudes to PhDs, and that this is less of a factor in other countries⁴⁹.

“There is a cultural aspect that we need to overcome – there is a crude derogation of people with PhDs. You’re looked upon with a negative image”
– Academic stakeholder

“Industry also has to stop looking at PhDs as subject matter experts, it’s more about smart people dealing with complex problems and that can create insight and can see things that other people can’t”
– Industry stakeholder

Some PhD supervisors prefer pure academic research and this influences their supervision style and the PhD candidate's view.

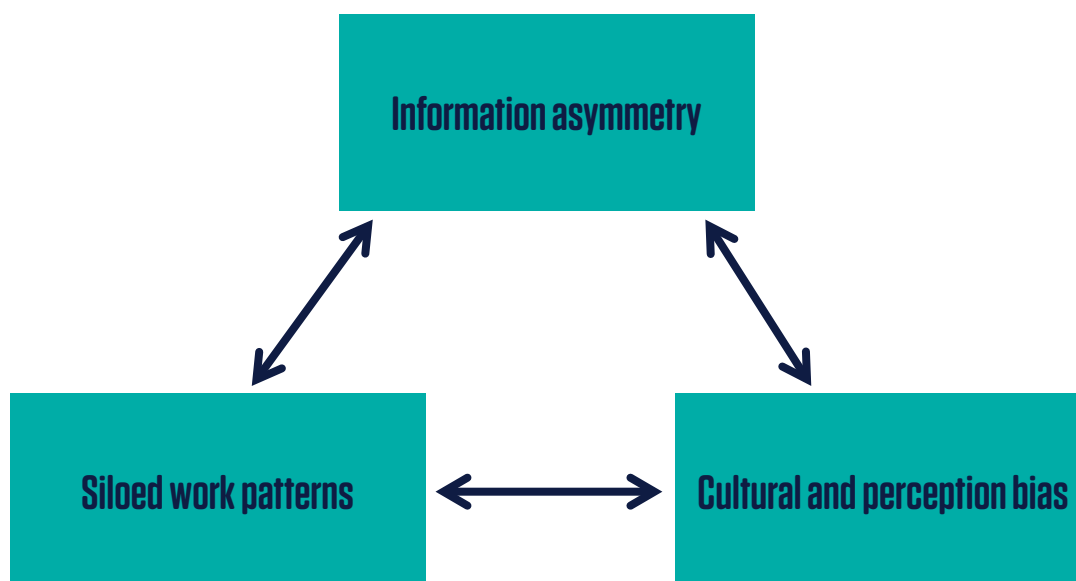
Nous' consultations with education professionals revealed that some academics prefer pure academic research, and have limited value for industry engagement and contribution and the skills required to be industry ready. This is compounded by their need to publish, as the opportunity to co-author papers with PhD candidates can be an incentive to focus a candidate's time away from industry collaboration⁵⁰. The supervisor's own perspectives and behaviours towards industry collaboration may also influence the views of their PhD students who may then choose to focus on the skills more valued by academia. Additionally, such students may also choose not to learn more about industry and may not have an accurate view of opportunities and expectations within industry.

PhD candidates lack relevant information to assess differences between institutions to make informed choices.

Comparative information about PhD training models, development opportunities, coursework opportunities and career outcomes either does not exist, or is only reported at a national level. This creates difficulties for PhD applicants to make informed choices about which PhD training course aligns with their long term career aspirations and the pathways available to help them work towards those aspirations⁵¹.

The limited information and knowledge as to the benefits of PhD holders to industry, and vice versa, has created a cultural and perception bias between industry and universities that limits collaboration. There are often deep-seated misconceptions by each stakeholder group⁵², and this is accentuated through lack of further engagement⁵³. This cycle, depicted in Figure 3: Cycle of behaviour limiting collaboration, only serves to limit awareness and appreciation of the strengths of each stakeholder group and creates a mindset that is apprehensive of collaboration.

Figure 3: Cycle of behaviour limiting collaboration



Industry has criticised PhD training for being too narrow

Concerns that research training does not meet business needs are reflected across the relevant literature^{54,55}. Without substantial data, it is difficult to ascertain whether this gap is real or perception based. This gap can be viewed from two perspectives.

PhD students may have less transferrable career skills training relative to other potential job applicants.

Transferrable career skills will become an increasingly important asset for employees into the future. A survey conducted by Talent Q and the Hay Group identified that 92% of business and HR leaders believed transferrable career skills to be necessary in a globalised economy, and 9 in 10 indicated that such employees made a bigger commercial impact⁵⁶.

Research conducted into PhD training suggests that graduates may not enter the workplace with the required level of soft and interpersonal skills. One study found that early career researchers “[did] not appear to articulate their personal skills well and seem[ed] to be unable to talk to employers in their language”⁵⁷. A research paper commissioned by the Department of Innovation, Industry Science and Research in 2010 similarly found that researchers most frequently need to improve transferrable career skills rather than technical skills⁵⁸. This was particularly true for disciplines with little emphasis on collaboration and interdependent learning.

PhD training is perceived as too specific to a particular sub-discipline.

Over 25% of respondents on a research project investigating the reasons why STEM PhD graduates were not hired identified that a key reason was that “holder’s focus was too narrow”⁵⁹. Consultations indicated that the more specialised a topic, the less likely the relevance could be to an industry setting⁶⁰.

One potential reason for this is that PhD graduates tend to focus on marketing their thesis in an interview setting, instead of the broader skills they gained through the PhD⁶¹. Such an emphasis would create the perception that their training was very narrow and specific to a particular area of study.

This could also be due to the fact that some students are currently unable to reframe their knowledge and repurpose their skills to suit the required context. Skills such as analytical and problem solving are useful across many contexts and could enable PhD graduates to be effective employees across many different industries and functions. These skills can be developed regardless of the “narrowness” of the research topic.

Financial capacity is a potential barrier to recruiting PhDs

Financial capacity is reported by some businesses as a barrier to recruiting high quality researchers⁶². Australian Council of Learned Academies’ (ACOLA) review of innovation in Australian businesses found the single most reported challenge to innovation was financial capacity⁶³. This is reinforced by poor collaboration and limited partnerships between industry and education institutes, which therefore increases the cost of the recruitment process. It is anticipated that the proposed changes to the tax incentives may help to address this, if changes are adopted by the Government.

Financial constraints are also seen through the view from industry that some PhD holders have wage expectations that are too high as compared to the salary premium industry is willing to pay. A survey conducted by the Office of the Chief Scientist into supply and demand issues regarding Australia’s STEM workforce indicated that 32.6% of respondents did not hire PhD graduates due to their wage expectations being too high (the fifth largest reason for PhD graduates not being employed)⁶⁴. This could be a result of industry not appreciating the value of a PhD graduate and the impact they can have on an organisation.



“I see PhD students and I see the emphasis on their PhD and area of specialisation, people will market themselves with their PhD rather than their range of their experiences”
– Industry stakeholder

UNIVERSITIES ARE ACTIVELY ENGAGED IN EQUIPPING PhDs WITH SKILLS THAT INCREASE EMPLOYABILITY

Universities deliver a range of programs for their PhD students to provide them with opportunities to develop generic transferrable career skills and to directly train their students in specific skills. A sample of programs that incorporate this type of skills development are discussed below.

ATN's e-Grad school prepares researchers with professional skills

The e-Grad School (Australia) (eGSA) is a virtual graduate school managed by QUT as a joint collaboration of the ATN. Its primary aim is to recognise the broader career paths that research graduates now undertake and support these by offering the opportunity for HDR (PhD and Masters by Research) students to develop non-discipline specific generic professional skills during their research training candidature so that they are more employer and industry ready.

The eGSA model is a unique and contemporary model that has been running successfully for more than 12 years and provides training to research students across Australia via short, fully online, flexible and easily accessible modules. The content of each module is responsive to the skills needs identified by non-academic employers of research graduates and offers foundational understanding of key concepts, authentic learning and case studies within community of practice environments.

These courses cover industry and employer relevant skill building areas including public policy, project management, research commercialisation, leadership and communication, and career skills and portfolio management.

To date over 10,000 students have registered for training with eGSA, including ATN HDR students, HDRs from other Australian universities and a small number from New Zealand universities. Demographic data on students undertaking the eGSA modules suggest that most students are under 40 years of age, undertaking full time study in a PhD, with enrolments evenly split between domestic and international students. Student satisfaction rates for all modules are routinely over 85% and data suggests that undertaking this additional training has no measurable effect on HDR completion times, indicating that the model works successfully within the HDR context.

Recent longitudinal data suggests that students undertake these modules because of self-identified skills gaps, or that they recognise the need for more than just research skills training with respect to their employability needs⁶⁵. Students who have completed the modules have indicated that they feel eGSA training has augmented their career goals and improved employment prospects.

Demand for eGSA modules seems to be increasing, indicating a growing demand for training via this model and also an increased need to provide employment and industry skills training to PhD students.

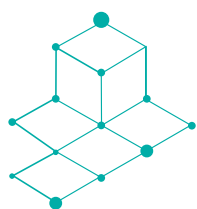


3 Minute Thesis develops communication skills

Most Australian universities, as well as some international universities, participate in the transnational 3 Minute Thesis (3MT) competition. 3MT provides a platform for PhD students to share their research, and develop their presentation and communication skills at the same time. It was originally developed by the University of Queensland in 2008 and has since gained an international following, with universities from North America, Europe, Africa and the Asia Pacific participating⁶⁶.

The competition requires participants to synthesise their research topic into a succinct three minute presentation that can be understood by non-academics. The presentations are honed over several rounds of competitions at various levels. Research students begin at the school level, and can progress all the way to the University and Asia-Pacific levels. This format pushes students to take their research from the lab into the real-world and build highly valued transferrable career skills in the process.

The competition is also valued by participants as it provides an opportunity to present their research topic to industry representatives. For example, the 2016 competition winner was approached by Boeing to engage in consultancy work following her presentation. She was also offered funding to support the second round of her research⁶⁷.



ATN's Industry Doctoral Training Centre demonstrates the potential for university collaboration with industry to develop PhD skills so that they are prepared for and can directly contribute to industry.

Institutional PhD programs develop transferrable career skills

Two examples illustrate how institutional PhD programs help students develop transferrable career skills.

The University of South Australia's Engaged PhD program provides PhD candidates with both soft skill development and insight about the potential pathways outside of academia. The program involves students undertaking a research based PhD with an added structured co-curricular experience that aims to develop transferrable career skills, complement the research experience, and enhance the global capability of graduates.

The Engaged PhD program takes place over three years

Year 1 – Induction, skill development, pathway selection: Students initially participate in a networking and program information retreat to understand the purpose of the program. Throughout the year, students attend core skill development workshops and masterclasses across topics such as communication, effective publishing and finding funding. Guidance is also provided to identify a suitable pathway that best fits the PhD candidate's interests and career aspirations.

Year 2 – Pathway training: Students undertake two pathway-specific study activities such as courses, workshops or masterclasses.

Year 3 – Pathway experience, portfolio development: Students participate in a work or community engagement experience and develop a portfolio that demonstrates their acquired skills and experiences relevant to their chosen pathway.

The University of Technology Sydney's Industry Doctorate Program (IDP) engages students in researchable industry problems and provides specialised support to students' research and helps to develop the professional skills needed to further their career. The program provides knowledge and skills to effectively create, plan, negotiate outcomes and deliver on industry projects. It aims to develop strong researchers who are collaborative, enterprising, strategic and entrepreneurial. The IDP contains the Industry Researcher Development Program (IRDP), which further develops researchers' professional skills.

The IRDP is facilitated by a range of research and industry experts, in block mode to enable candidates to work within supportive cohorts.

Modules cover:

- Collaboration and relationship building;
- Business management;
- Innovation, commercialisation and entrepreneurship;
- Industry engagement/awareness and;
- Career planning and management.

ATN Industry Doctoral Training Centre

ATN's Industry Doctoral Training Centre (IDTC) demonstrates the potential for university collaboration with industry to develop PhD skills so that they are prepared for and can directly contribute to industry.

The IDTC was initially established as a collaboration between the Australian Government and ATN universities. The IDTC is funded by ATN universities and industry. The program looks to pair students' PhD research with work in industry. The national centre is the first of its kind in Australia, and is based on similar initiatives at Oxford and Cambridge universities.

PhDs collaborate with an industry partner to work on an industry challenge, where solutions are driven by mathematics, statistics, information technology, and information sciences. Research under the program originates from industry, not academia (the candidate may be a present employee of the industry partner), and candidates spend three to four years completing their PhD. Industry research is supplemented by tailored coursework units which develop students' technical research skills, as well as their professional skills.

Industry partners include a wide range of organisations from a diverse range of sectors including financial services, mining and resources, health and Government.

The IDTC delivers value to industry and students as summarised below:

Value delivered to industry

- Addressing skills shortages – the program aims to attract more PhDs to research roles in STEM – an area of high demand in industry.
- Producing well-rounded, industry-ready graduates – the IDTC aims to produce graduates who are not only adept in research, but who possess strong professional, communication and leadership skills.
- Talent development – industry partners are given access to some of the brightest research talent in Australia, and are able to develop candidates in line with their specific needs and goals.

Value delivered to students

- Industry-centric education – the focus of the IDTC is to enable students to develop skills and experience that reflect the current demands of industry. The program is built around an industry-based problem, rather than starting with an academic issue and then trying to make it relevant to industry.
- Tailored professional skills development – through its e-Grad school and residential schools during a student's candidature, the ATN provides individualised professional development training modules in areas such as project management, leadership and communication, research commercialisation, entrepreneurship, public policy and global sustainability, financial decision making, leading and managing teams, business process modelling, and lean transformation.
- Collaborative learning – rather than industry partners outsourcing work to research students, PhDs spend part of their time at the partner site, working collaboratively with business leaders as part of the research team.

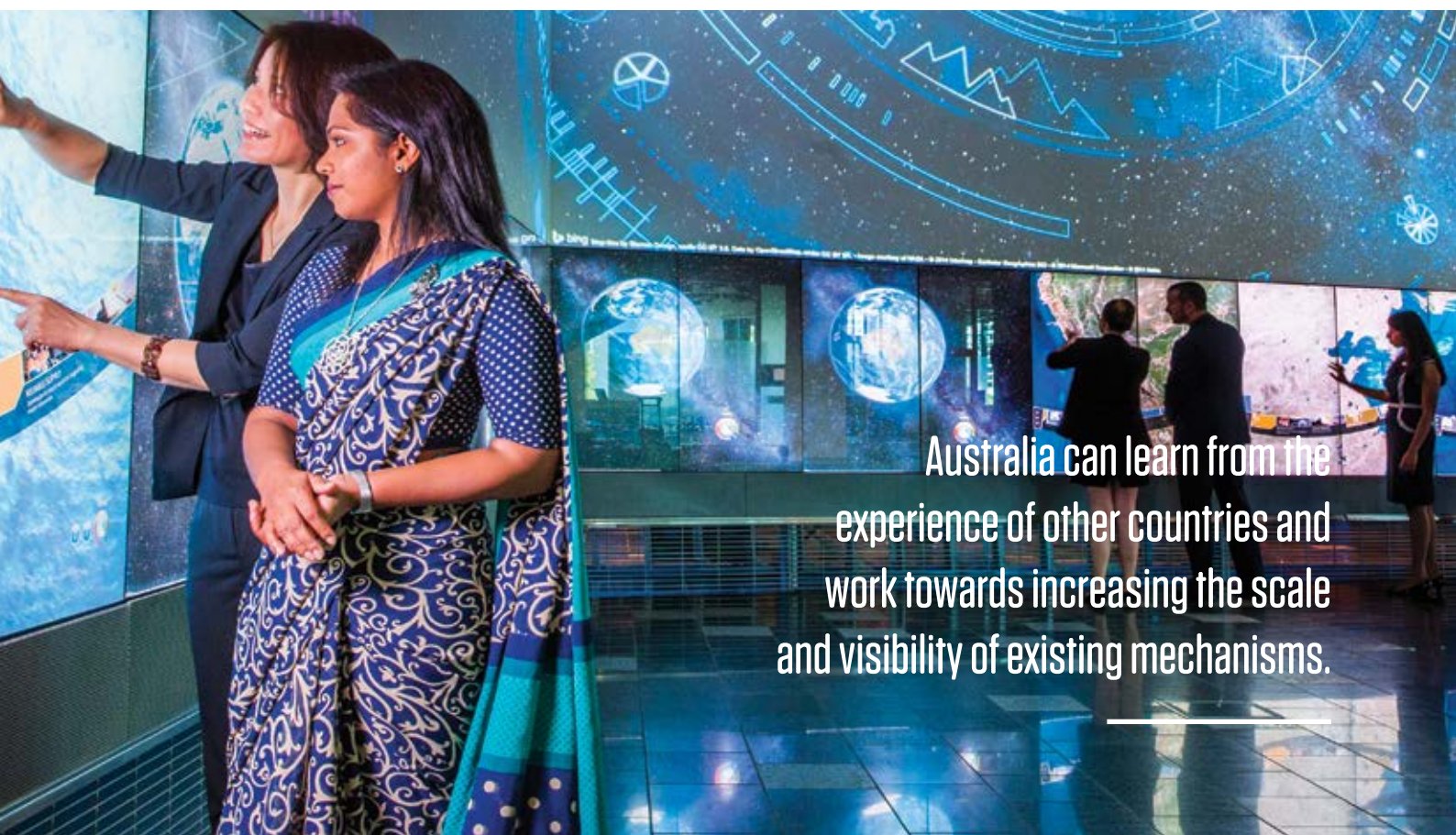
SCALING UP AND IMPROVING VISIBILITY OF EXISTING MECHANISMS HAS SHOWN TO HELP INDUSTRY AND PhDs ENGAGE WITH EACH OTHER

Many of the mechanisms in other countries to encourage PhD and industry collaboration are similar to what is already in place in Australia. One difference, however, is the scale of the initiatives implemented. For example, in some countries major collaborative partnerships are in use to enable mutually beneficial outcomes, and Governments play active roles in funding and running various programs to facilitate engagement. As a result, there is significant consistency and visibility in relation to the mechanisms in place.

Australia can learn from the experience of other countries and work towards increasing the scale and visibility of existing mechanisms. This will help ensure positive impact on the extent and quality of PhD and industry collaboration locally.

Other countries have partnerships that are carefully designed around stakeholder objectives

A range of countries have designed and implemented collaborative partnerships, based around the objectives and needs of both industry and students. In Europe there is a trend towards increasingly structured approaches to doctoral education involving industry, such as Government-led collaborative PhD programs. Internationally, national programs have been used to implement changes in industry and university engagement. Examples include France's CIFRE (Convention Industrielle de Formation par la Recherche), the UK's CASE (Collaborative Awards for Science and Engineering) and Denmark's Industrial Ph.D. programs. Key characteristics of collaborative programs like this are outlined in the table beside.



Australia can learn from the experience of other countries and work towards increasing the scale and visibility of existing mechanisms.

Key characteristics of Government-led collaborative PhD programs⁶⁸



Strategic engagement: There is strategic engagement between companies and universities, allowing for sufficient experience and trust to emerge to justify developing high-quality, long-term research partnerships. This in turn allows the university and company to commit to providing the required infrastructures and resources.



Skills: Many doctoral programs now involve coursework elements known as transferable skills, and structured placements (a period of time spent in industrial premises as an integral part of the candidate's education) are increasingly important.



Role of industry partner: The industrial contribution typically involves five main elements: supervision, funding, placements, data provider and network facilitator.



Admission requirements: Admission into collaborative programs involves requirements that are in addition to the university's policies for admission to doctoral education. Candidates may need to go through additional interviews, follow company-standard recruitment procedures, accept different rights, or possess pre-existing professional experience.



Formal agreement: A contractual agreement established at the start of the project provides a sign of commitment and establishes boundaries, resources and type of support that the partners commit to the project. Its main value lies in the discussion that precedes signature, increasing trust and clarity over objectives and mitigating risks such as disputes over Intellectual Property Rights (IPRs) and publication rights.



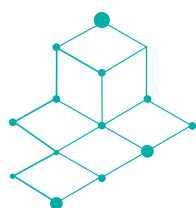
Confidentiality and IPR: Confidentiality and IPR agreements to manage potential tensions between the candidate's and university's need to publish and the company's (and in many countries also the university's) need to secure possible future exploitation of results.



Other considerations: Consideration of other issues such as the legal status of the doctoral candidate (which can affect Government funding), process for topic selection (which party makes the selection) and supervisory scheme.

Internationally, Government plays an active role in encouraging and facilitating collaboration

Governments across a range of countries in Europe, the Americas and Asia have taken an active role in encouraging and facilitating collaboration between industry and universities. These initiatives are largely based on the provision of funding by Governments, and there are also examples of other policy initiatives being progressed. Established initiatives across other jurisdictions illustrate the active role of Governments in either modifying incentives to encourage PhD and industry collaboration, or directly intervening to create the desired outcome. These are summarised as follows^{69,70,71}.



For PhD students without substantial work experience, industry placements have the potential to help them develop industry-relevant skills, and form relationships with industry.

Championing the professional and career development of researchers

This involves championing PhDs to stakeholders such as universities, commercial employers and policy-makers in ongoing dialogue to address cultural issues.



Vitae (UK) is a national program funded by the UK Research Councils which champions the personal, professional and career development of doctoral researchers and research staff in higher education institutions and research institutes. It produces a range of information resources tailored to the needs of employers and potential employers of researchers to highlight the value that doctoral graduates can bring to companies, address misconceptions or stereotypes and tackle specific issues such as effective recruitment.



This highlights the potential for developing content to enable employers to better understand the value that PhDs provide in Australia. The UK and Australia generally share a range of cultural similarities, including perceptions of PhDs, and solutions to cultural challenges may translate to the Australian context. This has informed the recommendation that the Australian Government implement a national communication strategy to improve industry awareness and help industry develop a deeper understanding of the PhD, outlined in Recommendation 4.

Transfer of research results and collaborations

This involves cross-sectoral transfer of results from public funded research to industry through initiatives such as support to create spin-off companies and jointly funded doctoral projects with an industrial focus.



CIFRE program (France) is an incentive scheme linking a company and a public research group in order to finance a doctoral candidate working in an applied area likely to be profitable for the company as well as to produce doctoral graduates better adapted to the needs of employers. The program involves a three year full time contract for the PhD candidate, providing certainty for all parties. Approximately 1,300 new fellowships are awarded each year.

“The Industrial PhD Programme” (Denmark) is a three year research project and training program with an industrial focus conducted jointly by a private company, a doctoral candidate and a university. The company and the university each receive a subsidy through the program.



A national program of Collaborative Doctoral Awards [CASE awards] (UK) encourages and develops collaboration and partnerships between higher education institutions and non-academic organisations and businesses. Awards provide opportunities for doctoral candidates to gain first-hand experience of work outside an academic environment with some candidates having support from both academic and non-academic supervisors.



Incentive programs such as these can enable deeper understanding by PhDs of industry needs, and new knowledge and innovation for Australian companies. Similar approaches are being considered in Australia. The Australian Government has recently announced changes to research and policy funding arrangements to further incentivise businesses to engage with universities. For example, the new RTP (Research Training Program) Research Block Funding uses industry engagement income as a funding driver.

Overseas approaches have informed the recommendation that the Australian Government link a portion of PhD scholarships to industry collaboration to specifically incentivise PhD engagement with industry. This would be a further step in the Government's current direction and is detailed as part of Recommendation 3.

Development of transferable skills such as practical application of technical knowledge and career management skills.

This involves support for training and opportunities to address a mismatch between the skills of doctoral graduates and those required by employers, contributing to increased mobility between universities and industry



UK: Specific funding to support career development and the development of transferable skills was made available to research institutions on a per-head basis for doctoral candidates and post-doctoral research staff funded by the UK Research Councils following the "Roberts' Review".

France: The Association Bernard Gregory (ABG) which is an association specialising in professional development and career counselling for researchers was established. The ABG have developed an exemplary program of training and services to develop and place doctoral candidates.

Canada: The Canadian Government has invested in the Collaborative Research and Training Experience (CREATE) Program which is

designed to improve the mentoring and training environment for Canadian researchers in areas such as professional skills, communication etc. Training focuses on providing a value-added experience to the university training environment to prepare researchers for a future in either industry, Government or academia.



This highlights the opportunity for the Australian Government to contribute to the development of industry-relevant skills among PhD students. For PhD students without substantial work experience, industry placements have the potential to help them develop industry-relevant skills, and form relationships with industry. The Australian Government has considered similar approaches and has recently committed funds to scale up the Australian Mathematical Sciences Institute's internship program. This is detailed as part of Recommendation 1.3.

Incentives to employ specialist research staff

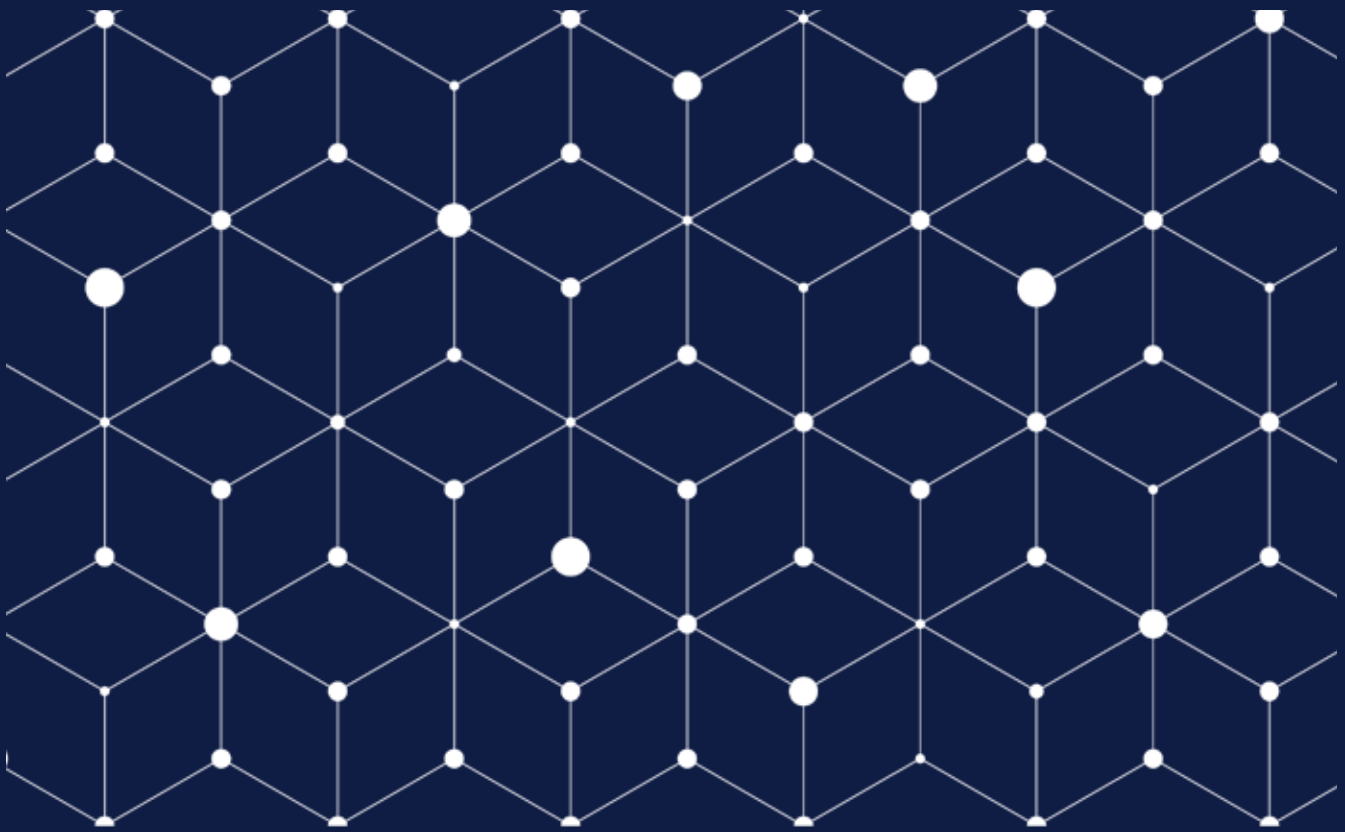
This involves subsidies to businesses, especially to SMEs, to reduce the risk of hiring staff for R&D projects.



Spain: The Spanish Ministry of Science and Education (MEC) fund the Torres Quevedo program to promote the incorporation of doctoral graduates and technologists into companies by relieving companies (especially SMEs) of the considerable cost of employing specialist staff during the first year of their business activity or when starting a new R+D+I project. Grants available are direct subsidies and may amount up to 75% of the total recruitment cost, depending on the project and the kind of beneficiary.

Hong Kong: The Hong Kong Government has funded a University-Industry Collaboration Program (UICP) to stimulate private sector interest in R&D through leveraging the knowledge and resources of universities. One of the specific schemes that sits under this supports local companies to take on graduate students to assist in proprietary R&D work.

This highlights the potential for the Australian Government to create financial incentives so that Australian businesses are incentivised to employ PhD graduates. The Australian Government is currently considering tax incentives to encourage businesses to engage with PhDs. The potential introduction of the collaboration premium for businesses, in particular for the cost of hiring PhD graduates for the first three years of employment, will help further incentivise businesses to employ specialist research staff. This is detailed as part of Recommendation 5.



RECOMMENDATIONS

Based on the findings outlined above, Nous has identified five recommendations that could further enhance the value of PhDs to industry:

1.

Expand in place supporting structures to deepen PhD and university collaboration with industry

4.

Implement a national communication strategy to improve awareness and develop a deeper understanding in industry of the PhD

2.

Ensure initiatives targeting PhD employability have broad scale

5.

Introduce tax incentives to encourage businesses to engage with PhDs

3.

Link a portion of PhD scholarships to industry collaboration



EXPAND IN PLACE SUPPORTING STRUCTURES TO DEEPEN PhD AND UNIVERSITY COLLABORATION

Structured programs are strategic initiatives involving a mix of stakeholders, including Government, industry, university and PhD students. These programs aim to increase industry engagement of PhD candidates, and are usually time-bound with clearly defined objectives. Structured programs can occur in several formats, including strategic collaborations, work placements, national industrial placement schemes, and the establishment of research institutes.

It must be noted that universities now recognise that a large number of graduate research projects should be applied in nature and respond to real world problems, often engaging industry partners throughout the PhD lifecycle, including in problem definition, project design, data collection or review of methodology/findings. These are not always structured strategic collaborations but do involve collaboration with partners and ultimately produce 'value' for industry/end users.

1.1 Strategic collaborations involve candidates working with industry on a specific project

A strategic collaboration can be defined as an existing or new collaboration between a university, a supervisor or a candidate and an industry partner that results in the identification of a research project that has a specific application to a particular industry. This includes collaboration involving industry supervisors and candidates working on industry defined research problems that enhance engagement between industry and PhD candidates⁷².

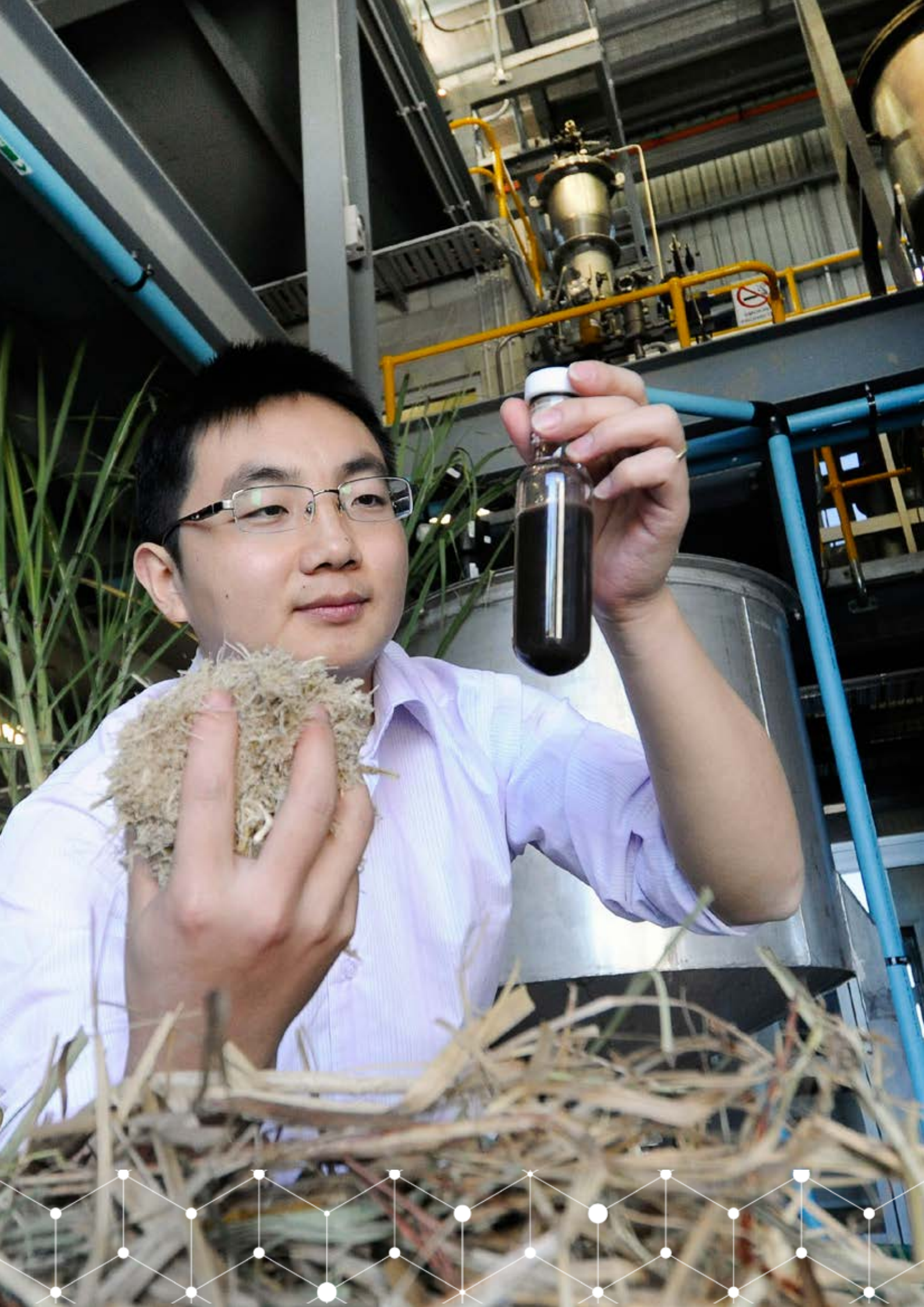
In addition to the value of the research and innovation that can come from strategic collaborations, they also provide opportunity for PhD candidates to expand their industry connections and knowledge.

One example of a strategic collaboration of this type is the Smart Skies project involving Boeing, QUT and the CSIRO⁷³.

CASE STUDY:

THE SMART SKIES PROJECT INVOLVING BOEING, THE QUT AND THE CSIRO

Smart Skies was a \$10M, three year joint venture project focused on developing automated flight technology through experimenting with efficient and portable unmanned aerial technologies for a variety of applications⁷⁴. It was a highly successful program that involved eight flight campaigns and resulted in the publication of over 20 scientific publications. The project was awarded the 2010 Business & Higher Education Round Table Award for Best Research and Development Collaboration.



1.2 Work placements enable candidates to develop industry-ready skills

Short term placements or internships provide opportunity for PhD candidates to develop workplace skills and experience. They can take place at any time during a candidature and may not be directly related to a research project.

Work placements can result in greater integration with industry⁷⁵. They have been suggested as key to overcoming potential disjunctions between research training and employer needs, particularly for PhD students without prior work experience⁷⁶, with many businesses finding them an important step to ready graduates for careers in industry⁷⁷.

Work placements can also be used as a recruitment tool, helping businesses filter from a large pool of high quality candidates, while establishing strong connections with researchers⁷⁸.

CASE STUDY:

THE QUEENSLAND GOVERNMENT'S PhD INDUSTRY EXPERIENCE PROGRAM

The Queensland Government's PhD Industry Experience Program is one example of a work placement initiative. The program supports knowledge transfer between PhD candidates and industry through unpaid internships of up to 30 days⁷⁹. Students are able to expand their industry knowledge and networks while also demonstrating their skills and competence to industry. Projects chosen become a part of the student's course with business supervisors providing feedback on contribution to the university.

CASE STUDY:

IPREP WA PROGRAM INVOLVING CURTIN UNIVERSITY

iPREP WA is a unique collaboration between the five WA universities. The program involves PhD students in interdisciplinary teams, working on a six week project for an industry partner during their thesis examination period to solve authentic workplace problems. As part of this, PhD graduates will learn to recognise that skills they developed in the PhD, such as problem-solving and critical thinking skills, are applicable across a range of disciplines. Additionally, the program highlights to both PhD graduates and industry on the value of research engagement⁸⁰.

Patrick Fritz, a Curtin University PhD graduate who is also an iPREP WA alumni, worked on a project for the Fortescue Metals Group as part of the program. He acknowledged that the program led to an appreciation of employment outside of academia and contributed to both personal and professional development⁸¹.

1.3 National placement schemes have potential to develop capability and links on a large scale

National placement schemes involve embedding PhD candidates in the workplace, working on an industry identified, directed and sponsored project. Schemes of this type have the potential to develop closer working relationships between universities and industry, and provide a strong flow of research capability to industry via PhD candidates.

National schemes have received some attention over recent years. A scheme was proposed in the Review of Research Policies and Funding Arrangements (2015) by Dr Ian Watt and re-emphasised in the Review of Australia's Research Training System (2016) by ACOLA. The Government has recently accepted this proposal and has committed \$28.2 million over four years to expand the Australian Mathematical Sciences Institute's internship program to a national-scale program. This is expected to provide upward of 1,400 placements for PhD researchers from a wide range of disciplines, with a particular focus on women⁸³.

1.4 Institutes and targeted programs can be critical facilitators of industry engagement

A range of organisations have established Institutes which run programs designed to facilitate industry experience while completing research. These Institutes play an important role in bridging the gap between the needs of industry and the skills and knowledge of PhD students and graduates. Coordinated programs can help provide PhD students with a clear pathway to developing industry experience while completing their studies and help PhD students understand what the needs of industry are⁸⁴.



CASE STUDY:

CANADIAN MITACS PROGRAM

Mitacs is a Canadian national not-for-profit with over 15 years of experience in designing and delivering research and training programs. Mitacs works with 60 universities, thousands of companies, and federal and local Governments to build partnerships that foster industrial and social innovation in Canada. Mitacs' six core programs involve embedding students within industry to varying degrees, to ensure that any skill deficits for industry are addressed directly by industry. This design ensures that students learn directly from representatives and staff at the partner organisation to improve graduates' repertoire of skills and abilities most aligned with enhancing social and industrial innovation⁸².

ENSURE INITIATIVES TARGETING PhD EMPLOYABILITY HAVE BROAD SCALE

Programs that cover transferrable career skills can help to ensure that PhD graduates receive optimal and appropriate training during their studies from an industry perspective⁸⁵. Universities have started to invest in this. There is opportunity to progress and expand these initiatives across the sector, increasing their scale and reach to have a greater impact on PhD employability through workplace skills development.

There are currently programs and initiatives in place to encourage collaboration between PhD candidates, universities and industry. Many Australian universities are working with industry on issues of employability. These programs should be expanded to ensure more beneficial collaborations take place. To support these programs and initiatives, supporting structures need to be put in place to maximise chances of successful collaboration. Key supporting structures include co-designing and expanding the range of programs available, expanding industry funding, and enhancing performance incentives within universities for collaboration. Additionally, a project is currently underway by Professor Hamish Coates, which has a focus on reviewing the structures and programs to enhance transferable skills⁸⁶.

More broadly, there is opportunity to scale up initiatives to achieve substantial and sustainable impact in PhD engagement and employment in industry. Previous reviews and reports on Australia's training system have identified that Australia's approach to tackling the problem of research and industry collaboration have lacked scale^{87,88}. As highlighted throughout this document, there are already a range of initiatives in use, many of which have substantial potential to be applied at greater scale to achieve broader impact. Government, universities and industry all have a role to play in scaling up initiatives that are found to have achieved benefits.

2.1 Expand the range of programs available for PhD candidates to collaborate with industry as part of their candidature

There are a range of programs and initiatives already in place to enable collaboration between PhD candidates and industry. These initiatives highlight the potential for innovation and productivity increases for individual organisations and whole industries.

Expanding the number, variety and availability of programs would likely be of substantial benefit, particularly when coupled with communication to industry about the value of collaboration with PhDs.

The recent decision by Government to progress a national placement scheme should deliver greater scale in collaboration. While this is just one mechanism which may not suit candidates, it is a welcomed initiative which contributes to the suite of initiatives necessary to encourage collaboration.

It is important for programs to emphasise a co-design approach between industry and universities if the aim is to boost collaboration. The current system does not highlight the need for universities and industry to collaborate on a consistent basis through the course of the PhD or through specific programs. This can lead to issues where solutions designed are not practical for one or both stakeholder groups, resulting in a loss of commitment over time. A co-design approach would involve both parties equally identifying the scope and intent of the PhD project and regularly meeting to discuss project updates to develop a project that is both grounded in rigorous research and reflects commercial realities, for example the IDTC and the other structured programs.

2.2 Expand industry funded scholarships to increase collaborative opportunities

Industry can also help to enable PhD involvement through providing financial assistance via scholarships themselves or in-kind support to PhD candidates that support any government funded scholarships. An increase in industry based PhD scholarships would also require an increase in mentoring and coaching support from industry to ensure that PhD candidates maximise their learning and development through the process. This is a great opportunity for industry to solve problems in a cost effective way, boost innovation within their organisation, and deepen links to publically funded research organisations.

The case study below provides an example of how industry can drive increased collaboration through funding.

2.3 Adjust performance incentives within universities to explicitly signal the importance of industry collaboration

Performance incentives within universities may need to change to enable improved collaboration. Universities can explicitly build in performance metrics that focus on the amount and nature of collaboration that university staff have with industry to demonstrate the importance placed on strong ties with industry. This will also help to signal the behavioural shift desired and ensure that industry collaboration is built into the academic work cycle. Closer ties should help further highlight the array of skills and experiences PhD candidates obtain and may lead to increased numbers of PhD graduates hired into industry.

“We’d love the opportunity to engage early in the planning process. Even if it comes down to us giving questions to academia that we’d like answered and saying we’d be willing to invest time to help the student in doing that and us getting an understanding of how PhD study is created”
– Industry stakeholder



CASE STUDY:

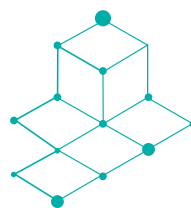
THE IBM PhD FELLOWSHIP PROGRAM

The IBM PhD fellowship program recruits exceptional PhD graduates to advance cross-sector innovation⁸⁹. The IBM fellowship program selects exceptional PhD graduates with an interest in solving problems important to IBM and fundamental to cross-sector innovation. The academic disciplines that IBM selects from are broad and include engineering, public sector and business sciences, physical sciences and more. The program helps to develop collaborative links between these graduates and organisations to solve industry problems. IBM PhD fellows are matched with an IBM mentor and are strongly encouraged to undertake IBM internships while completing their studies⁹⁰.

LINK A PORTION OF PhD SCHOLARSHIPS TO INDUSTRY COLLABORATION

Financial incentives are an important element to drive desired behaviour in PhD and industry collaboration. Government has recently announced changes to research and policy funding arrangements which seek to provide greater incentives for business and other research end-users to engage with university. In particular, the Government is increasing its weighting of Categories 2, 3 and 4 research income (Category 3 being related to industry and other research income, for the provision of research support). Under the National Innovation and Science Agenda, the Government is also allocating further funding to increase collaboration between universities and business engagement.

While current Government changes are a positive sign in displaying their intent to encourage industry and university collaboration, these changes do not have a specific PhD focus. The Government could incentivise PhD specific engagement with industry through increased and targeted funding. Specifically, the Government could tie a percentage of its scholarships to industry collaboration. This percentage could be informed by international benchmarks or through discussions with universities. Financial incentives provided would help to further amend university behaviour and would clearly signal the intent of Government, university and industry to continue to shift the nature of PhD-industry collaboration.



While current Government changes are a positive sign in displaying their intent to encourage industry and university collaboration, these changes do not have a specific PhD focus.



IMPLEMENT A NATIONAL COMMUNICATION STRATEGY TO IMPROVE AWARENESS AND DEVELOP A DEEPER UNDERSTANDING IN INDUSTRY OF THE PhD

There is a need to raise awareness across industry of the attractiveness and value of PhDs. This should include targeted communications initiatives led by Government, with support from the university sector and peak bodies. PhDs also have a role in promoting their capabilities, and targeted training and information could be provided to better enable this.

4.1 Champion the training, experience, and skill sets of PhD graduates to deepen the understanding in industry of the value of PhDs

Currently, industry does not appear to have a clear sense of the wide range of skills that PhD holders develop nor the benefit that PhD graduates are able to deliver to productivity and innovation⁹¹. A national communication strategy led by Government and supported by universities and peak bodies, to highlight such skill development amongst PhD holders, may help improve awareness and understanding of PhDs. This should focus on the wide range of skills developed and the applicability of these skills to a variety of contexts.

Together, with other improvements suggested, educating industry on the value of PhDs may also help to overcome existing cultural barriers and provide a clear narrative around the benefits a PhD brings to business⁹². This cultural change could further enhance collaboration^{93,94}.

4.2 Train PhD candidates to market themselves in a holistic manner

PhD candidates and holders have a role in better communicating the value they provide to industry. In particular, there is potential for PhD candidates to better understand and communicate the broader skills they develop during their candidature. This requires some level of information provision and training during their candidature to help them understand what attributes are sought after by industry. Universities are making efforts to assist PhD students in this area, as previously discussed. However, there is opportunity for universities to do more to explain the benefits of a PhD to students, explain how PhDs can engage with industry, and provide training to help students identify and contextualise their skills. This could be embedded across the entire PhD training process, from enrolment through to supervision⁹⁵.

One way to achieve this is to provide PhD students with career counselling and support. The provision of specialised career counselling and support for PhD students may help provide them with tailored advice and information. There is a need to develop programs which provide more effective career management services to doctoral candidates, starting from the point where an individual is choosing the topic for research. Support services can help them in deciding on the best opportunities, initiatives and career investments to make⁹⁶. A better understanding of industry, including hiring requirements, would enable PhD students to better market themselves holistically. An example of this approach is the 'World of Work' program at the John Moores University, outlined below.

CASE STUDY:

LIVERPOOL JOHN MOORES UNIVERSITY (UK) PROVIDES UNIVERSITY CAREER SUPPORT

Liverpool John Moores University has developed a collaborative 'World of Work' program with employers which supports a pro-active approach to preparing for work and identifies eight transferable skills that all their graduates should have: analysing and problem solving, team working and interpersonal skills, verbal communication, personal planning and organizing, initiative, numerical reasoning, information literacy, and IT skills⁹⁷. The program includes a skill gap analysis, workshops and group sessions, filmed interviews with employers, placement opportunities, conventional careers guidance and employer-endorsed certification.

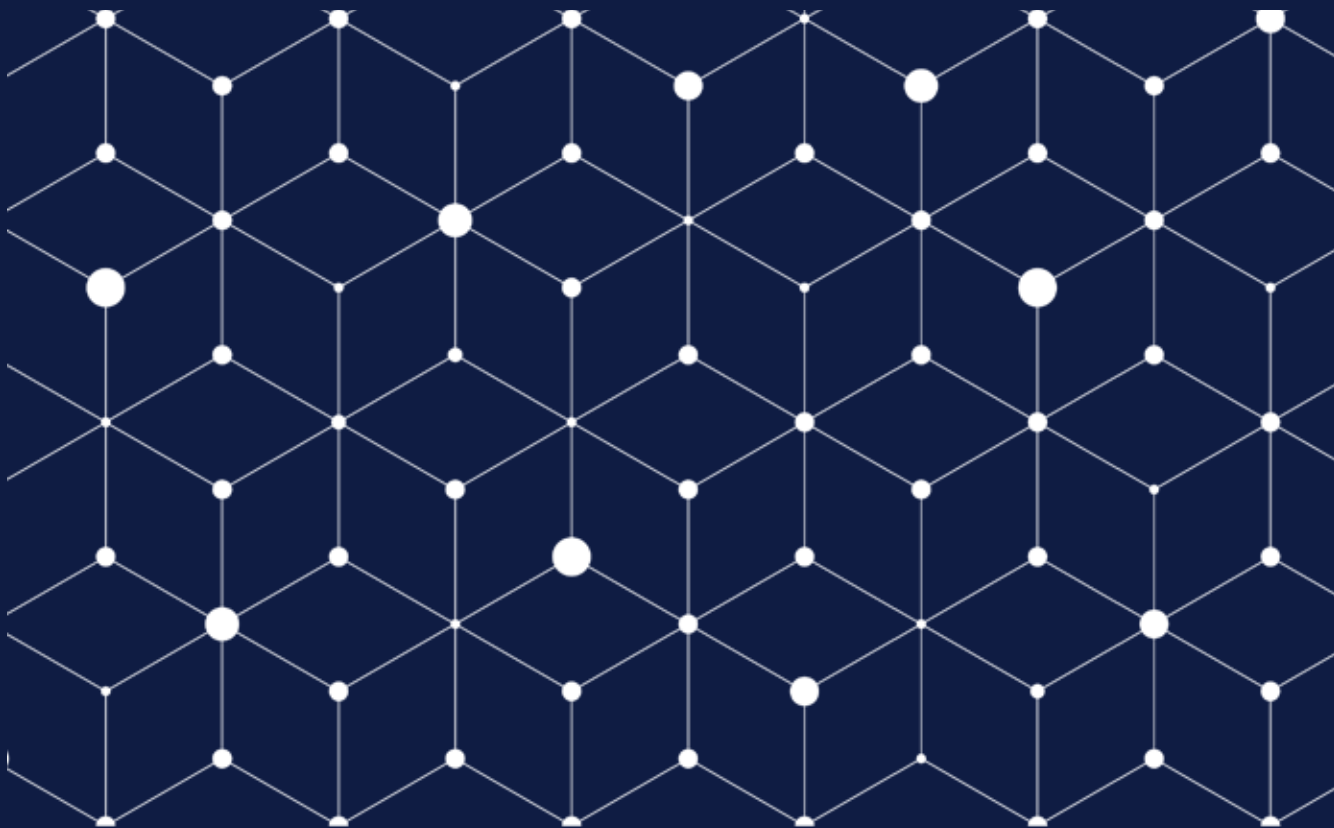
INTRODUCE TAX INCENTIVES TO ENCOURAGE BUSINESSES TO ENGAGE WITH PhDs

Tax incentives could help to subsidise the cost of PhDs to businesses, as well as help to promote research collaborations between industry and universities. The recent Review of R&D Tax Incentive conducted by Mr Bill Ferris AC (Innovation Australia), Dr Alan Finkel AO (Chief Scientist), and Mr John Fraser (Secretary to the Treasury) recommended a package of measures to improve the R&D tax incentive's effectiveness and integrity. The proposal, in particular to introduce a collaboration premium for businesses to partner with publicly-funded research organisations, including the cost of hiring PhD graduates in their first three years of employment, was welcomed by the university sector⁹⁸. The Government is currently reviewing feedback provided through the first phase of consultation on the report with a further two waves of consultation planned. The final response is due in early 2017. Such changes, if adopted, should create stronger pathways between PhD graduates and industry, while also fostering a greater culture of innovation and outcome-orientated research among Australian businesses^{99,100}.

The Government should consider implementing the tax incentives as it is expected to create stronger pathways between PhD graduates and industry, while also fostering a greater culture of innovation and outcome-orientated research among Australian businesses^{101,102}. Additionally, the Government could consider expanding the applicability of the tax incentives to all PhD graduates, and not just those in STEM.



Tax incentives could help to subsidise the cost of PhDs to businesses.



APPENDIX & REFERENCES



APPENDIX A: INDIVIDUALS/ ORGANISATIONS CONSULTED

Alison Gould / Red Cross

Allahmanli Lutfiye / Powerlink

Andrew Crevald / College Director / Western Australian Private Education & Training Association

Andrew Gooley / Chief Scientific Officer / Trajan Scientific and Medical

Associate Professor Angela Scarino / School of Communications / International Studies and Languages / UniSA

Bronwyn Brown / Landgate

Christine Voge / Business Coordinator / Queensland Academy of Sports

Damien Thomas / Director / Industry Business Development / RMIT

Professor Denise Cuthbert / Associate DVC Research Training and Development / RMIT

Fiona Zammit / Executive Officer of the Australian Council of Graduate Research

Professor Garry Allison / Associate DVC – Research Training / Curtin University

Professor Glenn Wightwick / Deputy Vice-Chancellor and Vice-President (Research) / UTS

Greg Allen / Sydney Water

Professor Helen Klæbe / Dean of Research and Research Training / A/DVC R&C / QUT

Ian Chubb / Former Chief Scientist

Jan Van Emden / Business Manager Research & Development / Helping Hand

Jenny Lambert / Director / Employment, Education & Training / ACCI

Paige Maguire / Deputy Director / eGrad School Australia

Richard Taube / Australia Manager / University Programs / Ford Motor Company of Australia Ltd

Sam Bailey / Dept Transport & Main Roads

Scott Cowans / Client Executive / IBM

Shaji Mathews / Technical Director / AICA Engineering

Dr Sharon Winocur / Executive Director / Business/ Higher Education Round Table (B/HERT)

Susan Carter / Learning, Leadership & Development / Siemens Ltd

Professor Tanya Monro / Deputy Vice Chancellor / Research and Innovation / UniSA

Professor Wasim Saman / Professor of Sustainable Energy Engineering / School of Engineering / UniSA



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