SECURING
AUSTRALIA'S
FUTURE

Review of
Australia's Research
Training System

FINAL REPORT

PROJECT

13

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Review of Australia's Research Training System

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Letter of Transmittal

Professor AB Holmes AM PresAA FRS FTSE
President
Australian Council of Learned Academies
Melbourne VIC 3004

Dear Professor Holmes,

I am pleased to deliver to you the report of the Review of Australia's Research Training System.

ACOLA was commissioned in May 2015 by the previous Minister for Education and Training, the Hon Christopher Pyne MP, to conduct a comprehensive review of Higher Degree by Research (HDR) training in Australia. This project was undertaken by an Expert Working Group (EWG) consisting of Fellows from the four Learned Academies, with expertise in research, higher education and industry. The EWG expresses its thanks to the officials from the Department of Education and Training, the Office of the Chief Scientist, and to the Review secretariat for their advice and assistance during the Review.

The EWG consulted extensively with stakeholders in the higher education, government, not-for-profit and private sectors to seek their input on the state of HDR training in Australia and how the system can be strengthened. We received 80 written submissions, conducted 84 individual stakeholder interviews, and held six public forums around Australia, as well as additional consultations with Deputy Vice Chancellors of Research and the Australian Council of Graduate Research. We also analysed literature and program materials on the HDR training systems of comparator countries. HDR candidates and graduates were a particular focus during the evidence gathering process.

From this data collection, the EWG developed a focus on three key themes:

- Supporting our research training candidates

- Delivering benefits to the nation through research training

- Improving the research training system

The Key Findings and Recommendations contained in this report speak to these three themes.

Research training has been well-studied and well-reviewed in the recent past. We analysed many of these previous key reviews that have been conducted both in Australia and internationally in recent decades, and found that many of the recommendations have been consistent over time. We are of the strong view that the sector does not require further reviews for at least five years. The focus of the sector as a whole must be on implementing the learnings from the Key Findings of this Review to ensure that Australia has a world-class HDR training system.

Government clearly has a regulatory and financial role in improving the system, but many of the actions required fall under the remit of universities working in close collaboration with other stakeholders, especially industry, communities, and other parts of the innovation sector. Although the Recommendations detailed here are directed primarily at the Government, the EWG stresses that many of the actions flowing from the Key Findings will require implementation by the higher education sector, wider industry and community stakeholders.

Importantly, we recommend that the Government establishes an implementation working group to ensure that the Findings can be implemented–essentially *how the system can do this to and for itself*. Recognising the introduction of the Government's *National Innovation and Science Agenda*, and the clear priority on improving the links between universities and industry, this working group would be empowered by strong links with Innovation and Science Australia, such as by including a Board member on the working group. We also highlight the important roles that industry (in its broadest sense– businesses, governments, government business enterprises, non-government organisations, not-for-profit organisations, and community organisations) has to play, particularly in ensuring that HDR training makes its maximum contribution to national prosperity. This important work will be advanced by the Government's commitment to fostering research-industry collaboration through the National Innovation and Science Agenda.

The Review worked closely throughout with Dr Ian Watt AO and his team conducting the *Review of Research Policy and Funding* to ensure cooperation and collaboration between the two reviews. We are pleased that the recommendations of the *Review of Research Policy and Funding* largely mirror those of this Review, particularly in supporting industry placements for HDR candidates and broader industry–university collaboration.

We consider that the *Review of Research Policy and Funding* recommendations are an important first step in helping reverse Australia's poor performance in industry–university collaboration. We are concerned that our national industry–university collaboration performance lies close to last in international comparators, and submit that this situation is unacceptable for a nation striving to transition to an innovation-driven economy. There is an urgent need for Australia to address this issue. We encourage the university sector to develop a range of industry engagement models in research training to drive proactive industry-university collaboration. We encourage industry to engage with universities in order to benefit from the skills and expertise of researchers. We consider that building a national industry placement scheme for HDR candidates of significant scale and scope through a national coordinating body would contribute considerably to this endeavour. Australia must aspire to improve its industry-university collaboration performance to equal that of the top 25 per cent of our OECD international competitors. We consider that research training has a crucial role to play in achieving this aspiration.

Australia has a strong and well-respected HDR training system, but if we are to maintain and strengthen this system we will need to face the many challenges that lie ahead. By implementing the Key Findings and Recommendations detailed here, Australia can have a truly world-class HDR training system that provides social, economic and environmental benefits to our nation.

Yours sincerely,

John McGagh FTSE
Chair, Expert Working Group
Review of Australia's Research Training System
11 March 2016

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Acronyms

AAHMS	Australian Academy of Health and Medical Sciences
AAMRI	Association of Australian Medical Research Institutes
AARNet	Australia's Academic and Research Network
ABS	Australian Bureau of Statistics
ABSTUDY	Aboriginal Study Grants Scheme
ACGR	Australian Council of Graduate Research
ACOLA	Australian Council of Learned Academies
AFL	Australian Football League
AHEG	Australian Higher Education Graduation Statement
AMSI	Australian Mathematical Sciences Institute
ANSTO	Australian Nuclear Science and Technology Organisation
ANU	Australian National University
AO	Officer of the Order of Australia
APA	Australian Postgraduate Award
ARC	Australian Research Council
ATN	Australian Technology Network
Austudy	Austudy payment
BPhil	Bachelor of Philosophy
CAPA	Council of Australian Postgraduate Associations
CASE studentship	Collaborative Awards in Science and Engineering studentship
CRC	Cooperative Research Centres
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSP	Commonwealth supported place
DAAD	German Academic Exchange Service

DASSH	Australasian Council of Deans of Arts, Social Sciences and Humanities		NATSIHEC	National Aboriginal and Torres Strait Islander Health Equality Council
EMCR Forum	Australian Early- and Mid-Career Researcher Forum		NERC	Natural Environment Research Council
ERA	Excellence in Research for Australia		NHMRC	National Health and Medical Research Council
EWG	Expert Working Group		NTEU	National Tertiary Education Union
FAA	Fellow of the Australian Academy of Science		OECD	Organisation for Economic Cooperation and Development
FAHA	Fellow of the Australian Academy of the Humanities		PhD	Doctor of Philosophy
FASSA	Fellow of the Academy of the Social Sciences in Australia		PREQ	Postgraduate Research Experience Questionnaire
FTSE	Fellow of the Australian Academy of Technology and Engineering		QUT	Queensland University of Technology
HDR	Higher Degree by Research		RMIT	Royal Melbourne Institute of Technology
HECS-HELP	Higher Education Contribution Scheme - Higher Education Loan Programme		RTS	Research Training Scheme
IP	Intellectual property		SANTOS	South Australia Northern Territory Oil Search
iPREP WA	Industry and PhD Research Engagement Program Western Australia		SME	Small to medium enterprises
			SORTI	Centre for the Study of Research Training and Impact
IPRS	International Postgraduate Research Scholarship		TEQSA	Tertiary Education Quality Standards Agency
IRU	Innovative Research Universities		UK	United Kingdom
JCU	James Cook University		Uni SA	University of South Australia
JDRF	Juvenile Diabetes Research Foundation		UNSW	University of New South Wales
JRE	Joint Research Engagement		UMETRICS	Universities: Measuring the Impacts of Research on Innovation, Competitiveness, and Science
MDPP	Medical Device Partnering Program			
MCEETYA	The Ministerial Council on Education, Employment, Training and Youth Affairs		US	United States of America
			UTS	University of Technology Sydney
MCM	Melbourne Conservatorium of Music		UWA	University of Western Australia
MP	Member of Parliament		VCA	Victorian College of the Arts
MRes	Master of Research		WA	Western Australia
NAF	National Academies Forum			

Review terms of reference

The Review will examine Australia's HDR training system, and consider the priorities for reform, including how to:

- ensure that Australia's HDR training models are comparable with the best in the world

- ensure that research graduates are equipped for and achieve employment outcomes in a range of sectors, including academic teaching, research and industry

- provide greater opportunity for industry relevant HDR training, including through

    - support for industry relevant research projects and experience

    - access to industry and business relevant skills within HDR training programs, such as entrepreneurial skills

    - recognition of prior experience in industry or other relevant employment

- remove barriers in the regulatory framework to facilitate innovation in degree models and align with international best practice, including

    - facilitating opportunities for more structured HDR training programmes, including through professional development, coursework and internships

    - supporting alternative pathways to a PhD that align with international best practice, such as Masters degree preparatory models

- support admission and attainment for PhD candidates from non-traditional backgrounds, including supporting Indigenous research candidates

- ensure the research workforce pipeline is secure in fields of national importance, including areas aligned with national science and research priorities

- ensure that our HDR training system delivers a high quality research and learning environment and continues to support candidate choice and competition between providers, and

- make the best use of current resources invested in HDR training by all stakeholders, including universities, industry and the Australian Government.

Executive summary

Australia's Higher Degree by Research (HDR) training system is critical to our future economic strength. It provides a highly qualified research workforce, enabling research and innovation across the academic, industry, government and not-for-profit sectors, as well as contributing substantially to Australia's and the world's body of knowledge.

This Review has engaged widely with stakeholders, including higher education and research institutes, HDR candidates and graduates, peak bodies, industry, business groups, government agencies, experts, and not-for-profit organisations in order to deliver evidence-based findings which identify opportunities to improve Australia's HDR training system.

There was broad agreement from stakeholders that Australia's HDR training system currently performs well in the areas of academic outputs. Other strengths identified include: a rich variety of choices in pathways; flexible entry requirements with provision for academic equivalence assessment;

an independent, high quality examination process; and an emphasis on high quality disciplinary research and the development of associated research skills. Nevertheless Australia's performance in the area of industry-research collaboration is amongst the lowest when measured against OECD competitor countries. This situation is extremely concerning for a nation that strives to develop a vibrant knowledge based economy.

Evidence suggests that there is significant room for improvement across a range of important areas relevant to HDR training. These improvements, which are detailed below, need to be implemented with high priority to ensure that the system delivers the best returns on investment for HDR candidates, graduates, and the nation. Australia must aspire to improve its industry–university collaboration performance to equal that of the top 25 per cent of our OECD international competitors. We consider that research training has a crucial role to play in achieving this aspiration.

Improvements to Australia's HDR training system must be delivered by the sector in collaboration with key government and industry stakeholders, and reform initiatives must be undertaken in an environment which provides the necessary time and policy stability to develop and implement solutions, and assess their outcomes. The vital issues at the heart of improving our research training system are not the responsibility of any particular stakeholder (be it universities, industry, governments or communities). Solutions, however, require the effective coordination and collaboration of all stakeholder groups.

Most of the findings and recommendations arising from this Review build on the findings of previous reviews, both within Australia and overseas. We believe that additional reviews are unlikely to uncover fundamentally new insights. The system now needs a strategy to develop and implement responses to the recommendations and findings of the past decade's reviews. As such, this Review recommends that the Australian Government should support the establishment of a sector-based implementation working group to develop such a strategy and timeline for implementation.

Outcomes from this reform strategy should be subject to ongoing monitoring, but further reviews of research training in Australia should not be undertaken until the reforms have had enough time to take effect. The highly influential 'Roberts Review' in the United Kingdom (UK) was undertaken in 2002. The reforms arising from the Robert's Review were given 8 years to take effect before a further comprehensive review was undertaken in 2010. This Review considers that Australia's HDR training system requires a similar period of time to implement a reform strategy and assess its outcomes before being subject to another review.

The need for better data and information on the system itself was a common thread across the different areas of the review. Poor data on the performance of our HDR training system makes it difficult to understand what return is generated from Australian Government investment of more than $1 billion annually and how best to go about improving the system. Longitudinal data sets on HDR graduate outcomes would provide valuable information to drive performance improvements in the system and enable prospective HDR candidates to make informed choices about their HDR training. Further, international benchmarking of HDR training performance at the disciplinary level would provide a nuanced understanding of the actions needed to ensure our HDR training system remains world class.

Within this report collaboration and engagement with industry refers to any potential end user of research including but not limited to: businesses, governments, government business enterprises, non-government organisations, not-for-profit groups and community organisations. Research training has the potential to drive closer and broader engagement between industry and the university research sector, and contribute to reversing Australia's unacceptable international performance in this critical area. Increased industry linkages during research training, through placements with industry partners and undertaking industry-defined research projects, will drive the establishment of long-term

relationships between industry and researchers. This will help to overcome the cultural differences that stand in the way of increased collaboration.

The successful Canadian Mitacs Accelerate program of industry placements for HDR candidates provides a useful model for the development of a national scheme in Australia. Building on the lessons of existing placement schemes, and catalysed by the funding recommended by the 2015 *Review of Research Policy and Funding Arrangements*, Australia's HDR training system has the potential to place thousands of HDR candidates with industry partners over the coming years. Such placements will not only build engagement and cultural understanding between research and industry, but will also provide another mechanism for HDR graduates to develop industry-relevant transferable skills and obtain good employment outcomes following graduation.

Some funding arrangements currently underpinning Australia's HDR training system are preventing it achieving the best possible outcomes. Australia's unique Honours year as an extended Bachelor qualification is currently the most accepted entry pathway into HDR training, but it may not be providing the best preparation for candidates to undertake research training. Innovative entry pathways, such as a for-purpose HDR training Masters degree, would improve the overall outcomes of Australia's HDR training system but the development of such pathways is currently limited by regulatory and funding restrictions. Such pathways could also provide increased opportunity for industry placements.

Greater flexibility in the HDR training funding structure would also enable universities to tailor support as required, such as aligning the length of scholarships with the duration of HDR training. Targeted funding arrangements can also drive increased participation by underrepresented groups: providing an increased weighting of completions for Indigenous HDR candidates would send an unambiguous signal about the importance of Indigenous participation in HDR training.

One of the most fundamental factors determining the quality of HDR training experiences and output is the quality of supervision. Most universities have taken steps to improve the supervision of HDR candidates, such as the introduction of supervisory committees and the provision of training for new supervisors, but there is much greater scope to address the standards and consistency of HDR training supervision. Universities should move towards the professionalisation of HDR training supervision through performance monitoring, ongoing regular training and professional development, recognising and rewarding excellence in supervision, and the application of professional standards to manage underperformance. There are a number of examples of best practice in the sector at present, the challenge is to standardise these practices across the sector. These initiatives would give HDR candidates confidence in the quality of supervision they can expect, and drive broad improvements in HDR training quality.

Improving the examination of HDR candidates would complement a focus on supervision quality. The graduate is the most important outcome of the research training process, and a more holistic reporting of their achievements would provide graduates with a stronger evidence base to communicate their value to prospective employers. Research training milestones could be leveraged by universities to provide useful reference points for the ongoing evaluation of HDR candidates, combined with the preparation of a skills portfolio to record their transferable skills development and industry experience.

The sector is aware of the changes required, as identified in this and previous reviews. A coordinated, strategic national response is urgently required. This response must be owned and developed jointly by the sector, industry and government. The resultant initiatives must have sufficient time and space to demonstrate progress before being subject to further reviews.

Key findings and recommendations

Key finding 1

Universities have a duty of care to communicate the likely outcomes of HDR training prior to candidates commencing their training. The information currently available to aspiring candidates is inadequate. Candidates need to be provided with information on the career outcomes of past HDR graduates, as well as comparative information on the quality, performance and components of HDR training provided by each university. The Quality Indicators for Learning and Teaching website provides a potential opportunity to communicate this information to candidates in a clear and effective way.

Undertaking HDR training is a substantial commitment, involving significant time and financial investment by candidates and the Australian Government or the sponsors of international candidates. To get the most out of HDR training, and to make an informed choice, prospective candidates need access to a range of information about HDR training including what is involved, the potential career outcomes, and comparative information on the performance and range of training
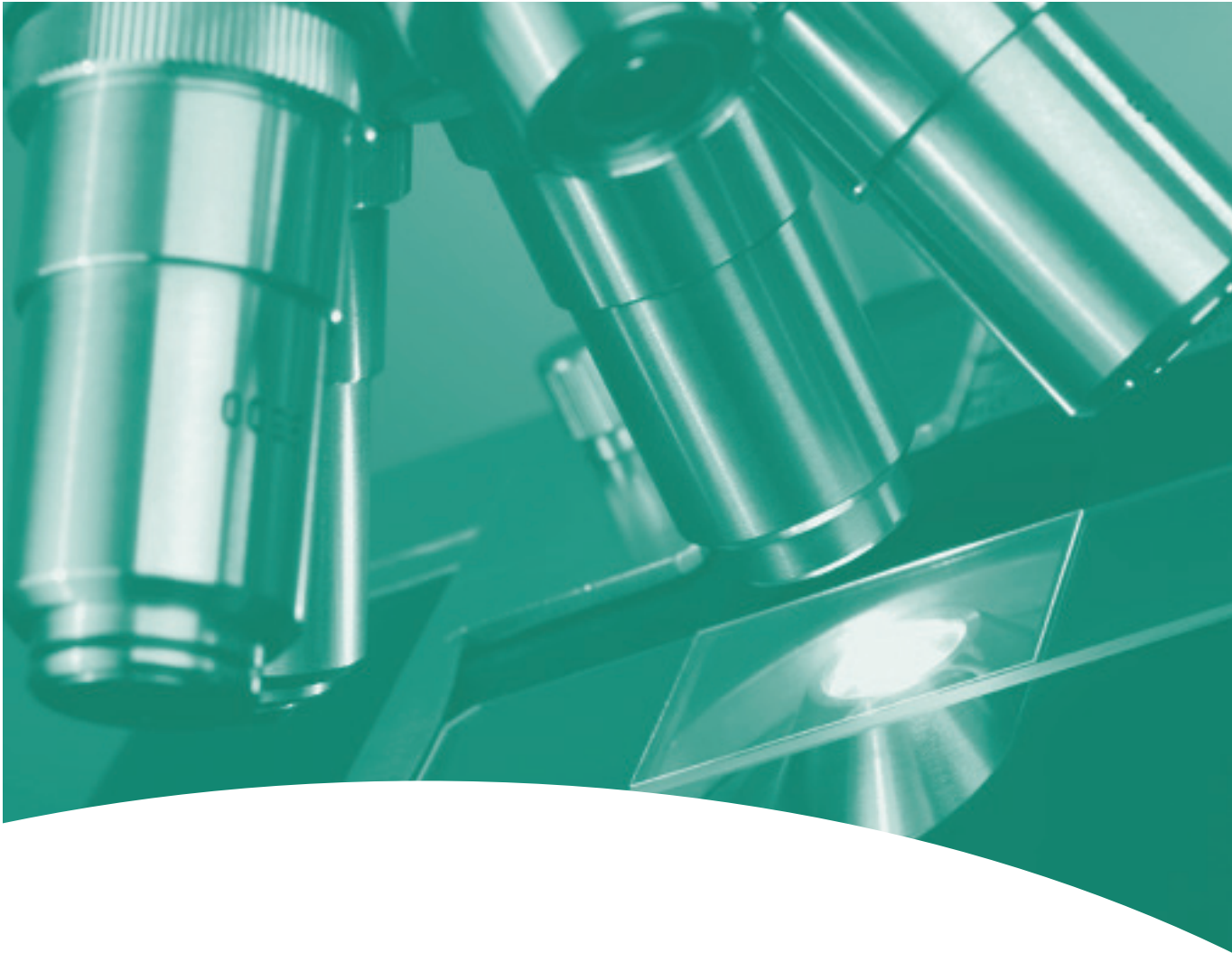
opportunities available. An understanding of the career outcomes for HDR graduates, such as that most find employment outside of academia, would prevent the development of unrealistic expectations.

Candidate choice is currently limited by an absence of comparable data on the HDR training system, but some specific barriers stand in the way of the collection and dissemination of this information. Longitudinal data on Australian HDR graduate outcomes and career pathways needs to be collected, as well as comparative information on the quality and types of HDR training opportunities offered by different providers. Enabling prospective candidates to make informed choices requires this information to be readily available, preferably through an online portal.

Key finding 2

Current regulatory and funding arrangements limit the development and uptake of innovative and internationally recognised entry pathways to HDR training. Flexibility in the current funding structure would allow universities to develop new accessible entry pathways which better prepare candidates for HDR training, such as a for-purpose HDR training coursework Masters degree.

There is growing demand to establish sustainable alternative entry pathways to the Research Doctorate to better prepare candidates prior to commencing training, and to provide alternative routes that better meet the needs of the diverse range of people wishing to undertake HDR training.

Although the traditional Honours pathway is the most accepted route to a Research Doctorate, this situation is changing, with an increasing number of candidates undertaking postgraduate education or entering the workforce prior to embarking on HDR training.

To meet the changing needs and backgrounds of prospective candidates there is particular interest in developing a for-purpose HDR training coursework Masters degree, but regulatory and funding barriers are making this route difficult to establish at a national scale.

Key finding 3

The disparity in length of the Australian Postgraduate Award (APA) and International Postgraduate Research Scholarship (IPRS), and the expected length of research doctoral programs causes financial stress for some candidates at the end of their HDR training. The value of awards and scholarships for candidates needs to remain competitive to attract the best and brightest candidates to HDR training. Providing universities with the flexibility to use their allocation of HDR training funding to extend scholarships to 4 years, and where necessary provide scholarship top-ups, would help resolve these issues.

The Australian Government provides substantial financial support for candidates undertaking HDR training. For domestic Research Doctorate candidates, this support includes covering the cost of tuition for 4 years, and providing to outstanding candidates tax-free APA scholarships lasting from 3 to 3.5 years.

This disparity in length between scholarships and HDR training duration, as well as the relatively low value of available scholarships, makes HDR training an unattractive option for many outstanding candidates. Providing greater funding flexibility to universities for the length and value of APA scholarships would help ensure candidates are better supported while they undertake HDR training, enabling universities to attract the best HDR candidates.

Key finding 4

Broader transferable skills development is a necessary aspect of HDR training. Although many universities have made significant investments in this area, transferable skills development is not as strongly embedded in our research training system as it is in some other comparable research training systems around the world. Skills development must be flexible and candidate-directed, and take into account the diverse backgrounds and experience of candidates. The UK Vitae Researcher Development Framework is an established and comprehensive approach that provides a useful model that could be adapted for use in Australia.

HDR graduates go on to a range of research and non-research careers in business, academia, government, community and not-for-profit sectors. The skills developed through HDR training need to be appropriate for graduates to succeed in careers right across the spectrum of the economy.

Flexibility is important when considering transferable skills training and a one-size-fits-all approach should be avoided, given the variability between disciplines and the diverse backgrounds and career aspirations of HDR candidates.

There is high overlap between the skills that employers report they need, and those gained during HDR training. Nonetheless, employers perceive the training of Doctoral candidates, particularly in transferable skills, as inadequately preparing graduates for careers in industry.

An effective way to deliver skills training, while tailoring it to candidates' needs, is through a skills development framework. Such a framework would allow candidates to identify their training needs and achievements against skills domains, and helps them recognise skills gained, where they need improvement, and how their skills can be applied in a range of settings. Further, this approach gives graduates a more effective and transparent way to demonstrate the skills they have gained to prospective employers.

While many universities make a significant effort to deliver transferable skills training to HDR candidates, there is a need for greater accountability and transparency in this aspect of research training—particularly given the perceptions of employers when it comes to HDR graduates.

Key finding 5

Australian industry-university collaboration performance lies close to bottom in terms of the international comparators reported by the Organisation for Economic Cooperation and Development (OECD). Industry-university collaboration would be greatly improved if there was increased engagement at the HDR level. Australia should be aiming for its level of industry-university collaboration during HDR training to be in the top 25 per cent in the OECD, and further research will be needed to determine appropriate indicators of this benchmark. Increased industry engagement will require a greater proportion of HDR training opportunities to be focused on an industry-defined research problem, take place in industry settings, or involve an industry supervisor for the project. Funding mechanisms should be used to drive the significant change required.

Australia's research effort is considered to be of high quality by global standards, but our translation of research into commercial and societal outcomes tends to be poor. This outcome results in part from the low levels of collaboration between industry and public sector research organisations, including universities.

HDR training can play an important role in driving this research translation and collaboration, by embedding a culture of collaboration at an early stage of a researcher's career, and giving industry an insight into the benefits of research skills. Increasing the proportion of industry-focused HDR training opportunities will help to improve industry–university collaboration.

Addressing barriers to industry collaboration within HDR training will require new approaches to be designed and implemented. It makes sense to encourage flexible ways to achieve industry involvement in HDR training.

Key finding 6

HDR candidates benefit from industry placements, and there would be value in building a national industry placement scheme of significant scale and scope through a national coordinating body. No such at-scale Australian placement system currently exists, although there are several small-scale, unaligned schemes. Other countries have been successful in developing large-scale industry placement systems, from which Australia can learn international best practice. Placements should not be mandated, but every HDR candidate who wishes to undertake a placement should be encouraged to do so. Placement schemes must balance the interests of HDR candidates appropriately with their industry partners and enhance the HDR training program.

Complex intellectual property arrangements with universities are a barrier preventing prospective industry partners from providing HDR placements. A national approach to HDR industry placements could help to address this problem by developing a simple, uniform default approach to intellectual property arising from placements, in which industry partners retain ownership.

With a majority of HDR graduates moving into careers outside university research, providing candidates with an opportunity to collaborate with industry partners can help improve their future employability while giving industry an insight into the benefits of employing researchers. Industry placement schemes for HDR candidates are already a common approach to this within Australia and overseas, but existing Australian programs are generally small in scale and scope.

There can be significant barriers to delivering meaningful industry placements from the perspective of both HDR candidates and industry partners, and a larger-scale national scheme would help to overcome these. A national placement scheme run by a dedicated intermediary organisation would help to facilitate the process of matching industry partners with HDR candidates, relieve administrative burdens for both universities and industry partners, and provide a simple, uniform default approach to intellectual property issues.

Such approaches have been successfully developed internationally, with examples such as Canada's Mitacs Accelerate program now supporting over 3000 HDR candidates in industry placements per year. To be broadly successful, a national industry placement scheme must be open to all disciplines and industry sectors.

Key finding 7

Currently available data is inadequate to determine the performance of the research training system and its value to Australia's economic and social wellbeing. Longitudinal data on HDR course satisfaction, course completions and career outcomes needs to be collected and reported in a nationally consistent and statistically robust fashion. The absence of this data prevents effective performance monitoring and evaluation and the development of institutional performance incentives. Data gaps could be filled by making changes to some existing data sources and collector methods, exploring opportunities associated with administrative data linkage, and introduction of a specialised fit-for-purpose longitudinal survey. Research training system performance data should be longitudinal, reported by institution and discipline at the two- or four-digit field of research level as appropriate, and used to drive performance improvements as well as aid prospective HDR candidates in making decisions about HDR training.

The current performance of HDR training in Australia appears to be good but data is lacking in key areas. Graduates report a high level of satisfaction with their HDR training experience, and have good employment outcomes. The absence of performance data at the institutional and disciplinary level makes it difficult to identify where the system is performing well and where it can be improved.

Data needs to be collected in key areas so that the performance of the HDR training system can be assessed over time in order to drive performance improvement.

Key finding 8

HDR training could be improved by institutions benchmarking their HDR training against that offered by institutions with outstanding international reputations. This benchmarking should be undertaken at the four-digit field of research level.

To produce high-quality, internationally competitive graduates, and to continue attracting the best and brightest from overseas, Australia's HDR training system needs to remain competitive with the best training systems in the world. The absence of high quality performance data makes it difficult to identify how best to improve the HDR training system and addressing this lack of data should be a priority.

While the absence of performance data is a hindrance, improvements can still be made by benchmarking Australia's HDR training system at the disciplinary level against systems that are perceived to be among the best in the world. A quantitative and qualitative benchmarking exercise would allow Australia's relative performance to be better understood, and the specific components of the world's best HDR training systems to be identified and where appropriate implemented in Australia.

Key finding 9

The current examination system ensures Australia's HDR outputs are of high quality, but a statement of the skills and knowledge gained by the candidate is also needed. The Australian Higher Education Graduation Statement provides a potential vehicle for such information, the evidence base for which can be built through HDR milestones (confirmation of candidature, mid-candidature, and final), preparation of a skills portfolio, seminar presentations, industry and international placements, and oral examinations.

The current assessment process for research degrees does not necessarily align well with the aims of contemporary HDR training. The primary outcome of HDR training is no longer seen as the thesis per se, but also includes the skilled professional researcher and the skills they have gained. However, assessment of research degrees in Australia tends to focus exclusively on the thesis and does not includes an assessment of the candidate's broader research competencies, while transferable skills are typically not assessed.

Many stakeholders considered that the Australian research training system would benefit from greater emphasis being placed on the assessment of the candidate and the skills gained, rather than focus predominately on the assessment of the thesis.

Key finding 10

Universities have a responsibility to provide ongoing high quality HDR supervisory training, and a responsibility to act where supervisory performance falls below expected performance levels. Outstanding HDR supervision should be recognised and reinforced by universities through the application of professional standards and rewards for performance.

High quality supervision plays a central role in producing positive HDR training outcomes. Quality supervision is also central to ensuring the HDR training system remains internationally competitive. Although supervisory experience is generally improving, the quality of supervision in Australia's HDR training system is variable between individuals, disciplines, and institutions.

Improving supervision standards will require sustained investment in supervisory training along with increased structural support for supervisors. To ensure the quality of supervision improves, ongoing monitoring and evaluation of supervisor performance is needed as well as mechanisms to drive and reward improvements over time.

Key finding 11

Indigenous researchers have much to offer the nation and their communities, but participation by Indigenous candidates in HDR training and employment of Indigenous people remains low. Targets and specific measures, such as increased weighting for Indigenous HDR completions through the Research Training Scheme block grant, have the potential to acknowledge

the value to the nation and the universities of Indigenous participation in HDR training. Incentives are also needed to support the training of Indigenous HDR candidates such as higher value stipend scholarships and real-wage competitive fellowships. To ensure accountability, performance outcomes of targets and measures should be regularly reported. Increasing Indigenous participation in HDR training will require the pipeline of Indigenous high school and undergraduate students to be strengthened. Providing a welcoming, supportive and culturally safe environment, including culturally competent and high quality supervision, would help to create a positive university experience for Indigenous HDR candidates.

Improving the participation of Indigenous candidates in the HDR training system was seen by stakeholders as a priority area where effective action is urgently needed. Initiatives to encourage Indigenous people to undertake HDR training would not only benefit individuals and communities, but would also have a significant benefit to the nation's prosperity.

The barriers to increasing participation of Indigenous candidates in HDR training include lower levels of Indigenous participation at the undergraduate level, an absence of academic Indigenous role models and HDR supervisors, lack of cohort support networks in some universities, and financial pressures. A range of actions is needed to overcome these barriers including better acknowledging Indigenous rights and culture, providing better supervision training, providing greater financial support for Indigenous HDR candidates, and introducing system incentives.

Recommendations

The recommendations identified here are primarily directed at the Australian Government. The Review emphasises, however, that many of the solutions required to address the issues identified in the Key Findings will need to be implemented by the higher education sector as a whole.

1. The Government should support the establishment of a sector-wide implementation working group, tasked with developing within six-months a specific and actionable implementation plan with measures relating to the three broad categories of reform identified by this Review (regulation and policy, university cultural change, and industry incentives/ cultural change). This working group should have an independent chair (appointed by or negotiated with the Government), with a requirement for high-level representation from relevant stakeholder groups (universities, industry bodies, research organisations and institutes, government and HDR candidates) to ensure broad consensus on the final plan. This working group would also be empowered by strong links with Innovation and Science Australia.

2. The Government should remove the regulatory and financial barriers that prevent universities from developing accessible entry pathways to HDR training and offering flexible scholarships of appropriate duration and value.

3. The Government should implement Recommendation 4 from the *Review of Research Policies and Funding* to provide additional funding to incentivise industry–university collaboration, with a particular focus on initiatives that connect HDR candidates with industry-led research problems.

4. The Government should implement Recommendation 11 from the *Review of Research Policies and Funding* to develop a national program to support industry placements for Research Doctorate candidates. The successful Canadian Mitacs program would be a useful template for developing an Australian scheme, and it will be imperative to learn from and engage with existing Australian schemes. Over time, the national scheme should be expanded to be accessible to all HDR candidates who wish to participate.

5. The Government should institute a longitudinal national data collection exercise to monitor course satisfaction, course completions and career outcomes for HDR training.

6. The Government should institute increased weighting for Indigenous HDR completions in the Research Block Grants formulae, and flexibility in scholarship guidelines to allow for higher value stipends and real wage fellowships to further encourage Indigenous participation in HDR training.
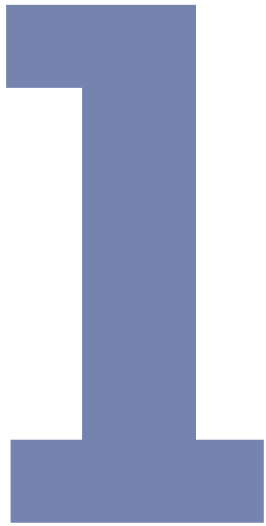
1 Introduction

Supporting our research training candidates

Research training is an investment in people, knowledge, and the future prosperity and well-being of Australia. Grand challenges, be they economic, social, health, environmental or security challenges, will only be overcome by undertaking research, finding solutions, and applying the knowledge gained. The shift towards a knowledge economy continues at a rapid pace, and the demand for high-level research skills in a wide range of industries is expected to grow. Nations around the world are responding to this increased demand for research and researchers by investing in HDR training, and over the past 10 years the Australian Government has also substantially increased its investment in HDR training.

In May 2015 the Australian Council of Learned Academies (ACOLA) was asked by the Minister for Education and Training to undertake a review of Australia's HDR training system, to ensure it meets the country's research needs in the 21st century and ensure the nation receives the best return on its investment.

Delivering benefits to the nation through HDR training

From humble beginnings in the post-war period, graduating its first Research Doctorate candidate in 1948 (Group of Eight, 2013), Australia has built a substantial HDR training system which is now producing more than 8000 new Research Doctorate graduates each year, and just under 1500 Research Masters graduates, as shown in Figure 1 (Department of Education and Training, 2015a). In 2014, there were 11,894 commencing Research Doctorate candidates, compared with 8196 in 2003, and just 1838 in 1988, representing a six-fold increase over this time period, also shown in Figure 1. This growth in Research Doctorate candidate intake has been driven by policy changes that have made HDR degrees more accessible to domestic candidates, increased international enrolments, and raised incentives for universities to increase the number of places they offer (Larkins, 2011). This expansion has occurred in response to both the anticipated need for high level research skills within the broader economy, and the projected replenishment needs of the existing workforce, with a large number of researchers set to transition to retirement in the coming years (Hugo and Morriss, 2010).

Over the past 10 years there was a substantial increase in investment in HDR training (see Figure 2), and in 2016 the Australian Government will invest over $980 million in HDR training through the university research block grants alone (see Figure 2). Over the same period the number of Australian Postgraduate Award (APA) scholarships more than doubled to nearly 3500 per year, providing a tax-free stipend of nearly $26,000 to assist HDR candidates in undertaking HDR training (see Table 1).

One of the most notable changes in the HDR training system has been the increase in the number of international HDR candidates, more than tripling between 2001 and 2014, from 6249 to 20,384 enrolments. International candidates now represent 32 per cent of enrolments, up from 16 per cent 10 years earlier (see Figure 3 and Figure 4). Given the important role that international HDR candidates play in Australia's research system, providing both expertise to the nation and valuable income to universities, it is essential to ensure Australia's HDR training system remains among the best in the world in order to attract the best international HDR candidates.

Figure 1: Commencing HDR candidates between 1988 and 2013
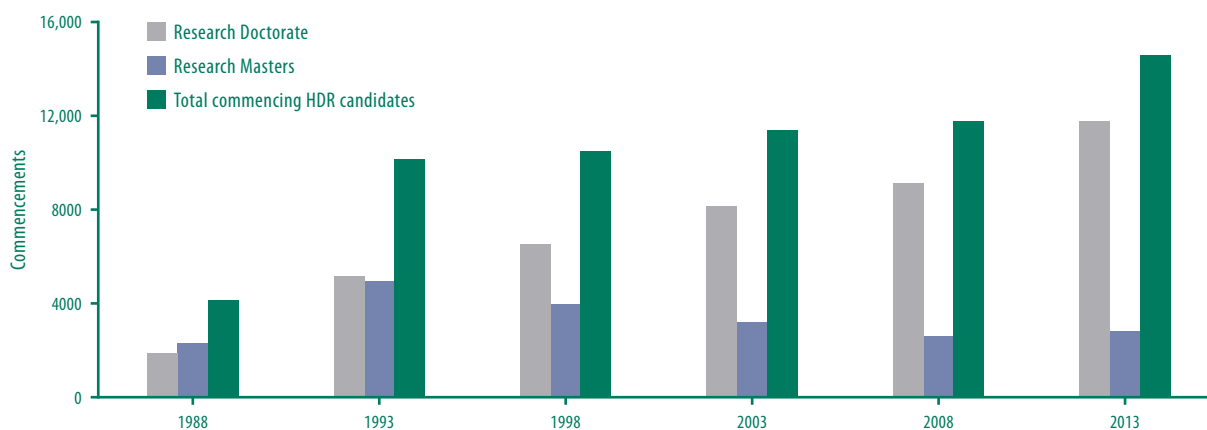
Source: Data from Larkins (2011) and Department of Education and Training (2015j).

Figure 2: Australian Government support for research training through the research block grants
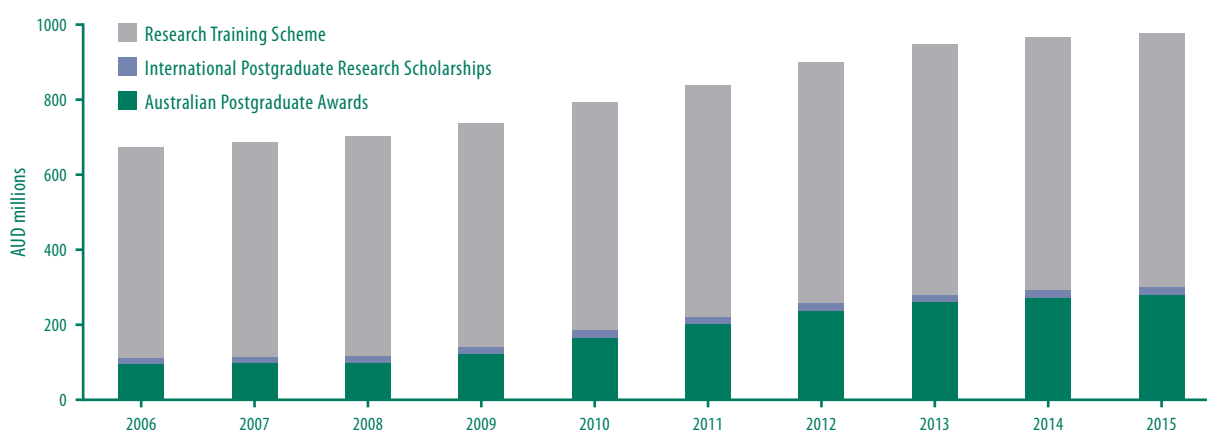
Source: Department of Education and Training (2015f) and Department of Education and Training (2015i).

Table 1: Number of Australian Postgraduate Awards awarded each year between 2006 and 2015

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Australian Postgraduate Awards	1561	1581	1584	2584	3069	3270	3500	3500	3499	3497

Note: The number of International postgraduate Research Scholarships has remained constant at 330 every year.
Source: Department of Education and Training (2015i).

The increases in international HDR candidate enrolments have not been uniform across all disciplines (see Table 2). International HDR candidates now make up the majority of the cohort in engineering and related technologies, and are near parity in information technology. Domestic HDR candidates dominate the creative arts, society and culture, health, and education disciplines.

The most popular disciplines for HDR training are society and culture, natural and physical sciences, health, and engineering. These disciplines account for nearly 78 per cent of HDR completions (see Table 3).

Candidates undertaking HDR training come from a range of backgrounds, which is reflected in their age range. Two thirds of candidates are aged over 30, with 27 per cent over the age of 40 as shown in Table 4. A large number of candidates coming to HDR training already possess a wide range of skills and work experience.

Improving the HDR training system

Background and objectives

On 20 May 2015 the Minister for Education and Training announced that the Australian Council of Learned Academies would undertake a review of Australia's HDR training system to ensure it meets the country's research needs in the 21st century.

While there are many different ways in which HDR training can be delivered, this Review predominantly focuses on the practices and activities undertaken during the completion of a higher degree by research (HDR), such as a Research Doctorate or Research Masters degree. Research in these programs typically comprises two-thirds or more of the qualification (Australian Qualifications Framework Council, 2013).

Figure 3: Domestic and international candidates enrolled in HDR programs
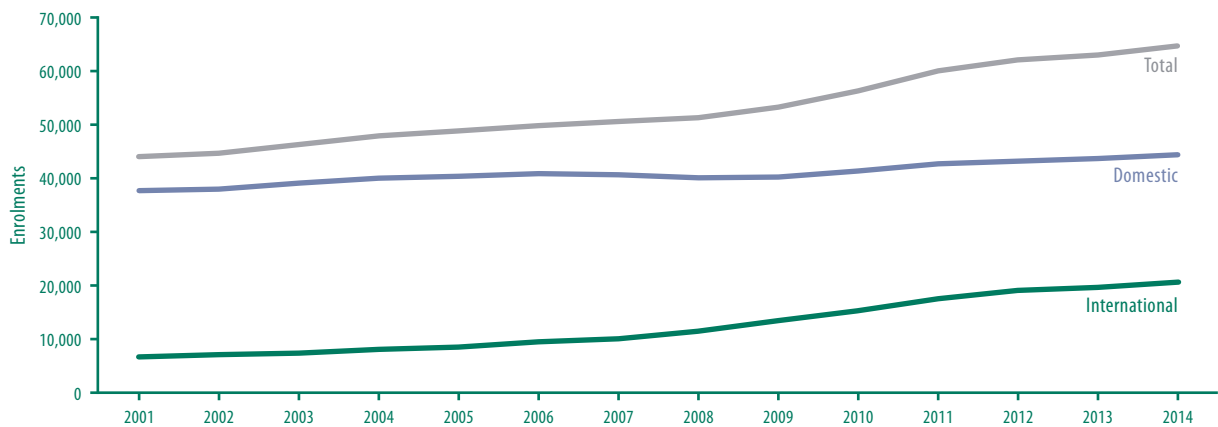
Source: Department of Education and Training (2015f).

Figure 4: Proportion of HDR candidates by citizenship category

Source: Department of Education and Training (2015f).

Domestic   International

Table 2: Proportion of domestic and overseas HDR candidates by broad Field of Education

Field of Education	Proportion of enrolment (per cent)	
	Domestic	International
Natural and Physical Sciences	63	37
Information Technology	51	49
Engineering and related technologies	47	53
Architecture and building	72	28
Agriculture Environmental and related studies	57	43
Health	80	20
Education	79	21
Management and Commerce	60	40
Society and Culture	81	19
Creative Arts	90	10
TOTAL	69	31

Source: Department of Education and Training (2015f).

Table 3: HDR completions by field of education in 2013

Field of Education	Doctorate by Research	Masters by Research	Percentage of total HDR completions
Natural and Physical Sciences	1748	207	21
Information Technology	313	45	4
Engineering and related technologies	1113	245	15
Architecture and building	99	18	1
Agriculture Environmental and related studies	344	51	4
Health	1140	220	15
Education	482	95	6
Management and Commerce	592	65	7
Society and Culture	1615	227	20
Creative Arts	341	249	6
TOTAL	7787	1422	100

Source: Department of Education (2015) Selected Higher Education Statistics—2013 Candidate Data: 2013 Award completions.

Table 4: Age profile of domestic HDR candidates in 2013

Age group	Doctorate by research	Masters by research	Proportion of enrolment (per cent)
Under 30	12,562	2084	34
30–39	10,367	2064	29
40–49	6718	1398	19
50–59	4768	912	13
60 and over	1920	381	5
TOTAL	36,364	6861	100

Source: Department of Education and Training (2015i).

Approach

An ACOLA Expert Working Group (EWG) comprising Fellows from the four learned Academies and reflecting a range of different disciplines and backgrounds was established to lead the Review. The EWG consulted widely with interested stakeholders including universities, businesses, government, non-government organisations, research institutes, community organisations, peak bodies, not-for-profit groups, and research candidates and graduates.

Interested stakeholders were invited to put forward their views on the future of HDR training by responding to a discussion paper and consultation questions, meeting individually with the EWG, and participating in public forum sessions. There was a high level of participation in the consultation process, including:

- 80 written submissions received
- 84 stakeholder interviews held
- 184 participants attended forums in Sydney, Canberra, Melbourne, Brisbane, Adelaide and Perth
- additional forum event and ongoing consultation with the Australian Council of Graduate Research
- consultations with the Universities Australia Deputy Vice Chancellors Research.

In addition to the comprehensive input from stakeholders, the EWG also considered a substantial volume of literature—including academic studies and past reviews into HDR training—to help inform its work.

The EWG heard from stakeholders on a wide array of different issues facing HDR training and were presented with many potential areas where effective action would support Australia's HDR training system to remain among the best in the world. The EWG was thorough in reviewing these concerns but accepts that even within a substantial exercise such as this it was not possible to address all the issues brought to its attention. To ensure this Review has the best chance of improving the HDR training system, the EWG focused on those issues that have the greatest potential for a positive impact.

The EWG concentrated on identifying areas of focus within three broad domains:

- Supporting our research training candidates
- Delivering benefits to the nation through research training
- Improving the research training system

These three areas are explored in the following three chapters. Chapter 2 explores how HDR training can be improved to achieve the best possible outcome for HDR graduates. Chapter 3 investigates the different ways in which HDR training can contribute to the economic and social prosperity of the nation. Chapter 4 focuses on the HDR training system itself and the areas where work is needed to achieve positive outcomes for individuals and the nation, and to ensure the HDR training system remains world class.

2 | Supporting our research training candidates

Introduction to Chapter 2

This Chapter looks at three priority areas where action is needed to ensure HDR training produces high quality researchers capable of succeeding in different sectors. The three priority areas examine how to better enable choices about HDR training, how to better prepare candidates prior to undertaking HDR training, and how to better support candidates during their training through flexible funding arrangements.

Section 1: Enabling candidates to make an informed choice about HDR training

HDR training requires substantial time and financial commitments from candidates and a considerable financial investment by the Australian Government, and by the sponsors of international candidates. Prospective candidates should have access to a range of information about HDR training including what is involved, the potential career outcomes it can lead to, and comparative information on the performance and range of training opportunities available.

This section finds that candidate choice is being limited by an absence of comparable data on the HDR training system, and that specific barriers need to be overcome to enable the collection and dissemination of this information to prospective HDR candidates. Two areas for action are identified as priorities. The first is to start collecting longitudinal data on Australian HDR graduate outcomes and career pathways. The second is to develop comparative information on the quality and types of HDR training opportunities offered by different providers, and to communicate this information through an easy-to-use comparison website.

Section 2: Better preparing candidates for HDR training

There is growing demand to establish sustainable alternative entry pathways to the Research Doctorate to better prepare candidates prior to commencing training, and to provide alternative routes that better meet the needs of the diverse range of people wishing to undertake HDR training.

This section explores the different entry pathways to HDR training, issues associated with them, existing and potential responses to developing new entry pathways, and barriers preventing the development of national responses. The review finds demand for developing a for-purpose HDR training coursework Masters degree to better prepare candidates for undertaking a Research Doctorate, but that regulatory barriers need to be overcome and funding arrangements for domestic candidates made more flexible for this to happen.

Section 3: Providing financial support to HDR training candidates

The Australian Government provides substantial financial support for candidates undertaking HDR training. For domestic Research Doctorate candidates, this support includes covering the cost of tuition for 4 years, and providing tax-free living allowance stipends to outstanding candidates through APA scholarships lasting from 3 to 3.5 years.

This section of the report looks at the disparity in length between stipend scholarship funding and tuition funding, and also the need for scholarship value to remain competitive to ensure outstanding candidates are attracted to HDR training. The Review finds that providing greater funding flexibility to universities for the length and value of APA scholarships would help ensure candidates are better supported while they undertake HDR training.

Section 1
Enabling candidates to make an informed choice about HDR training

1.1 Introduction

Enabling prospective candidates to make choices about HDR training requires readily available, useful information about training experiences and career outcomes. Unfortunately, data on the performance of the research training system in Australia is lacking, and this situation prevents candidates from gaining an understanding of their potential career outcomes and from making informed decisions about whether and where to undertake HDR training. Longitudinal data on HDR career outcomes and system performance (see Section 7) needs to be collected and made accessible to prospective HDR candidates.

This section explores the importance of candidate choice and the steps needed to enable choice.

1.2 The importance of enabling candidate choice

Undertaking HDR training is a substantial commitment. A Research Doctorate usually takes about 4 years to complete, but can take longer. In undertaking HDR training, candidates are potentially making a range of sacrifices, such as forgoing immediate potential career earnings and progression. The financial commitment is even greater for candidates without a scholarship. HDR training is very demanding intellectually and requires candidates to devote large amounts of time and energy to their training, which can be disruptive to other commitments. An indication of the level of commitment required and the sacrifices made can be seen in the significant

number of candidates, estimated at about 30 per cent (Palmer, 2016), who commence HDR training but do not complete.

Universities have a duty of care to provide the information that HDR candidates need to determine whether HDR training is right for them. Given the level of commitment involved in HDR training, it is essential that prospective candidates are fully informed of what HDR training involves and the potential outcomes. Such information will help prospective candidates weigh up the pros and cons and determine whether HDR training aligns with their own aspirations.

There are multiple reasons why prospective candidates might choose to undertake HDR training, including personal satisfaction, intellectual curiosity, and to enhance future career outcomes. Without comprehensive information, there is a risk that HDR candidates will undertake HDR training with unrealistic expectations as to the future career opportunities it will provide them. This may result in:

- candidates withdrawing part-way through HDR training after realising the training will not provide them with the career outcomes they were expecting

- candidates shaping their HDR training experience in a way that is not suited to their career or personal aspirations

- candidates and graduates becoming disillusioned with the HDR training system if their expectations are not met, presenting a potential threat to the ongoing viability of HDR training.

All prospective HDR candidates need two categories of information to make an informed decision about whether HDR training is appropriate for them. The first relates to how HDR training will help potential candidates meet their career goals. This would be best communicated by providing prospective candidates with detailed information from universities on the career outcomes, pathways and destinations of past HDR graduates. The second relates to helping candidates determine the most appropriate provider for their training, in the context of their requirements, expectations, and the HDR training options available from different universities. Overall, information should be provided on graduate employment levels and salary ranges, past candidate satisfaction, completion times and ratios, HDR training facilities offered, training opportunities available, and professional development opportunities.

The needs of prospective international candidates can differ from domestic candidates, and as such it is important to provide them with additional information to help them make decisions about HDR training. Some international candidates may need additional training in English language (Regional Universities Network, 2015; Faculty of Education QUT, 2015; James Cook University, 2015) and some specific disciplinary skills, and candidates might benefit if the necessity and availability of additional training was better communicated. Other international candidates may benefit from more information about undertaking HDR training in Australia, including the available support services, and how the Australian research training system works.

1.3 Barriers to enabling choice and the issues this is causing

There is an absence of available data on HDR graduate outcomes and comparative information on the performance of different universities. Specific barriers need to be overcome to enable the collection of this data and its dissemination in easy to access formats to prospective HDR candidates.

1.3.1 Barriers to providing information about HDR graduate career outcomes

There are significant barriers to providing information to candidates that would help them make an informed choice. Data on career outcomes for HDR graduates is very poor, both in Australia and overseas. There is only limited data available relating to immediate short-term post-graduation outcomes, and a few small-scale Australian and international studies that show career outcomes beyond the short term. The absence of performance data for the research training system is a recurring theme within this Review, and is explored in further detail in Section 7.

The limited studies that have been undertaken show that career outcomes for HDR graduates are generally good, and there is a positive message to deliver to prospective candidates. HDR graduates are less likely to be unemployed than the broader population, have higher salaries, and have the skills needed to succeed in a changing

economy. Crucially, the data shows that HDR graduates do not simply flow into academic careers, and instead find employment in a range of different professional careers, including research and non-research careers. Approaches to further measuring the performance of the HDR training system are discussed in Chapter 4. A summary of the evidence showing that HDR graduates take up a range of careers beyond academic research is provided in Box 1.

The absence of detailed data means that the positive message of HDR training supporting different and successful careers is not delivered, and prospective candidates are making decisions about HDR training without having a full understanding of their possible career outcomes. When prospective candidates look for information about how HDR training fits into their broader aspirations, they are either receiving no message at all, or are only able to find particular viewpoints from potential supervisors and universities.

The absence of such data creates an information vacuum. In part, this leads to the continuing discourse that HDR training is predominantly an academic apprenticeship, as an academic career is the most visible career outcome. Such a discourse presents two significant issues:

- Those wishing to pursue non-academic careers might be dissuaded from or overlook HDR training, as they are unable to see the relevancy to their career aspirations. This can mean the broader economy is missing out on high-level research skills that can deliver economic, social, health and other benefits.

Box 1: Career destinations for HDR graduates

Short-term career destinations: The Postgraduate Destinations survey gives an indication of the short-term employment outcomes for HDR graduates (Guthrie and Bryant, 2015). This survey shows the following destinations for HDR graduates: higher education (40.9 per cent), other education (9.6 per cent), government (9.0 per cent), health (8.9 per cent) and the private sector (24.8 per cent). Given that this survey is conducted between 3–9 months after graduation, it does not give an accurate overview of the longer-term career destinations for HDR graduates. However, even after only 3–9 months, it shows that a large proportion of HDR graduates pursue non-academic careers.

Medium- and long-term career destinations: Longitudinal data on medium- to long-term career destinations for HDR graduates are not routinely collected in Australia, but an indication on the different career outcomes can be gained from the small number of surveys that have been undertaken here and overseas.

A 2006 survey of Group of Eight Research Doctorate graduates between 5 and 7 years after graduation showed that 90 per cent of respondents were in employment, with about half of all respondents working in the higher education sector, and an additional 13 per cent working in scientific research services (Western et al., 2007). A larger study by Neumann and Tan (2011) of Australian Doctoral employment destinations for the period 2000–2007 shows that less than half (44.4 per cent) of Doctoral graduates are employed in the higher education component of the education sector. An evaluation of the Cooperative Research Centres program, which surveyed Cooperative Research Centres (CRC) and non-CRC Research Doctorate graduates 5 years and 10 years post-graduation, found 42 per cent of Research Doctorate graduates from CRCs and 60 per cent of non-CRC graduates were employed in the university sector in various research and non-research positions (Manathunga et al., 2011).

Career outcomes for HDR graduates are diverse. Australian Bureau of Statistics (ABS) Census data showing the breakdown of where Australia's employed Doctorate holders are working can be seen in Table 12. It shows that approximately 26 per cent of Doctorate holders are employed in university or vocational education teaching positions, which may or may not include a research component. This suggests that a large number of Doctorate holders are pursuing careers outside of universities.

A similar situation can be seen overseas. A recent survey in the UK on Doctoral graduates between 7 and 9 years after graduation found that 50 per cent of graduates worked in higher education (Diamond et al., 2014). This figure masks differences by subject discipline, with graduates in the arts and humanities (62 per cent) and social sciences (65 per cent) most likely working in higher education. Although 79 per cent of HDR graduates within the study were employed with permanent or open-ended contracts, among researchers in higher education, this figure was only 26 per cent.

Other overseas studies have found that 50 per cent of current Doctorate holders in Europe are employed outside of academia, in businesses, government and other education sectors, holding both research and non-research positions (Borrell-Damian, 2009). A similar trend for a growing proportion of HDR graduates to pursue non-academic careers has been found in the United States (Nerad, 2007), Canada (King et al., 2008), the United Kingdom (Hayes et al., 2009) and France (Giret, 2005).

- HDR candidates develop unrealistic career expectations, with candidates having a greater expectation that HDR training will lead to an ongoing academic career, despite data suggesting that the rate of HDR completions far outstrips the number of new academic positions available. Further information on this is provided in Box 2.

1.3.2 Barriers to providing information on different HDR training opportunities

Similar to the absence of adequate information on career outcomes in guiding candidate choices, there is a lack of comparative information to help prospective candidates make choices on where to undertake their HDR training. Submissions to this Review show that there is a great deal of variation in how HDR training is delivered in Australia, and different models will suit different candidates. Key information that prospective candidates might find useful, including comparative information on the HDR training environment, coursework opportunities, professional development opportunities, past candidate satisfaction, and completions rates, is unavailable at the institutional level. Some of this information has been collected but reported only at the national level, such as through the results of the Postgraduate Research Experience Questionnaire (PREQ) (see Lindsay, 2015), and in future will be collected through the Graduate Outcomes Survey.

The only method currently available to prospective candidates to compare institutions is through the use of metrics that measure research performance, such as through the results of the ERA, world university rankings, and citation metrics. However, while such performance metrics give an indication on the research environment of an institution, they do not provide adequate information about the other

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Box 2: HDR candidates and academic careers

Over the past 10 years, the number of academic staff employed by universities has risen substantially. In 2014, universities employed 56,343 full-time equivalent academic staff, up from 41,291 (Department of Education and Training, 2015f). Renewal of the existing academic workforce will increasingly be required in the coming years. Over 40 per cent of the academic workforce is over 50 and set to retire in the next 10–15 years (Access Economics, 2010; Hugo and Morriss, 2010). The need to increase the number of HDR graduates to meet both academic workforce demand as well as the increased demand for research skills within the broader economy has been previously identified (Department of Innovation, Industry, Science and Research, 2011b). However, the expected gaps in the academic workforce caused by an ageing workforce have yet to materialise. In 2013, there were 21,454 positions at the level A and B appointment level (considered to be the entry level) and yet in the following year there were 9828 HDR completions, of which 6392 were domestic candidates (Department of Education and Training, 2015f). If this rate continues, there will be more domestic HDR completions within a few years than there are academic entry level positions. The number and turnover of academic positions within universities has for a long time been insufficient to accommodate most HDR graduates into the academic workforce.

Despite HDR candidates having very negative perceptions on the availability of academic careers, they are still generally enthusiastic about pursuing such a career (Edwards et al., 2011). In one survey by Edwards et al. (2011) the vast majority of HDR candidates, 83 per cent, have seriously contemplated an academic career at some point. The same survey shows that a much lower proportion views an academic career as realistic in the immediate short term, or would plan to pursue one in the long term. Gould (2015) conducted an international survey of 3400 HDR science graduates in China, India, UK, Germany and the USA and found that graduates were overly optimistic about their chances in academia. Seventy eight per cent of respondents were likely or very likely to pursue a research career in academia, and 51 per cent thought they would secure a permanent job within 1–3 years (see Woolston, 2015). In the US, approximately 26 per cent of Research Doctorate graduates secure tenured or tenure-track positions, and securing such positions usually takes much longer than 1–3 years (Gould, 2015).

Participants in this Review were strongly in favour of ensuring that potential HDR candidates are made fully aware of the wide range of different career options available to them, so they do not enter HDR training solely with the view that it will lead to an academic research position. Although participants considered that there is a need to provide as many sustainable academic research careers as possible, they recognised that the supply of researchers is likely to exceed demand for the foreseeable future. As such, participants considered that universities have a duty of care to make sure this message is clearly received by prospective HDR candidates and their supervisors. HDR training must not be seen as an academic apprenticeship, but as the highest level of university education, the outcomes of which can be applied across a range of different careers.

important components that affect the quality of research training being provided.

The absence of data on career outcomes for HDR graduates and absence of comparative data on the performance of different institutions present potential candidates with serious difficulties in making an informed choice. This situation means that the discourse of HDR training being predominantly an academic apprenticeship is largely unchallenged, despite the data showing positive and successful outcomes for HDR graduates in a range of careers. Given the level of commitment being made by individuals when they embark on HDR training, and the level of investment in HDR training made by the Australian Government and others, there is a need to provide much more substantial information to prospective candidates.

1.4 Steps needed to better enable choice

1.4.1 Developing information on HDR career outcomes

Tracking longitudinal data on Australian HDR graduate outcomes and career pathways would provide an effective method for benchmarking HDR quality (National Tertiary Education Union, 2015), and stakeholders have suggested that there is a real need for such data to be collected (University of Newcastle, 2015; University of Melbourne, 2015; University of Sydney, 2015). In addition to enabling candidate choice, such data would also provide better information to inform policy directions for HDR training (University of Melbourne, 2015). Collecting information on career outcomes will take time and resources, as well as the participation of stakeholders and HDR graduates. Longitudinal data should be collected and reported at the institutional and disciplinary level. It should include information on career outcomes at particular stages post-graduation and allow prospective candidates to make

comparisons between universities. The few studies that have been undertaken in Australia show that such an approach is possible, but will only be effective if it is comprehensive and ongoing.

The Review is particularly encouraged by efforts in the United States (US) to track HDR graduate career outcomes in research. The program called UMETRICS is combining anonymised human resource and administrative data from universities with US Census data on earnings and occupations. The program aims to produce campus-level reports on the career outcomes of graduate candidates. As Gould (2015) reports, candidates interested in a chemistry Research Doctorate will be able to view a campus report and see the career and salary outcomes of previous graduates. Although it will take several years for the first datasets to be released, once the data is available candidates will be entering into HDR training with a greater awareness of the likely opportunities available to them after they graduate.

The positive developments from other research systems highlight the strategic advantages of enabling candidate choice through the provision of accurate information on graduate outcomes (see Raddon and Sung, 2009). Australia would benefit from a similar approach. A possible model to follow in developing a longitudinal survey is the Graduate Longitudinal Study New Zealand (University of Melbourne, 2015)

Given that data similar to UMETRICS will take some time to compile, there is much that can be done in the meantime to improve the availability of information on career outcomes. Most importantly, national-level data showing the broad career destinations of HDR graduates needs to be collected retrospectively 5 and 10 years post-graduation. Although the data would only be from a subset of the HDR graduate population, it would give greater strength to the case that HDR training provides enhanced career opportunities across a range of careers, as it should be possible to make comparisons with non-HDR graduate cohorts.

Graduate case studies can also help inform prospective candidates. These case studies would provide examples of HDR graduates from various backgrounds, genders and ages in academic, non-academic, research and non-research careers, and explain how HDR training was essential to their career development. Such case studies can be developed quickly, are easily shared, and provide credible, in-depth exposure on the relationship between HDR training and positive career outcomes.

1.4.2 Developing comparative information on different HDR training opportunities

Comparative information on the quality and types of HDR training opportunities available at different providers should be achievable within the short-term. There are already existing data sets, such as the PREQ, which collected data from 2000 to 2015, Postgraduate Destinations Survey, and the Beyond Graduation Survey, that provide useful information from the perspective of past graduates' experiences. However, there are sample size problems in reporting at the disciplinary level for many disciplines and institutions unless the data is pooled over several years. The future Graduate Outcome survey will also provide an opportunity for refreshing the data collected in this area, although sample size challenges will need to be addressed.

The Australian Graduate Research Good Practice Principles developed by the Australian Council of Graduate Research state that candidates should have an opportunity to engage with scholarly communities while undertaking their research (Australian Council of Graduate Research, 2014). The principal community with which they would usually engage would be within their discipline at their university. Providing an overview of the quality of research being undertaken within different fields of research will help candidates make choices on the suitability of the research environment for their training. The Australian Research Council (ARC) Excellence in Research for Australia (ERA) provides robust data on the quality of research undertaken at universities,

and shows that excellence exists right across the sector. Outcomes of the ERA exercise are already readily available, but communicating them to prospective candidates alongside other data on research training would help aid choice.

Combining data on HDR graduate experience, career outcomes, research quality as defined by ERA outcomes, and other newly developed HDR training quality measures would provide a comprehensive snapshot of the quality of HDR training environments. Such snapshots and further information to aid candidate choice should be made available in an easy-to-use website that compares institutions and disciplines (as defined by field of research). The recently launched Quality Indicators for Learning and Teaching website allows prospective undergraduate students to compare student experience and graduate employment for courses and institutions. Charts and tables of relevant information for chosen universities and courses can be produced easily. Examples of this are provided in Figure 5 and Figure 6.

Such an approach would be desirable for HDR training but small sample sizes can make it difficult to report data in a meaningful way. However, it should be possible to report some useful data at the institutional level, and this approach would help candidates compare how institutions perform. It should also be possible to compare this by looking at performance at different disciplinary levels as defined by the Australian and New Zealand Standard Research Classification. In this classification disciplines are defined as two-digit and four-digit fields of research (FoR). The two-digit field of research code is the highest level and relates to a broad discipline field, and the four-digit field of research code relates to a specific discipline of a two-digit FoR code (further details on the classification of fields of research see Australian Research Council, 2015a; Australian Bureau of Statistics, 2008).

Combining institutional and disciplinary data together would not be feasible at present. Consideration should be given to amalgamating data over multiple years to ensure robust sample sizes.

Figure 5: Quality indicators for learning and teaching—experiences of current undergraduate students

Experience of current undergraduate students

Survey results	Humanities, Culture & Social Sciences			
	The Australian National University	Murdoch University	The University of Melbourne	The University of Sydney
Overall quality of educational experience ⓘ	82.5% (81.0% - 84.0%) 1263 responses	82.0% (79.5% - 84.5%) 428 responses	85.9% (84.5% - 87.3%) 1355 responses	79.8% (78.5% - 81.1%) 2013 responses
Teaching quality ⓘ	84.5% (83.1% - 85.9%) 1259 responses	86.9% (84.7% - 89.1%) 428 responses	87.8% (86.5% - 89.1%) 1352 responses	84.6% (83.5% - 85.8%) 2013 responses
Learner engagement ⓘ	56.4% (54.5% - 58.3%) 1263 responses	45.3% (42.1% - 48.6%) 428 responses	57.5% (55.6% - 59.5%) 1356 responses	54.7% (53.1% - 56.3%) 2012 responses
Learning resources ⓘ	81.5% (79.8% - 83.1%) 1143 responses	76.7% (73.4% - 80.0%) 335 responses	85.0% (83.6% - 86.4%) 1307 responses	78.2% (76.8% - 79.6%) 1894 responses
Student support * ⓘ	67.4% (64.6% - 70.2%) 564 responses	78.9% (74.7% - 83.2%) 190 responses	72.1% (68.5% - 75.8%) 359 responses	59.5% (56.5% - 62.6%) 615 responses
Skills development ⓘ	77.8% (76.2% - 79.4%) 1247 responses	78.8% (76.1% - 81.5%) 425 responses	79.5% (77.9% - 81.1%) 1342 responses	78.2% (76.8% - 79.5%) 1998 responses

L/N - Low numbers – The number of survey responses are too low to display

N/A - Data not available for this study area or institution

* - Data source: 2014 only

Data source: University Experience Survey 2013-2014   *How to interpret this data*

Source: <www.qilt.edu.au>.

Figure 6: Quality indicators for learning and teaching—employment outcomes

Source: <www.qilt.edu.au>.

1.4.3 Enabling choice for international HDR candidates

The motivations for undertaking HDR training will differ for some international HDR candidates, compared to domestic candidates. Many of these candidates are already employed in academic positions in their home country and are sponsored by their government or institution to come to Australia to upskill, whereas others have the desire to pursue an academic career once they have completed their training. Additional information on the availability and quality of other aspects of HDR training experiences for international candidates, such as access to English language training and some specific disciplinary skills training, should also be made available.

1.5 Key finding 1

Universities have a duty of care to communicate the likely outcomes of HDR training prior to candidates commencing their training. The information currently available to aspiring candidates is inadequate. Candidates need to be provided with information on the career outcomes of past HDR graduates, as well as comparative information on the quality, performance and components of HDR training provided by each university. The Quality Indicators for Learning and Teaching website provides a potential opportunity to communicate this information to candidates in a clear and effective way.

Section 2
Better preparing candidates for HDR training

2.1 Introduction

The traditional pathway to undertaking a Research Doctorate in Australia has been the completion of a 3-year undergraduate Bachelor degree followed by a 1-year Honours program. The Honours program usually comprises both coursework modules and the completion of a research dissertation, although this varies between disciplines. Although it is the most accepted route to a Research Doctorate this is changing, with an increasing number of candidates undertaking postgraduate education or entering the workforce prior to embarking on HDR training.

To meet the changing needs and backgrounds of prospective candidates, there is growing demand to establish alternative entry pathways to HDR training. The Review received numerous suggestions on ways to enhance preparatory training. There is particular interest in developing a for-purpose HDR training coursework Masters degree, but regulatory and funding barriers make this route difficult to establish at a national scale.

This section explores the different entry pathways to HDR training, issues associated with them, existing and potential responses to develop new entry pathways, and the barriers that need to be overcome to develop responses on a national scale.

2.2 Entry pathways to HDR training

2.2.1 The Australian Bachelor Honours degree

The Australian Honours program rapidly became the primary pathway to HDR training (Manathunga et al., 2012). However, the number of students undertaking Honours has been steadily declining, and the proportion of candidates using Honours as their entry qualification for a Research Doctorate is also declining (Kiley, 2015). In 2011, 52 per cent of commencing HDR candidates used a Bachelor degree with Honours as the basis for admission to HDR training, whereas 43 per cent used a postgraduate qualification (Department of Innovation, Industry, Science and Research, 2011a).

Despite this slow decline, the Bachelor Honours degree will continue to remain the most accepted pathway to HDR training unless a desire to develop alternative entry pathways is combined with wider regulatory change. The Honours degree endures as the primary pathway to HDR training due to its funding status, receiving financial support from the Australian Government. Universities receive funding through Commonwealth Supported Places and from students who have access to HECS-HELP and FEE-HELP support to cover their tuition contribution. It is challenging for universities to develop financially viable alternative pathways owing to the absence of financial support for domestic candidates in alternative programs.

It is important to differentiate between different types of Bachelor Honours degrees. There is a distinction between *Honours programs* (such as the Australian four year Bachelor Honours degree) and programs that are *awarded with Honours* (such as those awarded in England and Wales, Ireland, Hong Kong, Malaysia and Singapore) (Manathunga et al., 2012, p. 10).

The traditional Australian Bachelor Honours degree is usually an additional fourth year of undergraduate education for those who have completed a 3-year Bachelor degree program (Australian Qualifications Framework Council,

2013). It is this degree that has traditionally been seen as a pathway to HDR training in Australia. There are also Bachelor Honours degrees that are embedded in a Bachelor degree, sometimes as an additional year (Australian Qualifications Framework Council, 2013). This approach often occurs in professional degrees, and such programs are sometimes referred to as integrated Honours. On completion of a Bachelor Honours degree graduates should have "advanced knowledge of the underlying principles and concepts in one or more disciplines and knowledge of research principles and methods." (Australian Qualifications Framework Council, 2013, p. 16).

Bachelor degrees awarded with Honours, such as those in England and Wales, are usually 3-year programs where Honours is awarded to signify a particular level of achievement. This has also been the case in the past in Australia within some disciplines and at some institutions where an Honours degree has been awarded to indicate a superior level of achievement. Within the England and Wales system, most Bachelor degrees are now awarded with Honours. This situation is in sharp contrast to Australia where approximately 162,000 Bachelor pass degrees were awarded in 2014, but only approximately 14,000 Bachelor Honours degrees were awarded (Department of Education and Training, 2015a).

2.2.2 Coursework Masters

The data shows there is a slow but steady increase in the number of candidates who are entering HDR training after completing a coursework Masters degree rather than a Bachelor Honours degree (Kiley and Cumming, 2014), and in part this is because a coursework Masters degree is no longer regarded as a terminal degree (Kiley, 2015). The increasing requirement for a research component within coursework Masters degrees is said to have improved their status as a valid entry pathway. A number of submissions to this Review point to coursework Masters programs with a 25–33 per cent research component as a potentially acceptable entry pathway (Queensland University

of Technology, 2015; Australasian Council of Deans of Arts, Social Sciences and Humanities, 2015; Dean of Creative Industries, Queensland University of Technology, 2015).

2.2.3 Research Masters

The Research Masters degree has the potential to be an alternative entry pathway for those lacking the first-class Honours degree that many universities favour. University of Queensland (2015) suggested that as the Research Masters entry requirements were typically lower compared to Research Doctorate entry requirements, using Research Masters as a pathway could help those from non-traditional backgrounds and those with industry experience to enrol in a research degree. A broad definition of industry is taken in this report and includes businesses, governments, government business enterprises, non-government organisations, not-for-profit groups and community organisations. Research Australia (2015) suggested that a Research Masters degree would better prepare potential Research Doctorate candidates. Candidates that showed aptitude and excelled in this program could potentially upgrade to a Research Doctorate during their Research Masters candidature.

2.2.4 The US HDR training model

The virtues of the US Research Doctorate model were recognised in many submissions, which extolled the resultant quality and the broad and deep knowledge of graduates from this system. In particular, the coursework approach and the incorporation of teaching and research into the degree were highlighted as positive aspects (Flinders University, 2015). This model usually requires attainment at a Masters level degree before enrolment in Doctoral studies (Western Sydney University, 2015). The length of time for HDR completion is much greater than other HDR training systems around the world, ranging from an average of 6.5 years in the physical sciences to 11.7 years in education (National Science Foundation, 2013), a feature that is seen as a disadvantage.

2.2.5 The Bologna model

A qualifications framework has been adopted within the European Higher Education Area, and has led to the introduction of a three-cycle system of successive degrees: Bachelor, Masters and Doctorate (European Commission, 2016). The increasing adherence to this framework across Europe means that in most European research training systems, the typical pathway to Research Doctorate involves completing a 3–4-year Bachelor and a 1–2-year Masters degree. The Research Doctorate itself is expected to take 3–4 years to complete. This framework is frequently referred to as the Bologna process or Bologna model. Although there are many different ways in which the degree programs themselves are structured, it is now very common for a Masters degree to be the standard entry pathway to a Research Doctorate in Europe.

2.2.6 Post-Roberts review model

Following the Roberts (2002) review, the UK has taken steps to build specialist coursework Masters degree programs that are specifically designed as entry pathways to a Research Doctorate. Flexible funding arrangements are in place allowing tuition fee subsidies and stipends to be awarded to candidates to undertake both a Masters degree and a Research Doctorate.

2.2.7 Summary

There are a variety of different entry pathway models in use both within Australia and overseas. Nevertheless, the Australian Honours degree continues to be the traditional or default entry pathway, particularly for those moving straight through the system from a Bachelor degree. Entry pathways to HDR training overseas, and increasingly in Australia, are making use of a Masters degree to prepare candidates.

2.3 Issues with current entry pathways to HDR training in the Australian research training system

2.3.1 Adequacy of Honours in preparing candidates for HDR training

There are concerns expressed within the sector that the current Australian Honours model is not necessarily the best way to prepare candidates for HDR training. The University of Wollongong (2015) expressed concern that the current approach is breaking down. Concerns tend to centre on the relatively short duration and lack of breadth and disciplinary depth of the Honours program, leading to candidates being underprepared for HDR training compared with those trained overseas, as illustrated by this comment from the Australian National University.

> "…Honours programs encompassing only one year of HDR training may not equip students with enough prior knowledge."
>
> Australian National University (2015, p. 9)

Although described as a 1-year program, the amount of time spent by the candidate on the program is typically less than this. The program usually begins in late February and must be completed by early November because of the need to determine recipients of APA scholarships and other scholarship selection considerations for those wishing to pursue HDR training the following year. Thus, the Honours degree program is usually only 8–9 months in length. The shortness of the program is of concern to many Australian universities. James Cook University (2015) described Honours as increasingly inadequate as preparation for entry into the Research Doctorate. Flinders University (2015) echoed a similar concern, stating that in some disciplines, Honours provides inadequate time to train candidates for higher degree study and develop a wider skill base. In particular, stakeholders raised concerns that candidates do not receive adequate methodological training, especially in quantitative methods and data analysis.

2.3.2 International recognition of the Honours degree

The Australian Honours degree and its place in a globally connected world needs to be considered from the perspective of international candidates coming to Australia and Australian candidates going overseas. Many graduates from Australian universities (both domestic and international candidates) will seek employment for all or part of their career outside Australia. This is problematic for Australian Honours graduates, as Kiley et al. (2009) point out—the qualification is highly valued within Australia but not well understood overseas.

The impacts of a lack of global recognition are persistently raised by stakeholders and relate to two main areas:

- Australian candidates are uncompetitive for overseas HDR opportunities

- Difficulties are created in the recruitment of international candidates to the Australian research training system

Impact of the lack of recognition of Honours by overseas institutions

There are concerns that the lack of international recognition of the Australian Honours degree is harming candidates at the highest level when applying for prestigious scholarships or places at elite universities overseas (James Cook University, 2015; Giles, 2015). The Innovative Research Universities (2015) state that there are

issues relating to the international portability of the Honours program. The Council of Australian Postgraduate Associations (CAPA) expresses similar concerns:

> "International institutions do not always recognise an Honours program as a research preliminary program in the same way that a Masters program is considered. This can limit students that wish to enter HDR training in a different country's institution."
>
> Council of Australian Postgraduate Associations (2015, p. 10)

Impact of Honours on the competitiveness of Australia's HDR training system

The potential impact of the lack of international recognition of the Australian Honours system on recruiting international HDR candidates is also of concern to the university sector. International candidates are an important part of the research system in Australia, providing expertise in many fields where there is a domestic recruitment deficiency, and valuable income for universities to reinvest in education and research. The international HDR training market is very competitive, and deficiencies that undermine the competitiveness of the system should be addressed.

A particular concern relates to recruiting international HDR candidates that have already completed a coursework Masters degree but without a substantial research component. In such cases, the prospective candidate may need to undertake further preparatory training before

Figure 7: Main activity of HDR candidates the year before beginning a research degree, showing the large number of candidates entering HDR training with past work experience

Basis for admission, Bachelor or Postgraduate qualification completed:
Less than 5 years ago: 57%
5–10 years ago: 23%
10–20 years ago: 15%
More than 20 years ago: 6%

VET 0.4
Other 0.5
Looking for work 1
Travelling 1.2
Caring for others 1.4
Undergraduate study 3.6
Full-time work 45.6
Part-time work 9.6
Other postgraduate 16.2
Honours 20.4

Proportion of HDR candidates (%)
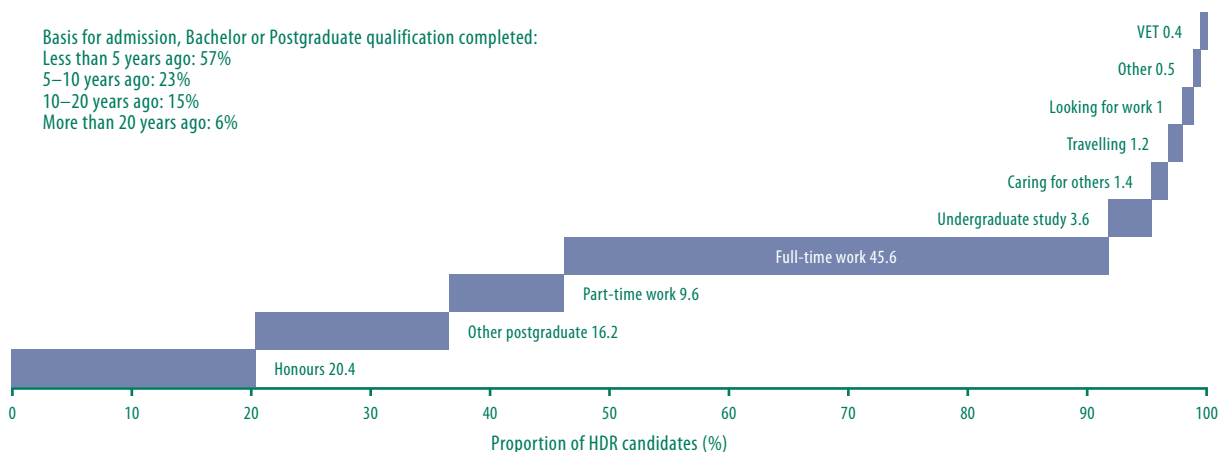
Reproduced from Department of Innovation, Industry, Science and Research (2011a).

commencing HDR training, and within Australia this training would often be at the undergraduate Honours level.

From the sponsor's perspective, there is reluctance to fund a qualification at a lower level than has already been achieved by the prospective candidate (Flinders University, 2015). If the candidate pursued HDR training in other research systems and needed additional preparatory training he or she would enrol in a Masters degree, an outcome which would be seen as more desirable for the sponsor and the candidate.

2.3.3 Changing demographics and not adequately recognising work experience

Completing high school, a Bachelor degree, a Bachelor Honours degree and a research degree in succession is no longer the typical route taken by most HDR graduates, with many candidates choosing to undertake research training later in life. About 60 per cent of candidates are aged over 30, with 27 per cent over 40 and 13 per cent over 50 (Department of Education and Training, 2015h). As Figure 7 shows, more than half of all HDR candidates were undertaking work (full or part time) as their main activity prior to commencing HDR training, and more than one-fifth of HDR candidates completed their bachelor or postgraduate qualification more than 10 years prior to starting their HDR training. This shows that a large proportion of candidates are coming to HDR training with substantial work experience.

The perception that APAs are generally awarded to prospective candidates with a first-class Honours degree is said by many stakeholders to be suppressing further demand for HDR training from those with substantial relevant work experience, but lacking this academic qualification. This perception exists despite many universities changing their assessment criteria to ensure adequate weighting is given to work experience. This is a particular problem for some older HDR candidates looking to return to university to undertake

HDR training. These candidates sometimes have substantial knowledge gained through their work experience, which could adequately substitute any perceived academic shortcomings, particularly when the prospective candidate might have undertaken their undergraduate education some time ago.

During consultations with stakeholders, there appeared to be some confusion as to whether Australian universities can substitute work experience for academic qualifications when making decisions about APA scholarships The *Commonwealth Scholarships Guidelines (Research) 2012* state that:

> "…universities may award an APA to an applicant that does not hold a Bachelor Degree with First Class Honours, if the university deems that the applicant has attained equivalent qualifications and experience to merit selection."
>
> Department of Education and Training (2015d)

Some participants had interpreted this to mean academic qualifications and academic experience, while others considered that it meant academic qualifications and work experience. Even where stakeholders were aware of flexibility within the funding rules, participants at some of the public forums expressed their frustration that APA scholarships are routinely only awarded to applicants with a first class Honours degree or academic equivalent such as coursework Masters degree, and those with substantial relevant work experience were often overlooked.

2.3.4 Current limitations for coursework Masters entry pathways

Although numbers are increasing, a wider uptake of a coursework Masters degree as an entry pathway is prevented by the absence of funding support. There are only a limited number of Commonwealth supported places available for such programs, and the current RTS funding requirement for a two-thirds-research component makes coursework programs ineligible for RTS funding.

As coursework Masters degrees are not funded entry pathways for HDR training, they are not usually structured to provide the preparatory training for an HDR degree. Such courses usually attract tuition fees and are often designed for professionals looking to improve their technical skills, as distinct from research skills. As a number of stakeholders stated at public forums, for a coursework Masters degree to be an effective entry pathway to HDR training it needs to have a HDR training focus, including a substantial research component.

2.3.5 Lack of enthusiasm for a Research Masters degree

Despite a Research Masters degree being an existing pathway, the data suggests that candidates and universities are not making use of it. Owing to the declining number of HDR candidates commencing a Research Masters degree each year (Figure 1), and the reluctance of many institutions to award places, the degree has limited use as an entry pathway for HDR training. Candidates now rarely enrol in a Research Masters degree and then upgrade their candidature to a Research Doctorate after 1 or 2 years (Kiley, 2015). Universities are choosing to apply the finite HDR training funding they receive through the block grants to Research Doctorate candidates.

The AQF requirement for the degree to be made up of a two-thirds research component also limits the capacity of the Research Masters degree to provide the structured learning required for a robust entry pathway to a Research Doctorate.

Despite the overall decline, there is a great deal of variation in the disciplines in which Research Masters degrees are offered. University of Melbourne (2015) points out that 42 per cent of completions within the Creative Arts are Research Masters, but for other disciplines Research Masters completions represent only 10–20 per cent of HDR completions. Any moves away from supporting Research Masters needs to recognise the impact on individual disciplines.

2.3.6 Difficulties of the US model— lengthy timeframe to deliver thorough training

The length of time taken to complete a Research Doctorate in the US is significantly longer than in Australia. Allowing for a greater amount of time to undertake a Research Doctorate means that candidates could be better prepared for employment (University of Sydney, 2015), although this claim is disputed (RMIT University, 2015), and it is noted that the system has high drop-out rates (Kiley, 2015). On the other hand, the shorter timeframe of the Australian system over the US model is seen as a positive distinguishing feature of the Australian system, and makes the system more attractive to international HDR candidates.

2.3.7 Summary

There are concerns within the sector that the Australian Honours degree, the traditional entry pathway into HDR training, is not adequately preparing candidates for a research degree. Furthermore, the lack of international recognition of this qualification is potentially harming the Australian research training system, as well as limiting outstanding Australian candidates from pursuing HDR training opportunities overseas. There has been a shift in the demographics of HDR candidates, with many candidates coming to training later in life and with substantial work experience. Demand from such candidates might be even higher if relevant work experience was more readily taken into account when places and scholarships are allocated. Following global trends, an increased number of candidates are using a coursework Masters as an entry pathway to HDR training. The uptake of this pathway is suppressed by a lack of funding support in comparison to the Australian Government funded Honours pathway, and such programs are not always designed with future HDR training in mind. The Research Masters degree has diminished in significance in Australia and is not frequently used as an entry pathway for

HDR training. While the North American model is acknowledged as producing high quality HDR graduates, there are questions regarding its effectiveness and efficiency in terms of the high number of graduates who do not complete, and the increased cost and time to complete.

2.4 Developing entry pathways with improved preparatory training

This section looks at how some stakeholders have been responding to concerns relating to the preparedness of candidates for HDR training. It then explores how entry pathways and HDR training might be restructured more generally to meet the changing needs of all stakeholders.

2.4.1 Existing responses to improve preparatory training

Despite regulatory and funding constraints, the desire to better prepare candidates for HDR training is high. Some institutions have developed alternative entry pathways with improved preparatory training models compared to the Honours pathway. Examples include candidates undertaking a graduate certificate in research methods or a newly developed dedicated Masters degree that focuses on improving research skills.

Lengthening the Research Doctorate

Like many other institutions, the University of Wollongong has recognised that candidates are starting HDR training underprepared. Instead of providing improved preparatory training prior to commencing candidature, the University of Wollongong has introduced a 4-year Research Doctorate program, which includes 1 year of coursework (University of Wollongong, 2015).

Graduate diplomas in research methods

An alternative Graduate Diploma entry pathway to HDR training has been developed by some universities. For example at Flinders University, candidates undertake a Graduate Diploma in Research Methods. The Diploma provides them with research methodology skills for undertaking a substantial research project and to gain entry into the Research Doctorate program (Flinders University, 2015). Similarly, Griffith University now offers a Graduate Diploma of Research Studies containing a 50 per cent research component as a pathway to HDR programs (Griffith University, 2015).

Coursework Masters degree

To enhance the coursework Masters degree as an entry pathway to HDR training, some universities have moved to introduce or strengthen the research component of the program. This has enabled the coursework Masters degree to be seen as an entry pathway to HDR training, rather than as a terminal degree. This approach is more appealing than Honours to international candidates or potential candidates with substantial work experience.

Two-year hybrid Master of Research degree

Perhaps the most innovative newly developed entry pathway model is that at Macquarie University. In 2013, Macquarie University adopted a 2-year Master of Research degree as its standard pathway for admission to HDR training. Macquarie University has overcome regulatory and funding barriers by offering the program as a hybrid degree, combining a Bachelor of Philosophy (BPhil)/Master of Research (MRes).

> *In Year 1, domestic students are enrolled in the Bachelor of Philosophy (BPhil) as a Commonwealth supported student and are liable for student contribution amounts which can be deferred through the HECS-HELP scheme if they are eligible. In Year 2, domestic students are enrolled in the Master of Research (MRes).*
>
> Macquarie University (2015b)

The first year of the hybrid degree is funded through Commonwealth supported places, in a similar way to a standard Honours program. The second year of the degree is funded through the Research Training System block grant. The careful use of these funding programs allows Macquarie University to offer a higher level program to domestic candidates without any up-front fees, in contrast with most coursework Masters programs.

One of the advantages of the Macquarie University approach is that it provides multiple exit pathways. Candidates can leave with a Bachelor of Philosophy degree if they wish to exit the program after 1 year. For those who do not wish to pursue a Research Doctorate after the 2-year program, they leave with an enhanced qualification that recognises the research skills they have gained. This approach allows candidates to progressively develop their research skills, and provides them with a longer opportunity to better determine their level of interest and suitability for HDR training. The program also provides a pathway into research careers that do not require a Research Doctorate but do require postgraduate HDR training.

The use of the different funding schemes introduces specific compliance requirements for the hybrid program and places limitations on the way Macquarie University can structure the degree (Macquarie University, 2015b). For example, as the second year of the program is funded through the RTS block grant it must have at least a two-thirds research component, thereby restricting the amount of coursework that can be undertaken in the second year.

A summary of the program is provided in Box 3.

Box 3: Summary of the Masters of Research program at Macquarie University

Year 1 units are advanced undergraduate coursework including study of research frontiers in the discipline

- 6×4 credit point units of advanced disciplinary content
- 1×4 credit point Research Communications unit
- 1×4 credit point Research Frontiers unit where candidates survey the key ground-breaking and innovative research issues in their field

Year 2 units are at the Masters postgraduate program level specialising in research preparation and experience in a specific research topic at the sub-discipline level.

The Year 2 program is based around five core activities:

- Research Frontiers
- Literature Review
- Research Methods
- Research Planning
- Thesis (20,000 words) based on a small research project

Source: Macquarie University (2015a).

2.4.2 Potential responses

Research training coursework Masters degree

A key component of HDR training is the need to develop a broad range of high level methodological skills. A criticism of the Honours approach is that candidates specialise in a particular research area at too early a stage, leading to a narrow a range of methodological skills and disciplinary knowledge. This means that candidates are not necessarily developing the broader skills needed to succeed across a range of research projects. Developing a more rounded set of research skills will allow candidates to pursue a wider range of future HDR training opportunities.

There was enthusiasm during the public consultations for developing a specialist HDR training coursework Masters degree. Consultations have revealed there is support for an entry pathway model that enhances disciplinary knowledge and research methods skills, which includes an assessable thesis component. The degree would allow graduates to develop their research skills at a level of proficiency suitable for many careers, while significantly enhancing their research skills if they wish to pursue further HDR training. Typical comments included:

> *"Entry pathways need to incorporate an independently-conducted capstone research project plus research methods training appropriate to the discipline."*
>
> Australian National University (2015, p. 9)

> *"…Australian universities need to put greater emphasis on high order disciplinary knowledge in HDR programs."*
>
> Macquarie University (2015b, p. 6)

A number of potential models were outlined in the written submissions and explored with participants during the public consultation phase. The most favoured approach for a new entry pathway to HDR training is the development of a for purpose 2-year HDR training coursework Masters degree. A similar approach is outlined in the written submission from University of Sydney (2015). This program would be made up of three major components

with a suggested one-third weighting for each. The first component would be high-level coursework disciplinary training, the second would be coursework research methods training, and the final component would be a research project assessable through the production of a research output, such as a dissertation. In addition to these academic components, there might also be an opportunity to integrate broader transferable skills development and industry placements within the program (see Section 4 and Section 6 respectively).

A number of participants state that a Masters level entry pathway is advantageous, as it aligns with the internationally recognised Bologna model of the Bachelor-Masters-Research Doctorate progression (see European Commission, 2016). This approach would overcome the significant barrier of international competitiveness associated with the traditional Honours approach. These advantages are outlined by the University of Tasmania (2015).

> "In regard to the pathways a student takes through their higher education career, a better structure for this would mirror the Bologna model: a three to four year undergraduate degree followed by a one to two-years Masters degree followed by a three year PhD degree. This 3+2+3 model would enable the development of broad-based research skills during the Masters degree years and would ensure that all students entering the PhD are well-trained."
>
> University of Tasmania (2015, p. 7)

A similar sentiment is echoed by the Australasian Council of Deans of Arts, Social Sciences and Humanities (2015) who, along with others, agree that candidates would be better prepared for Research Doctorate training, and therefore should require less time to complete their thesis.

> "The Bologna model is essentially a 3+2+3 model. By the time the students finish their Masters degree they should be aware of the requirements of the PhD. Ideally this model would discourage students unsure about their projects from enrolling and also reduce the amount of time needed to complete the thesis."
>
> Australasian Council of Deans of Arts, Social Sciences and Humanities (2015, p. 8)

Comparing preparatory training models

The Review compared four HDR training models that could be employed: the traditional (Honours) model, the Macquarie model introduced at Macquarie University, a new model proposed by the University of Sydney, and a new model developed by the Expert Working Group. Each of these models has advantages but the newly proposed model in Table 8 was favoured during stakeholder consultations as it offers HDR candidates enhanced preparatory training, and presents a new entry pathway for candidates with valuable work experience.

Multiple or a single approach to preparatory training

Most submissions favoured retaining multiple entry pathways to provide a greater diversity of ways for candidates to access HDR training, and allow universities the flexibility to offer their preferred pathway programs without funding disadvantages.

Table 5: Summary of the traditional model

Stage	Undergraduate education	Initial HDR training component	Research training
Component	Bachelors Honours degree, with Honours year acting as initial HDR training		Research Doctorate
Length	4 years		3–4 years
Course funding	CSP + HECS		RTS
Student support	Youth allowance, Austudy payment (Austudy), Aboriginal Study Grants Scheme (ABSTUDY)		APA/IPRS for 3–3.5 years

Table 6: Macquarie model

Stage	Undergraduate education	Initial HDR training component	Research training
Component	Bachelors degree	Hybrid BPhil and Research Masters degree	Research Doctorate
Length	3 years	2 years (with exit point after 1 year)	3 years
Funding	CSP + HECS	Hybrid Year 1 – CSP + HECS Year 2 – RTS	RTS + APA/IPRS
Student support	Youth allowance, Austudy, ABSTUDY	Univeristy scholarship	APA/IPRS 3–3.5 years

Table 7: Proposed model from University of Sydney (2015)

Stage	Undergraduate education	Initial HDR training component	Research training
Component	3-year Bachelors degree	Research track intensive Masters degree	Research Doctorate
Length	3 years	1–2 years	3.5–4 years
Funding	CSP + HECS	CSP + HECS FEE-HELP	RTS + APA/IPRS
Student support	Youth allowance, Austudy, ABSTUDY	Youth allowance, Austudy, ABSTUDY	APA/IPRS scholarship

Table 8: Preferred model emerging from consultations with stakeholders

Stage	Undergraduate education	Initial HDR training component	Research training
Component	3-year Bachelors degree	Research training coursework Masters degree	Research Doctorate
Length	3 years	2 years	3 years
Funding	CSP + HECS	CSP + HECS FEE-HELP	Research training block grant
Student support	Youth allowance, Austudy, ABSTUDY	Youth allowance, Austudy, ABSTUDY	Scholarship

2.4.3 Identifying and overcoming barriers

The three main barriers to developing alternative entry pathways with enhanced preparatory training are resistance, regulatory hurdles, and funding.

Resistance to change

Although the consultations revealed a significant desire for change from some stakeholders, many still passionately support the Australian Honours degree. Furthermore, within some disciplines Honours degrees form part of the training required for professional accreditation. Some stakeholders stated that although a move to increase the range of entry pathways should be pursued, particularly those that enhance preparatory training, flexibility should be maintained without mandating a one-size-fits-all approach. Multiple stakeholders commented that providing the opportunity to offer an enhanced entry pathway would be enough, and cultural resistance would soon fall away. The following is typical of many comments heard at stakeholder interviews and at public forum events.

> *Our experience has been when we made changes to our entry pathways there was some resistance, and so we allowed people to choose to keep doing things the same way in their discipline, or to take up the revised program. Within a year resistance had died away and nearly everybody had moved to the revised program as they could see it was working better for students.*
>
> Stakeholder interview

In addition, some stakeholders stated that decisions regarding entry pathways should be left to universities. Universities strongly defend their autonomy and there is a level of resistance in imposing a one-size-fits-all model across all institutions.

A move towards a Masters entry pathway was seen as the most feasible way of improving preparatory training and addressing candidate concerns about starting a Research Doctorate underprepared. This approach also has the advantage of potentially lessening coursework pressure within the Research Doctorate itself (James Cook University, 2015). The area of most concern for stakeholders was centred on what the course components would be, and how the obstacles preventing its widespread uptake would be overcome.

Regulatory hurdles for developing alternative entry pathways

The major barrier to developing alternative entry pathways centres on the current inflexible funding arrangements. For example, limited funding options available for domestic candidates make it difficult to develop a sustainable HDR training coursework Masters degree. Furthermore, the absence of incentives to develop such an approach, alongside the anticipated increased costs, provides little reason for universities to migrate from an Honours pathway to a Masters pathway.

There are clear and accessible funding arrangements in place for undergraduate Honours degrees. The Australian Government provides financial support through Commonwealth supported places, and candidates make a financial contribution that can be deferred through the HECS-HELP support system. Research training degrees are currently funded through the Research Training System block grant. Only a small number of Commonwealth supported places are available for coursework Masters degrees.

Some stakeholders stated that the current two-thirds research requirement within the Australian Qualifications Framework and within the RTS block grant funding rules are inflexible and represent a barrier towards developing new entry pathways. Although this rule prevents developing alternative entry pathways with enhanced preparatory training through the RTS block grant, its removal is not the only step that is needed to enable new entry pathways.

Enabling funding flexibility for alternative entry pathways

Stakeholders in favour of an alternative Masters entry pathway stated that the content should be structured around what would best prepare candidates for HDR training, rather than what adheres to existing AQF definitions or regulatory rules. This sentiment was expressed by the Australian National University in its submission.

> "Allocation of more CGS funding to research pathway degrees, and/or more flexibility in the AQF standards, would facilitate provision of necessary training to better equip research students to succeed at the PhD level."
>
> Australian National University (2015, p. 9)

As Macquarie University has shown, this approach to entry pathways can be developed within the existing funding envelope. However, this innovative approach would put significant pressure on the RTS budget if it were pursued by a large number of universities. Redirecting existing funding into a separate funding program for a for-purpose HDR training coursework Masters degree might be necessary to ensure the development of a financially sustainable and accessible program.

A HDR training coursework Masters degree program could be funded by allowing universities to redirect their CSP-funded Honours places to support HDR training coursework Masters degrees. If the model proposed in Table 8 is adopted, the course would be 2 years in length and additional funding would be required. Given the falling enrolments in Research Masters degrees, Australian Government support for this program could be redirected to enhance the funding available for the new HDR training coursework Masters degree. In addition to providing support in this way, the HDR training coursework Masters degree could be made more financially accessible for candidates by allowing them to access HECS-HELP to assist with making a financial contribution towards the cost of the program, in a similar way to the Honours degree.

From a candidate perspective, this would make a 2-year HDR training coursework Masters degree financially accessible. Postgraduate candidates who participated in this Review were generally supportive of this approach, as it would allow candidates to gain a greater level of preparation prior to HDR training through an accessible pathway.

2.4.4 Summary

Recognising the need to better prepare candidates for HDR training and to create alternative entry pathways suitable for a greater range of potential candidates, universities have already started to respond. This includes developing revised HDR entry pathways that include more specialist HDR training coursework such as in the form of a graduate certificate, lengthening and introducing coursework to the Research Doctorate, and developing a two-year hybrid Masters degree. After reviewing the responses and suggested models put forward during consultations, the Review favours the introduction of a 2-year HDR training coursework Masters degree. To enable this, barriers need to be overcome such as resistance to change and regulatory issues. In particular, funding flexibility needs to be provided to enable universities to offer this course to domestic candidates.

2.5 Key finding 2

Current regulatory and funding arrangements limit the development and uptake of innovative and internationally recognised entry pathways to HDR training. Flexibility in the current funding structure would allow universities to develop new accessible entry pathways which better prepare candidates for HDR training, such as a for-purpose HDR training coursework Masters degree.

Section 3
Providing financial support to research training candidates

3.1 Introduction

The Australian Government provides financial support to HDR candidates by subsidising the cost of tuition for all domestic candidates, and also for international candidates in receipt of an IPRS. Cost of living support is provided for outstanding candidates through APA scholarships and through university scholarships. There have been concerns expressed in the submissions to this review that the value and length of this support needs to be examined, to ensure that HDR training remains an attractive proposition.

This section explores how long a Research Doctorate is expected to take in Australia. It looks at the anticipated length as set out in the Australian Qualifications Framework, university course descriptions and through tuition support via the RTS block grant, and compares this to the actual length of time it takes candidates to complete, with completion in this report seen as the point at which a research thesis is submitted. It then highlights the disparity in the length of program funding for tuition through the RTS block grant and stipend funding through the APA. It also looks at the value of scholarships and the potential impact this has on recruitment. Finally, it proposes providing universities with greater autonomy on allocating funding for HDR training, allowing them to make decisions about the number, length and value of scholarships within a particular funding envelope.

3.2 Anticipated length of program

A recurring theme within this Review, and in previous reviews (e.g. House of Representatives Standing Committee on Industry, Science and Innovation,2008) has been determining what is considered a reasonable length of time to complete HDR training, and the duration of funding that should be provided to both institutions and candidates.

Unlike most other university degree programs, the length of study for a research degree is not modular and fixed by completing a set number of units, but is instead based on when the candidate has completed a research thesis. The Australian Qualification Framework describes a Doctoral degree as typically lasting between 3 to 4 years (Australian Qualifications Framework Council, 2013). Descriptions of Research Doctorate programs provided to prospective candidates reflect AQF requirements (for example see Australian National University, 2016a; University of Adelaide, 2014; Curtin University, 2015a; University of Canberra, 2015). Despite official policies often dictating candidature periods of no more than 4 years, exceptions can be made.

In Australia, Doctoral candidates have historically aimed to complete their Doctorates within 3 to 3.5 years, which is the typical length of a stipend scholarship, such as an APA (House of

Representatives Standing Committee on Industry, Science and Innovation, 2008). Consultations reveal that a maximum reasonable length of time for most candidates is approximately 4 years. This duration is in line with a series of past reviews within the UK that have also favoured a maximum of 4 years for a Research Doctorate (see Wright and Cochrane, 2000).

Some stakeholders have expressed fears that rushing through candidates quicker than this can lead to lower quality thesis outputs, and result in candidates being uncompetitive for academic position as they have not had time to build their researcher profile. On the other hand, there are concerns that some candidates take far in excess of 4 years to complete, which can have negative consequences for the candidate and represents inefficiency within the HDR training system.

Information on the average length of candidature and the proportion of enrolled candidates going on to complete a research degree is not readily available at the national, disciplinary, or institutional level. There have been a few small scale studies that have looked at completions data at the institutional level. For example Bourke et al. (2006) undertook a study of 700 individual candidates over a 10-year period at one Australian university. The study showed that 51 per cent of candidates completed in 4 years, 66 per cent within 5 years, and 70 per cent within 6 years. After 6 years, the remaining 30 per cent

of candidates discontinued. A more recent study by Palmer (2016) showed that in one research intensive university about one-third of candidates had completed after 4 years, and about half of candidates after 5 years (see Figure 8).

Within the existing HDR training system a 4-year period is seen as the anticipated maximum length of time needed to submit a Research Doctorate thesis, and this should be used to guide decisions on length of program and on length of stipend funding. As such, the HDR training period funded through research block grants should continue to be 4 years. This period could potentially be reduced from 4 to 3 years if an additional 1–2 years of effective preparatory HDR training was undertaken at the Masters degree level (see Section 2). If candidates commence their HDR training better prepared, candidature length could potentially be reduced.

Although AQF guidelines and the advice universities give to prospective candidates identify a program length of 3–4 years, more than half all candidates are taking longer than 4 years to complete, while 20–30 per cent do not complete at all (Bourke et al., 2006; Palmer, 2016). Prospective candidates should have access to accurate information on the past performance of different institutions to ensure their expectations on length of candidature are fully informed prior to commencing their HDR training.

Figure 8: Cumulative status at year 9 for research Doctoral candidates commencing in 2004 at a research intensive university
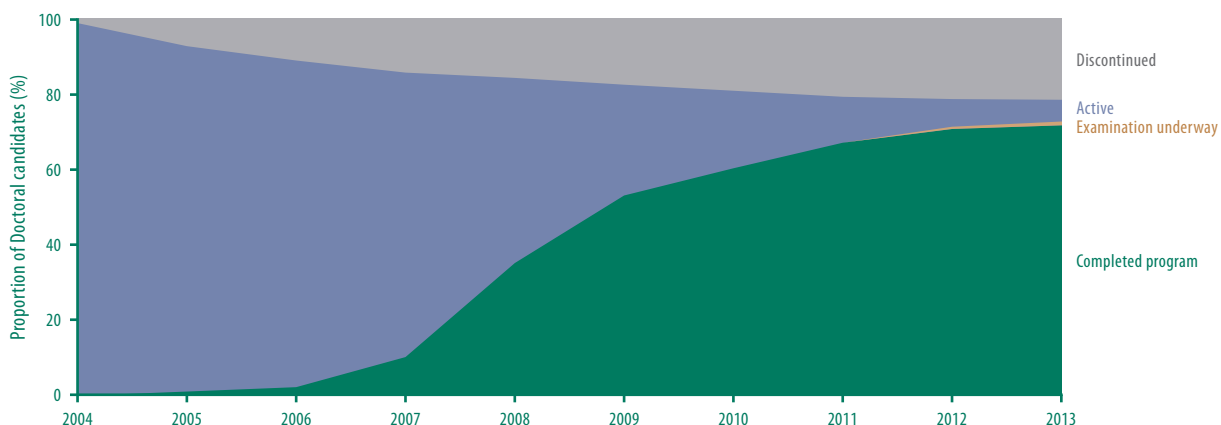
Source: Palmer (2016).

3.3 Issues with the length and value of funding for HDR training

3.3.1 Disparity in length of program funding and length of scholarship funding

There is widespread agreement from stakeholders that the value of stipend scholarships (such as APA scholarships) should align with the tuition period funded through the HDR training block grant (James Cook University, 2015; Australian National University, 2015; University of Newcastle, 2015; Australian Technology Network, 2015). At present, these government-funded stipends last between 3 to 3.5 years, whereas the RTS block grant provides funding for 4 years of tuition, in line with the anticipated length of the program. The disparity in length of program and stipend funding was previously highlighted in the House of Representatives Standing Committee on Industry, Science and Innovation (2008) inquiry into *Building Australia's Research Capacity*. The review heard from stakeholders at public forum events that this anomaly causes financial stress for some Research Doctorate candidates at the most critical point of their candidature. In many cases, candidates are forced to find employment, often unrelated to their HDR training, which can extend completion times.

A number of stakeholders raised the disparity in length of APA stipends with the anticipated length of the Research Doctorate as an issue that needed to be addressed (Queensland University of Technology, 2015; James Cook University, 2015; Australian National University, 2015; Western Sydney University, 2015; University of Sydney, 2015; University of Melbourne, 2015; University of Melbourne Graduate Student Association, 2015; University of Newcastle, 2015; Australian Technology Network, 2015). The majority of participants at consultation events and interviews considered that it was preferable to reallocate existing HDR training resources, to enable longer 4-year Research Doctorate scholarships, even if it meant offering fewer scholarships overall. They believed that it was better to offer fewer, higher quality scholarships.

3.3.2 HDR candidate funding

HDR training is made accessible through support from the Australian Government. All domestic HDR candidates are exempt from paying tuition fees, with the cost of HDR training met by the RTS block grant. In the 2014/15 Budget, the Government signalled its intention to reduce the amount of support it provides through the RTS block grant, and to allow higher education providers to introduce a candidate contribution for RTS supported places (Commonwealth of Australia, 2014). The maximum contribution rate would be $3900 per year for full time HDR candidates in a high-cost course, and $1700 for a low-cost course. Eligible candidates would have the option to defer this payment through the Higher Education Loan Programme. For international candidates the Australian Government provides support for 330 International Postgraduate Research Scholarships, which cover tuition fees.

In addition to this support for tuition fee costs, each year the Australian Government provides about 3500 Australian Postgraduate Award (APA) scholarships which are awarded on a competitive basis by universities. These scholarships provide outstanding HDR candidates with a tax-free stipend to assist with living costs while they undertake their training. In addition to this stipend, HDR candidates in receipt of a scholarship are permitted to work up to 8 hours per week, and many universities provide opportunities for paid teaching and research work for candidates to supplement their income.

There have been some concerns expressed within the consultations that the value of the APA scholarship, relative to higher paying opportunities and the high cost of living in some cities, might not be enough to attract the very best graduates (Victoria University, 2015; University of New South Wales Australia, 2015b; Australian Academy of Humanities, 2015; University of Melbourne Graduate Student Association, 2015). This problem affects all disciplines, as many graduates with the highest grades are often the most sought after, making it difficult for universities to compete in attracting the best and brightest to HDR training. Within some disciplines such as Engineering, it is even more difficult to attract

domestic candidates to HDR opportunities, as undergraduate employment prospects are good and initial starting salaries are high (Australian Council of Engineering Deans, 2015). Domestic graduates now make up just 45 per cent of HDR completions in Engineering and Related Technologies (Department of Education and Training, 2015a).

Some universities have responded by offering top-up scholarships, in a bid to attract outstanding candidates to HDR training. However, the limited funding available prevents widespread implementation of this approach. There is support for exploring how more generous externally funded support models can be incentivised, for example via an employer or industry partner (Victoria University, 2015). The value of APA scholarships will need to remain competitive so the very best graduates will continue to be attracted to HDR training opportunities. In addition to this, the positive career outcomes that HDR training brings over the long term need to be adequately communicated to prospective candidates (see Section 1), so the value proposition of HDR training is apparent. The recommendations within the *Review of Research Policy and Funding Arrangements* would provide an opportunity for universities to create more flexible funding packages that better meet the needs of HDR candidates (see Watt, 2015).

3.4 Providing greater autonomy to universities to determine support packages

Participants at consultation events supported the idea of relaxing the rules governing the length and value of research training scholarships, so long as safeguards are put in place to ensure that financial support and length of funding could not drop below their current levels. Universities would be allowed to use their HDR training budget in a more flexible manner to fund longer duration and higher value scholarships, where appropriate. The advantages of this approach are that universities would be free to offer fewer, but longer length and/or higher value scholarships, which would be one way to address the disparity

in length of program and scholarship funding. This approach could be particularly useful for disciplines where it is hard to recruit domestic candidates, or for disciplines that traditionally have longer completion times because of the nature of the fieldwork undertaken (for example, see Australian Anthropological Society, 2015). Stakeholder support for the proposal was dependent on setting minimum threshold scholarship amounts, to prevent any decreases in individual candidate funding.

3.5 Supporting international HDR candidates

The Australian Government provides support to about 330 outstanding international HDR candidates each year through the IPRS program. Scholarships from this program cover tuition fee costs for 3 years for those candidates undertaking a research doctorate. Candidates in receipt of an IPRS are eligible to apply for an APA to provide them with a living allowance stipend. Those international candidates that take longer than 3 years to complete their HDR training face the challenge of funding their tuition and living costs beyond the 3 year scholarship period. Providing universities with flexibility to extend scholarship support for international HDR candidates where there are special circumstances would help alleviate the financial stress for candidates that take longer than 3 years to complete their research doctorate.

3.6 Key finding 3

The disparity in length of the Australian Postgraduate Award and International Postgraduate Research Scholarship, and the expected length of research doctoral programs causes financial stress for some candidates at the end of their HDR training. The value of awards and scholarships for candidates needs to remain competitive to attract the best and brightest candidates to HDR training. Providing universities with the flexibility to use their allocation of HDR training funding to extend scholarships to 4 years, and where necessary provide scholarship top-ups, would help resolve these issues.

3

Research training delivering benefits to the nation

Introduction to Chapter 3

This Chapter explores how HDR training can be improved to deliver greater benefits to the nation. Firstly, it looks at how to better deliver transferable skills development through HDR training. It also explores how research can deliver greater economic and social benefits for the nation through increased industry–university collaboration in HDR training. Finally, it examines how both industry and HDR candidates can benefit through the development of an industry placements program. A broad definition of industry is taken here that includes businesses, governments, government business enterprises, non-government organisations, not-for-profit groups and community organisations.

Section 4: Delivering transferable skills development through HDR training

HDR graduates go on to a range of research and non-research careers in business, academia, government, community and not-for-profit sectors. The skills developed through HDR training need to be appropriate for graduates to succeed in careers right across the spectrum of the economy.

Flexibility is important when considering transferable skills training and a one-size-fits-all approach should be avoided. It is important to provide flexibility in what training is required and how it should be delivered, given the variability between disciplines and the diverse backgrounds and career aspirations of HDR candidates.

This section identifies the skills and broader transferable qualities needed for researchers to succeed in a range of careers, and finds there is high overlap between the skills that employers report they need, and those gained during HDR training.

One effective way to deliver transferable skills flexibly and tailor skills training according to candidates' needs is through the use of a skills development framework. This would allow candidates to identify their training needs and achievements against skills domains, and helps them recognise skills gained, where they need improvement, and how their skills can be applied in a range of settings.

Section 5: Supporting industry relevant research projects

Australia's research effort is considered to be of high quality by global standards. In contrast, Australia scores poorly in research translation, particularly the translation of research into commercial outcomes. This is in part because of low levels of collaboration between industry and public sector research organisations, including universities, a problem that the Australian Government is seeking to address.

This section explores the important role that HDR training can play in driving better research translation and collaboration. Embedding a culture of collaboration at an early stage of a researcher's career could have long-term benefits, and gaining a greater insight into how research can benefit industry has the potential to improve the low numbers of researchers employed in industry. This section explores current barriers to increasing collaboration levels. Despite these barriers, Australia should be aiming to increase its level of industry–university collaboration during HDR training. Increasing the proportion of industry-focused HDR training opportunities will help improve industry–university collaboration.

Section 6: Enabling industry placements in HDR training

With a majority of HDR graduates moving into careers outside university research, providing candidates with an opportunity to collaborate with industry partners can help improve future employability.

This section explores a number of industry placement schemes within Australia and overseas, noting that in Australia such programs are generally small in scale and scope. It outlines the barriers to their widespread uptake, which include funding, difficulties surrounding intellectual property arrangements, and the need to ensure that HDR candidates complete their training in a timely manner. Overcoming barriers will require a consistent national scheme of significant scale. Such a scheme needs to help facilitate the process of matching industry partners with HDR candidates. It is suggested that a national industry placement scheme similar to the Canadian Mitacs Accelerate program be developed in Australia.

Section 4
Delivering transferable skills development through HDR training

Australia's research training system is an investment designed to deliver new knowledge through the production of Masters and Doctoral theses, and to produce a workforce with the skills required to transform that knowledge into economic and social benefits.

Research graduates go on to a range of careers across business, academia, government, community and not-for-profit sectors. Over half of all HDR graduates will leave the academic sector shortly after graduating, as shown in Box 1. Skills developed through research training should be appropriate for graduates to succeed, not just in research and innovation, but across the whole spectrum of society.

The influential 2002 UK Roberts Review found that employers perceived the training of Doctoral candidates, particularly in transferable skills, as inadequately preparing graduates for careers in industry (Roberts, 2002). Submissions to the House of Representatives inquiry into Building Australia's Research Capacity noted that HDR candidates may require generic skills training to help them succeed in the workforce in addition to their research training (House of Representatives Standing Committee on Industry, Science and Innovation, 2008). In the United States, it was observed that Doctoral research training programs have typically not included a strong professional development component (Commission on the Future of Graduate Education in the United States, 2010).

The Australian Council of Graduate Research has championed the need for HDR training to provide graduates with the skills needed to succeed in a range of different careers (Australian Council of

Graduate Research, 2014). While many universities make a significant effort to deliver transferable skills training to HDR candidates, there is a need for greater accountability and transparency in this aspect of research training—particularly given the perceptions of employers when it comes to HDR graduates.

4.1 Skills development in research training

The completion of HDR training involves gaining new specialist disciplinary knowledge and demonstrating this knowledge through the production of a thesis. The development of knowledge in this way is likely to continue to be at the heart of the academic research enterprise. But while HDR candidates develop deep specialised knowledge in their discipline, this approach may leave graduates deficient in the kinds of transferable skills desired by employers. Although many employers are satisfied with the discipline-specific skills of HDR graduates, graduates are not always able to realise the potential of this specialised knowledge within the workplace (Cleary et al., 2007). McCarthy and Simon (2007) reported that 48 per cent of employers in one survey perceived Research Doctorate holders to be overly-specialised and unable to adapt to non-academic settings.

The Postgraduate Destinations Survey asks research graduates to assess the relationship of their current full-time employment with their qualification, field of education, and other skills and knowledge they acquired during their course. The survey shows that 61 per cent of

research graduates found their qualification to be either a formal requirement or important to their current job, 70 per cent found the same for their field of education, and 68 per cent considered this true of other skills acquired during their research training (Guthrie and Bryant, 2015). Considering that this survey is undertaken just a short time after graduation, it demonstrates that many graduates are able to apply the skills and training they developed during their research training to their current employment. This evidence contrasts with the perceptions of some employers reported above.

Research has shown that the most sought after skills by employers fall into three broad categories: problem solving and formulation; communication; and project management and leadership (Bath et al., 2004; Bowden et al., 2000; Leggett et al., 2004; Pitt et al., 2010). Employers also value graduates who can apply the skills

they have acquired in their disciplinary-based research in a flexible way to other contexts and problems (Pitt et al., 2010). Pitt et al. (2010) asked employers in Australia to list the most important attributes and skills for recent graduates in their organisation, and the responses were similar across private, public and university employers. Three traits were highly valued across all sectors: effective oral and written communication skills; in-depth knowledge of their field of study; and critical judgement and analytical skills.

4.1.1 Australian Qualifications Framework

The Australian Qualifications Framework (AQF) provides an overview of the skills that HDR graduates gain during their research training, as shown in Box 4 and Box 5 for Doctoral and Masters graduates respectively.

Box 4: Skills gained by a Doctoral degree graduate
as set out in the Australian Qualifications Framework

Skills—Graduates of a Doctoral Degree will have:

- cognitive skills to demonstrate expert understanding of theoretical knowledge and to reflect critically on that theory and practice
- cognitive skills and use of intellectual independence to think critically, evaluate existing knowledge and ideas, undertake systemic investigation and reflect on theory and practice to generate original knowledge
- expert technical and creative skills applicable to the field of work or learning
- communication skills to explain and critique theoretical propositions, methodologies and conclusions
- communication skills to present cogently a complex investigation of originality or original research for external examination against international standards and to communicate results to peers and the community
- expert skills to design, implement, analyse, theorise and communicate research that makes a significant and original contribution to knowledge and/or professional practice.

Source: Australian Qualifications Framework Council (2013, p. 64).

Box 5: Skills gained by a Masters degree (research) graduate
as set out in the Australian Qualifications Framework

Skills—Graduates of a Masters Degree (Research) will have:

- cognitive skills to demonstrate mastery of theoretical knowledge and to reflect critically on theory and its application
- cognitive, technical and creative skills to investigate, analyse and synthesise complex information, problems, concepts and theories and to apply established theories to different bodies of knowledge or practice
- cognitive, technical and creative ideas and concepts at an abstract level
- cognitive and technical skills to design, use and evaluate research and research methods
- communication and technical skills to present a coherent and sustained argument and to disseminate research results to specialist and non-specialist audiences
- technical and communication skills to design, evaluate, implement, analyse, theorise and disseminate research that makes a contribution to knowledge.

Source: Australian Qualifications Framework Council (2013, p. 60).

The skills mandated by the AQF appear to align closely with the skills desired by employers. Given employer perceptions, there would appear to be a difficulty in transferring or recognising the skills gained during research training and applying them in different settings. Part of the reason for this situation could be a lack of assistance given to candidates to recognise, identify, and build on the transferable skills they have gained, or to help candidates understand how to make a sound case for the importance of these skills in interviews with prospective employers (Cryer, 1998). Poor familiarity on the part of employers as to what is entailed in research training is likely to also contribute to this perception, combined with the lack of an accessible means for graduates to explicitly demonstrate skills development to employers. A report by Allen Consulting Group (2010) found that employers were largely happy with the disciplinary and technical skills of HDR graduates, but believed that they lacked broader transferable skills. A Business/Higher Education Roundtable Report in 2012 found that business representatives have a limited understanding and appreciation of the HDR training experience and skill sets (Business/Higher Education Round Table, 2012). Not only do HDR graduates need to develop the skills and the capabilities employers need, they also need to be assisted to communicate their abilities effectively.

4.1.2 Skills for high quality researchers

This Review called for public submissions to identify the skills necessary for high quality researchers, including research skills and experience, broader transferable qualities required for success in a range of careers, and any other capabilities. Stakeholders were also asked to identify the skills that employers needed from HDR graduates.

There was significant overlap in the responses received for research skills and broader transferable skills, as well as overlap for skills needed to be a high-quality researcher and skills required by employers.

Table 9 represents a non-exhaustive summary of the desirable skills and qualities expressed in submissions to the Review. Many of the skills identified can be captured by the following broad list of competencies, as synthesised from public submissions:

- Deep disciplinary knowledge and skills acquired through formal education and training.
- Work experience and workplace awareness through relevant workplace exposure.
- Complex problem solving, critical thinking and flexibility to apply research skills to a variety of environments and situations.
- Interpersonal and communication skills including: writing, oral communication to diverse audiences, teamwork, collaboration and leadership.
- Resilience, commitment to lifelong learning, and opportunity awareness.

Submissions from industry groups generally focused on the transferability of these skills from research settings into the workplace. Three main capabilities desired by employers were:

- ability to solve real-world problems in industry
- ability to understand industry needs and drivers
- well-developed communication and interpersonal skills

Submissions to the Review also stated that industry employers sometimes perceive HDR graduates as having too narrow a skill base, and that there is a subsequent need to demonstrate to employers the breadth of transferable skills that HDR graduates obtain through research training. This agrees with the evidence outlined in Section 4.1.

Table 9: Important research-specific and transferable skills for HDR candidates to develop, identified through public submissions to the Review

Skills and experiences needed to be an effective researcher	Qualities HDR graduates need to develop for a wide range of career paths	Broader capabilities that HDR candidates should develop
Problem solving		
Ability to conduct high quality, innovative research	adaptability	e-research skills
Advanced theoretical knowledge	advanced reasoning	flexible and open minded
Capacity to position themselves in relation to existing bodies of knowledge	critical thinking/reasoning	identify and ask relevant questions
Critical analysis/evaluation	creative and innovative thinking	
Data collection	intelligence	
Design of research questions	problem identification/solving	
Information seeking		
Innovative thinking		
Knowledge of research methods		
Technical skills		
Industry needs		
Awareness of research results transfer mechanisms	advances within discipline	applying knowledge beyond the immediate scope of the thesis
Budgeting	determination/resilience/flexibility	business and professional skills
Carry out independent original research	entrepreneurial skills	capable of functioning in a variety of workplaces
Compliance with regulations/legislation/ethics	financial management	digital literacy skills
Development of a relevant knowledge base	independence	interdisciplinary thinking and collaboration
Disciplinary knowledge	initiative	leadership
Ethical conduct	leadership	strategic planning
Independent and collaborative research	methodological skills	stress management
Knowledge of IP protocols	project management/time management	time management
Make an original contribution to knowledge	strategic thinking	understand of research field for greater public benefit
Project planning/project management	team work and mentoring	understanding of legal and social context of their research
Time management	time management understanding of ethics	vision
Communication		
Academic writing	communication skills	cultural awareness
Engagement	funding applications	knowledge exchange and translation
Grant writing	networking	language skills
Negotiation	patent application	networking
Oral presentation	written and oral skills	
Report writing		

4.1.3 Academic teaching

Universities are major employers of HDR graduates, and require skills in three core domains: research, community/industry engagement and teaching. Submissions noted that the HDR process is highly focused on research training, and that the transition to academic teaching can be overwhelming for HDR graduates (James Cook University, 2015). The PhD is seen as the entry-level qualification for a career in higher education, but this is not acknowledged in the learning outcomes and experiences that prepare graduates to become effective teachers (Charles Sturt University, 2015). Compared with Doctoral education offered in the US or in Europe, graduates in Australia are not as well prepared for academic teaching. Early-career researchers report they do not feel equipped by their HDR training experience, and need additional training in teaching skills (Australian National University, 2015; Group of Eight, 2015; Barrie et al., 2015).

Various programs assist early-career researchers with the transition to teaching roles. The Melbourne Teaching Certificate for Graduate Researchers is a professional development course for graduate researchers who are new to teaching (University of Melbourne, 2015). QUT offers the opportunity for participation in its Teaching Advantage program (Queensland University of Technology, 2015). The Doctoral learning experience could be improved more broadly by expanding teaching internship opportunities (University of Western Australia, 2015).There are various calls within submissions for teaching to be seen as a core skill to be developed during research training.

Despite many institutions offering teaching and teacher training opportunities, the pressure for timely completion and a publication profile impedes candidates' dedication to teaching excellence (Flinders University, 2015). Supervisors are often reluctant to encourage candidates to undertake teaching activities and instead advise candidates to concentrate on their research training (Knottenbelt et al., 2009). This is despite candidates reporting that they consider that teaching undergraduate students helps rather than hinders their future research career (Barrie et al., 2015).

For HDR candidates who wish to pursue a research career, opportunities to undertake academic teaching must be seen alongside the need to develop a research profile. Competition is fierce for early-career academic positions, and there is usually greater weight afforded to a candidate's research profile compared with teaching experience in the hiring decisions of most universities. For many candidates, there is pressure to start publishing academic papers during their research training to help build their research profile and increase their chances of securing an academic position. Thus many HDR candidates forgo teaching opportunities during their candidature and also, where available, forgo formal teacher training and other professional development or transferable skills development opportunities.

Probert (2014) undertook a review of the role of a Research Doctorate in university teacher training

and made the following recommendations to the Australian higher education sector:

- Clarify the role of the Research Doctorate program in preparing the academic workforce for the future.

- Undertake case-study analysis (by field of study, for example) to test the argument that the PhD has become over-specialised in focus, and to identify ways in which appropriate breadth might be introduced.

- Define the ways in which Doctoral training should offer a structured program in scholarly teaching for those committed to an academic career.

These recommendations can be applied to transferable skills development through research training for a range of careers, not just academic teaching. Universities must assess the level of transferable skills training delivered through their research training programs, and whether their current programs are overly-specialised given that HDR graduates will move into a range of different careers once they have completed their research training.

4.2 Delivery and assessment of transferable skills training

There is widespread agreement that HDR graduates develop skills in a range of areas, and these skills can be applied in a variety of settings—although issues exist with employers not recognising these abilities (see section 4.1). However, there appears to be less certainty regarding:

- the extent to which skills and transferable qualities are already being delivered, or need to be delivered, through existing HDR programs and/or other mechanisms

- the best ways to deliver both broader and specialist disciplinary skills through HDR training

- whether such skills development and/or assessment should be mandated for inclusion in HDR training.

There is some variation between universities in the extent to which the identified skills and transferable qualities are already being delivered through HDR programs, and whether further efforts are needed. Furthermore, it is recognised that candidates do not necessarily need to develop all possible skills, or the same skills, in the course of their research training—particularly given their varying backgrounds and levels of experience. HDR training should not be regarded as a 'finishing school' for generic capabilities.

As HDR graduates statistically have good employability and salary levels it appears they are generally being equipped with the skills needed to succeed (see Graduate Careers Australia, 2015a and section 1). Some submissions to the Review suggest that existing training already adequately delivers these skills (Curtin University, 2015b; Flinders University, 2015; National Tertiary Education Union, 2015). However, a number of submissions state that whereas graduates are highly qualified in some areas, particularly disciplinary skills, at times they lack the transferable skills needed to succeed in a wide range of careers, and more training is warranted (University of Melbourne, 2015; University of Notre Dame Australia, 2015; Council of Australian University Librarians, 2015). To add to the complexity of this issue, some submissions argue that candidates are not receiving adequate coursework training in disciplinary skills

HDR candidates gain significant skills across many of the areas identified in section 4.1. The extent to which these skills are developed depends to an extent on the research discipline, the topic being explored, the individual, and their supervisor. A significant issue in improving the delivery of transferable skills training is the lack of data about graduate destinations (see Section 1). With access to better information about graduate destinations for HDR candidates, universities would be able to tailor and improve their transferable skills development offerings by ensuring that candidates have access to relevant courses.

4.2.1 Delivery mechanisms

Consideration needs to be given to the best channels to deliver such skills development. Depending on the skills needed, there are a number of different mechanisms, including:

- research and production of a thesis
- industry placements or work experience
- formally taught coursework
- other professional skills development.

Industry has an important role to play in the skills development of HDR candidates, and industry placements are a major vehicle through which the delivery of industry-relevant experience and transferable qualities could be enhanced. Industry placements are discussed in detail in Section 6. Placements could be a formal part of a research course attracting credit, if implemented appropriately, or could simply be encouraged as an opportunity to work on real-world problems while building industry networks. Industry Growth Centres, industry advisory boards and representative organisations need to engage with universities to ensure that transferable skills development offerings meet industry needs, and industry partners can provide important opportunities for HDR candidates to learn industry-relevant skills through industry placements.

Mitacs is a Canadian not-for-profit organisation that takes industry involvement in HDR transferable skills training even further. Mitacs collaborates with graduate research schools at their partner universities to provide professional development opportunities for HDR candidates, in addition to offering industry placements (as discussed in detail in Section 6). These opportunities include workshops developed and facilitated by leading business and industry professionals focusing on skills in leadership and management, communication and relationship building, personal and professional management, and entrepreneurship (Mitacs, 2016).

Taught coursework provides formal opportunities to enhance skills development, including both disciplinary and transferable skills (RMIT University, 2015). This approach tends to be more common in overseas research training programs. The stage at which such coursework is undertaken during HDR candidacy is an important factor to consider. Opportunities may exist to deliver this kind of development through entry pathways prior to research training, such as during a HDR training coursework Masters degree (see Section 2). Alternatively, such coursework could take place early in the research training program, or even through a formal graduate certificate course (University of Melbourne, 2015).

The Australian Technology Network's (ATN's) e-Grad School online platform provides member universities with a convenient way to offer transferable skills development to their candidates through formal training and coursework. An advantage of this approach is that candidates receive assessment and accreditation for the units they complete. This credit may contribute to other qualifications such as graduate certificates.

Many submissions to this Review emphasised the importance of flexible mechanisms to deliver transferable skills development. Candidates need to be able to tailor their own development program by reflecting on their existing skills and identifying areas of deficiency. They can then take advantage of formal and informal opportunities to enhance their transferable skills and record this in a portfolio. Such an approach requires opportunities to be provided to candidates that do not necessarily have to be a formal or assessed part of the research training program. This approach is discussed further in section 4.3.

Some concerns were expressed that trying to add further transferable skills development activities to a research training program would be a distraction, and that the focus of the candidate should be on a timely completion. There is more resistance to mandating such requirements

where the focus is around transferable skills when compared with disciplinary, methodological or specialist research skills. James Cook University (2015) wrote that advanced coursework and skills development is too often inadequate for graduates to enter multiple careers. Nevertheless, it is worth noting that a number of research training programs are mandating that candidates undertake some formal coursework elements, for example in the Faculty of Arts at the University of Melbourne, business PhD students at QUT, and all Research Doctorate candidates at the University of Tasmania (Australasian Council of Deans of Arts, Social Sciences and Humanities, 2015).

Consultations highlighted the critical role played by HDR supervisors in guaranteeing or expanding transferable skills training, particularly with the potential impact on completion times. In consultations conducted by the Review with key stakeholders in the UK, supervisors were similarly identified as key to achieving the 'Roberts Agenda' of embedding transferable skills development in HDR training. In particular, this issue was raised in the follow-up review of the Roberts Agenda as an area that required more direct attention (Hodge, 2010). Strategies to implement aspects of this Review will therefore need to take careful account of how to ensure that HDR supervisors fully recognise and support transferable skills development. This issue is discussed in further detail in Section 10.

4.2.2 Assessment of transferable skills development

There was a mixed response from public consultations to the idea of making transferable skills development an assessable component of HDR training, and it is anticipated many would be hostile towards such a development. While mandating assessment of broader skills development is not favoured, it is recognised that transferable skills development is a necessary part of HDR training.

There is, however, a point of view that assessment drives behaviour, and without introducing appropriate assessment, or incentives, the importance of delivering transferable skills in HDR training will be diminished (Victoria University, 2015). Attaching assessment hurdles to candidature milestones may also be a useful mechanism to ensure that professional development is capitalised on throughout HDR training (James Cook University, 2015), and this is discussed further in Section 9.

A potential alternative to formal assessment might be a requirement for a set number of credits in transferable skills training to be obtained each year through participation in professional development activities. These activities could be recorded in an evidence-based portfolio or training résumé to document skills accrued throughout candidacy (Regional Universities Network, 2015). See Section 9 for further discussion of candidate assessment, including through portfolio development. Another simpler option may be for universities to list the skills attained during the course of research training on a candidate's Australian Higher Education Graduation Statement (AHEG) statement (Macquarie University, 2015b; Australian National University, 2015).

4.2.3 Accountability framework for skills development

Ultimately, it is important for training providers to be accountable for the quality and depth of skills development and training they provide to HDR candidates. Methods and approaches to delivering and assessing transferable skills development will vary between institutions, but a common accountability framework will ensure that all HDR candidates have access to high quality training opportunities. If such a framework involved public performance reporting, prospective candidates would be empowered to exercise choice based on the quality of the offering.

An accountability framework for HDR transferable skills development could be modelled on existing measures that guarantee the quality of education and training generally. National standards to

support the quality of transferable skills training should be developed with the input of industry stakeholders.

The Executive of the Australian Council of Graduate Research (ACGR) recommends that such standards should require:

- clear articulation by every university of the (non-research specific) skill sets that each candidate will acquire by the completion of their candidature

- provision of skills programs to address each of these identified skill sets

- curriculum development (or approval) within each university, informed by strong industry engagement

- early assessment of the skill level and development needs of every candidate, followed by the preparation of appropriate learning plans for every student

- provision of programs accessible to all regardless of location and enrolment type

- assessment regimes built into programs (or as hurdle requirements for degree completion) to assure that identified skills needs have been met.

(Australian Council of Graduate Research, 2016)

The ACGR suggests that these standards could be enforced through a two-step approach. The first step would involve incorporation into the Higher Education Standards Framework and inclusion as part of existing Tertiary Education Quality Standards Agency (TEQSA) institutional review processes. This would then be complemented by a collaborative self-regulation process involving individual Graduate Research Schools (or their equivalents) reviewing each other's performance, coordinated by the ACGR.

To provide a reference point for TEQSA's institutional review, the ACGR could work with industry representatives to develop an Employability Training and Industry Engagement Good Practice Principles statement, to augment the ACGR's existing Australian Graduate Research Good Practice Principles (Australian Council of Graduate Research, 2014).

4.3 Framework for skills development

HDR candidates come to research training from a wide range of backgrounds. Most already have some employment experience and many have substantial professional backgrounds. All HDR candidates come to research training having gained skills through undergraduate education (Macquarie University, 2015b). As such, candidates must not be treated by research training programs as a blank slate (Australian Academy of Humanities, 2015; Group of Eight, 2015; Research Australia, 2015; RMIT University, 2015). A one-size-fits-all approach to research training and skills development must be avoided. An approach is needed that helps HDR graduates assess their own skills, design appropriate training courses, and recognise and represent to employers the specific abilities they have developed through the course of their training (Macquarie University, 2015b). Candidates could also develop a portfolio demonstrating the transferable skills training undertaken during their research training in order to better communicate this to prospective employers, and for their own benefit. The preferred approach across many submissions to the Review is to enable individualised, personally relevant skills development.

4.3.1 UK Vitae Framework

The UK Vitae Framework is an example of a skills development framework that seeks to address the issues identified above. Identifying gaps, potential actions, and achievements against skill domains can help researchers to recognise their skills, where they can be improved, and how they can be applied in a range of different settings. This approach has been pursued in the UK, with the higher education agency Vitae leading the creation of a Researcher Development Statement and an operational framework called the Researcher Development Framework (Vitae, 2010b).

The Vitae Researcher Development Statement sets out the knowledge, behaviours and attributes of effective and highly skilled researchers appropriate to a wide range of careers (Vitae, 2010b). The statement is structured into four broad domains and sets out the different fields of knowledge, behaviours, or attributes of effective and highly skilled researchers. The skills developed in these four domains are not exclusive to the development of research skills, and this aligns with the overlap in the transferable skills outlined above in Section 4.1.2

The Researcher Development Framework (see Figure 9) is a tool for planning, promoting and supporting researchers, and has been incorporated into a downloadable professional development tool. The tool allows researchers, including HDR candidates, to identify development areas, create an action plan and record evidence of progress (Vitae, 2010a).

The Framework can be used to aid professional development. Researchers can map the skills they have developed through both formal and informal mechanisms, allowing tailored professional development plans to be created. This is an important consideration given the wide range of backgrounds and experiences that HDR candidates have already gained prior to starting their research training. The effectiveness of the Framework can be seen in its widespread uptake in the UK, its adoption by the CRC Association in Australia for its members (Cooperative Research Centres Association, 2015), and its praise as a model to follow in a review of graduate education in the United States (see Commission on the Future of Graduate Education in the United States, 2010). A review of the framework found that participants believed it was useful and that it has great potential to support researcher development (Bray and Boon, 2011).

The Framework was repeatedly put forward in submissions to this Review as a functioning and respected approach to support a researcher's professional development (Australian Council of Graduate Research, 2015; Cooperative Research Centres Association, 2015; Curtin University, 2015b; Flinders University, 2015; Griffith University, 2015; Kiley, 2015; Macquarie University, 2015b; Queensland University of Technology, 2015; RMIT University, 2015; University of Queensland, 2015; Western Sydney University,

2015; Australian Catholic University, 2015). There are calls for a similar national researcher development framework to be implemented in Australia (Flinders University, 2015; Macquarie University, 2015b). Such a framework would help demonstrate to employers the benefits that researchers will bring to their business. Some institutions have already implemented their own frameworks (University of New South Wales Australia, 2015b).

A nationally accepted framework would use a standard language and format to communicate to prospective employers the skills and attributes that HDR graduates developed through research training and prior experience.

4.4 Key finding 4

Broader transferable skills development is a necessary aspect of HDR training. Although many universities have made significant investments in this area, transferable skills development is not as strongly embedded in our research training system as it is in some other comparable research training systems around the world. Skills development must be flexible and candidate-directed, and take into account the diverse backgrounds and experience of candidates. The UK Vitae Researcher Development Framework is an established and comprehensive approach that provides a useful model that could be adapted for use in Australia.

Figure 9: Vitae Researcher Development Framework

Source: Vitae (2010b).

Section 5
Supporting industry–relevant research projects

5.1 Introduction

While Australia's research effort is of a high quality internationally, it scores poorly when it comes to research translation, particularly commercial outcomes. This result reflects low levels of collaboration between industry and publically funded research organisations, including universities. There are many steps being taken within the research system to help improve this situation, and it is appropriate to consider the role of research training in this effort. Enabling collaboration between industry and universities through HDR training will help to establish a culture of collaboration in the next generation of researchers and entrepreneurs. It will also ensure that the substantial research output of HDR candidates is being undertaken with industry collaboration and research end-users in mind.

Addressing barriers to industry collaboration within HDR training will require new approaches to be designed and implemented. It makes sense to encourage flexible ways to achieve industry involvement in HDR training.

In this Review, industry collaboration is taken to mean collaboration between a university and any potential end-users of research, including but not limited to businesses, governments, government business enterprises, non-government organisations, not-for-profit groups and community organisations.

This section explores the concerns that Australia is not making the most out of its high-quality research because of low levels of industry collaboration, and looks at recent initiatives to address this. It then identifies the barriers to increasing industry collaboration in HDR training, and finally it puts forward a proposal to encourage flexible industry involvement in HDR training.

5.2 Universities, research training and industry collaboration

The high quality of Australian research is well recognised, along with its potential to improve social, economic, health and environmental outcomes. However, indicators suggest there are low levels of collaboration between industry and public-sector research organisations, including universities, and that industry end-users are not taking advantage of research outcomes. Improved collaborations with industry end users will increase the positive benefits that research can deliver.

Consultations suggest that the low level of collaboration between industry and universities extends to HDR training. The Government has acted in a number of ways to ensure Australia receives greater benefits through the increased translation of research outcomes into broader benefits for society. It is important to consider what actions can be taken to improve industry–university collaboration within HDR training, given that HDR candidates undertake a significant share of Australia's research. Collaboration at this stage would help to embed a collaborative and end-user-focused culture within the next generation of researchers.

5.2.1 The high quality of Australia's research effort

With just 0.3 per cent of the world's population, Australia produced 3.9 per cent of the world's research in 2013, ranking 9th in the OECD. The share of top 1 per cent publications produced in Australia, as measured by relative citation impacts, rose from 3.8 per cent in 2004 to 6.7 per cent in 2013 (Department of Education and Department of Industry, 2014 cites Incites Thomson Reuters, 2014). Australia has the fifth highest number

of universities in the top 100 in the world, as measured by the Times Higher Education World University Rankings (2015), with six universities in the top 100. The ARC ERA exercise shows that 63 per cent of Australia's university research outputs are either above or well above world standard (Australian Research Council, 2015a).

5.2.2 Inadequate utilisation of high quality research

Concerns have been raised that Australia is not effectively translating its research into societal benefits, particularly economic benefits (Department of Education and Department of Industry, 2014), but also other benefits such as positive health outcomes (McKeon et al., 2013). Australia ranks 81st out of 143 countries on the Global Innovation Index Efficiency Ratio, and 90 per cent of patents filed in Australia in 2012 were filed by non-residents (Department of Education and Department of Industry, 2014). A previous *Securing Australia's Future* report, *The role of science, research and technology in lifting Australian productivity*, shows that there is substantial room for improvement in utilising research to enhance economic outcomes for the nation (Bell et al., 2014).

5.2.3 Insufficient transfer of knowledge between researchers and industry

Currently, there is insufficient knowledge transfer between public sector researchers (including university researchers) and industry. This was highlighted by the Department of Education

and Training (2015c) and a summary showing Australia's low level of performance is provided in Box 6.

Australia's performance relative to other OECD nations on two important measures of collaboration can be seen in Figure 10 and Figure 11. This relative deficiency of collaboration between research institutions and industry highlights an important barrier in the translation of research into wider social and economic benefits.

5.2.4 Industry–research collaboration

The extensive benefits of industry–research collaboration have been well documented in the past (for example, see OECD, 2013a; Belderbos et al., 2004; Dodgson, 1993), and were discussed in another 'Securing Australia's Future' report, *The role of science, research and technology in lifting Australian productivity* (Bell et al., 2014). These are summarised in Box 7.

As shown in Box 6, there is relatively less collaboration between public research institutions and industry than in other OECD nations. This means that the many benefits outlined in Box 7 are not being realised to the extent they could be. This is resulting in:

- lower levels of commercialisation of research
- industry missing out on productivity gains
- research not aligning with industry needs
- lower levels of translation of research into practice

Box 6: Examples of insufficient knowledge transfer between public sector research institutions and industry

- Australia ranks 29th out of 30 OECD countries on the proportion of large businesses collaborating with higher education and public research institutions on innovation (see Figure 10).
- Australia ranks 30th out of 30 OECD countries on the proportion of small and medium enterprises (SMEs) collaborating with higher education and public research institutions on innovation.
- The proportion of researchers working in industry is significantly lower in Australia compared with other countries.
- There are low levels of mobility between public research institutions and industry.
- Australia ranks 23rd out of 32 countries on the percentage of total research publications that are co-authored by industry and the research sector (see Figure 11).
- Australia ranks 16th out of 17 OECD countries on new-to-the-world innovation

Adapted from Department of Education and Department of Industry (2014).

Figure 10: Firms collaborating on innovation with higher education or public research institutions
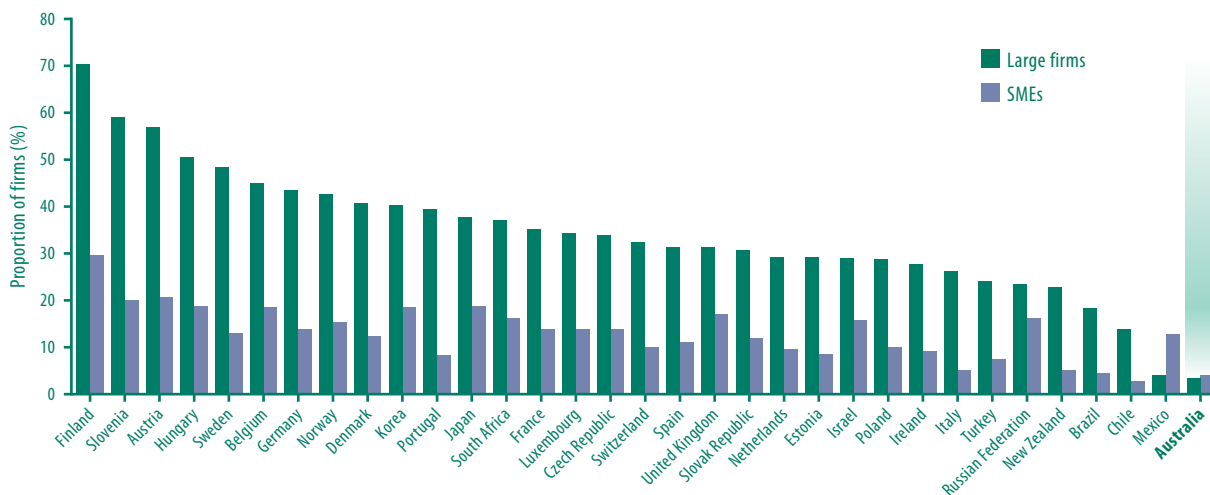
Note: By firm size, 2008–10, as a percentage of product and/or process innovative firms in each size category.
Source: OECD (2013b, p. 127).

Figure 11: Proportion of industry-science co-publications in total research publication output, 2006–10
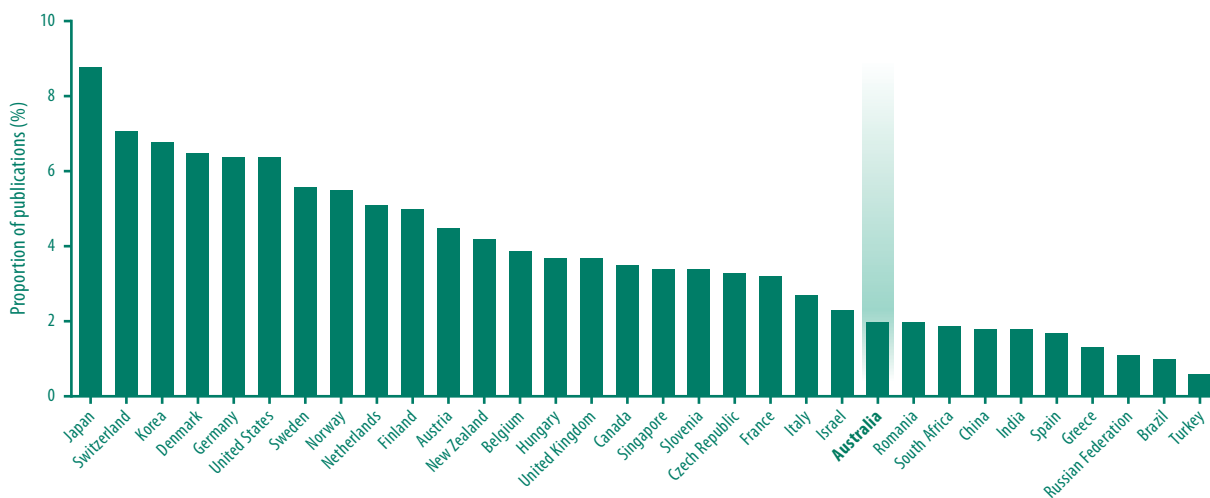
Source: OECD (2013a).

Box 7: The benefits of industry–research collaboration as detailed in Bell et al. (2014)

Benefits for companies and research organisations:

- 75 per cent of private sector patens draw on public sector research
- universities are a source of radical and disruptive innovations
- access to complementarities
- enhanced learning and capabilities
- dealing with uncertainty and complexity
- boosting productivity, particularly for SMEs

Benefits for researchers:

- enhanced reputation
- insights to shape research agendas
- opportunity to engage in 'real-life' problems
- engagement with the broader community
- seeing the translation of research to community benefit
- provides a reliable source of research topics
- access to new information and ideas

- fewer opportunities for HDR training in industry
- lack of awareness among public sector researchers of the context of research in industry

There are many successful examples of industry–university collaboration in Australia, including within HDR training, one of which is the Cooperative Research Centres (CRC) Program (see Box 8).

5.2.5 Recent actions to ensure Australia benefits more from its high quality research

Actions are required on multiple fronts to improve Australia's low levels of research collaboration. The causes of such low levels of collaboration include structural economic issues, such as the large number of small businesses in the Australian economy relative to other OECD nations, university system drivers, and cultural inertia. These issues are explored in greater detail by Bell et al. (2014) and Department of Education and Department of Industry (2014).

The Australian Government has developed strategies and commissioned reviews in a number of areas to boost collaboration between industry and public sector research organisations (outlined in Box 9), particularly universities. Actions are required by a range of stakeholders, and where necessary, incentives need to be put in place to make this happen. The Government has been working to ensure that the direction of Australia's research effort is broadly in line with future needs, and meeting the grand challenges that face the nation. This approach has included developing strategies that consider the application and commercialisation of research.

Box 8: The Cooperative Research Centres program and research training

The long-established CRC Program supports researchers in solving industry end-user problems. It has seen multiple changes over the years but has consistently supported candidates undertaking Research Doctorates, with support being mandated within the program guidelines (Department of Industry, Innovation and Science, 2015a).

The Miles Review (2015) found that, on average over the life of the Program, each CRC had 21.5 active research Doctoral candidates in any given year. Since the program's inception, CRCs have produced over 3600 Doctoral graduates. A previous study has estimated that an average CRC will support 50 HDR candidates over its lifetime (Montagu, 2010). Palmer (2012) found that, on average, there have been three Research Doctorate completions per CRC per year over the life of the program, and that taken together CRCs represent 4 per cent of all Research Doctorate completions. Given the industry and end-user focus of CRCs, this is probably the largest formal program through which industry-relevant research training is supported in Australia.

Research shows that CRC HDR candidates are significantly more satisfied with their degree experiences than non-CRC candidates from similar disciplines (Harman, 2004; Harman, 2008). A comprehensive study of industry Doctoral training through the CRC program was undertaken by Manathunga et al. (2011). In this study, 1068 CRC Research Doctorate graduates 5- and 10-years post-graduation were surveyed along with a similar cohort of non-CRC Research Doctorate graduates. This survey showed that involvement in CRC Doctoral programs resulted in a greater proportion of graduates being employed in non-university sectors. CRC graduates reported having more industry exposure during their HDR training, were more likely to have attended industry or business meetings, and were more likely to have interacted with professionals outside of universities.

CRCs develop their own tailored training models which have been successful in responding to industry needs. Some CRCs make use of the Vitae Researcher Development Framework as described in Section 4.

Box 9: Recent strategies to boost collaboration between industry and research organisations

- Developing the National Innovation and Science Agenda (Department of Prime Minister and Cabinet, 2015a).
- Developing Science and Research Priorities (Commonwealth of Australia, 2015).
- Reviewing the CRC program (Miles, 2015).
- Reviewing the arrangements for university research block grants (Watt, 2015).
- The release of the Boosting the Commercial Returns from Research agenda (Department of Education and Training, 2015c).
- The release of the Industry Innovation and Competitiveness Agenda, including the establishment of Industry Growth Centres (Department of Prime Minister and Cabinet, 2014).

5.2.6 The role of HDR training in research translation

The role of HDR training in research translation is important for many reasons, including:

- Embedding a culture of collaboration at an early stage could have ongoing benefits throughout a researcher's career.

- Gaining a greater insight into how research can benefit industry, and vice-versa, will potentially improve the low number of researchers employed in industry.

- HDR candidates produce a substantial amount of Australia's research output, and are working at the forefront of developing new knowledge.

5.3 Barriers and problems to increasing industry collaboration in HDR training

5.3.1 Low-levels of HDR training in industry

An absence of data makes it difficult to determine the extent of involvement of industry partners in HDR training, at a system level and at a discipline level. Consultations suggest that, in line with the data showing low levels of industry–university collaboration as a whole, there are low levels of HDR training involving collaboration between industry and universities. These low levels of collaboration make it difficult to scale-up opportunities from a small base. However, important lessons can be learnt from those examples where industry and universities have collaborated in developing HDR training opportunities.

The CRC program, the ARC industrial transformation research centres, and the ATN Doctoral Training Centre provide successful examples of industry collaboration in HDR training. The CSIRO and Medical Research Institutes also collaborate extensively with universities in providing HDR training opportunities. Within these examples, some level of HDR training is already being undertaken with industry partners and end-user applications in mind. This represents a relatively small but significant part of Australia's HDR training effort. Past research has shown that candidates who have had involvement with a CRC are more positive about conducting research in industry or government departments, taking up research positions in industry, and their own career prospects (Harman, 2004).

5.3.2 Lack of incentives for engaging industry in HDR training

Lack of incentives for universities

There are few incentives within the HDR funding system to encourage universities to collaborate with industry partners or vice versa, including supporting candidates to undertake research on industry-relevant research projects. Implementation of the findings of the *Review of Research Policy and Funding Arrangements* has the potential to change this, as the incentives to work more closely with industry are increased (see Watt, 2015).

Lack of incentives for supervisors

Within some disciplines, HDR candidates are part of a larger research team and their research is being undertaken in the context of other large externally-funded projects. This can mean that the direction of their research is heavily influenced by their supervisor, who might want them to be working on research relevant to the supervisor's interest and commitments, rather than industry-relevant projects. For many researchers there is a fear that an increased focus on working with industry partners can result in reduced academic outputs, such as high impact publications. As the publication track record heavily influences a researcher's career and research grant success, this significant hurdle needs to be overcome.

5.3.3 Low levels of business innovation and collaboration in Australia

Inhibiting greater business involvement in HDR training are the low levels of research and development undertaken by Australian businesses, and a business culture that does not fully recognise the benefits of collaboration and innovation. Australian business expenditure on research and development is approaching average in the OECD, but lags well behind leading OECD countries (Bell et al., 2014). Australian businesses are far less likely to collaborate with other organisations on innovation (either universities or other businesses) than in other OECD countries, and rank fourth last in the OECD for businesses collaborating on innovation activities (OECD, 2013b). Australia ranked 23rd out of 33 countries in the OECD in terms of large firms engaged in innovation, and only 42.2 per cent of Australian businesses were engaged in innovation activity in 2012–13 (OECD, 2013b).

The low level of business innovation and collaboration indicates the difficulty faced by universities in finding appropriate partners for HDR training collaboration. Cultural change within Australian businesses is needed to increase the level of investment in research and development, and participation in collaboration and innovation activities. Working with universities to develop industry HDR training opportunities provides one way in which businesses can benefit from research collaboration.

5.3.4 Developing a collaboration culture

Encouraging greater collaboration between industry and universities requires an increased focus on the cultural change required within institutions to encourage individuals to collaborate. As a recent US National Academies report pointed out "… colleges, universities, and businesses are not entities that can engage with one another, rather, it is the people employed by those institutions who initiate, continue, and in some cases halt those interactions." (National

Academies of Sciences, Engineering and Medicine, 2016, p. 7). It is individuals within these institutions that will need to be empowered and supported to build collaborations and relationships. As the report points out, leaders in industry and in the university sector need to work together to foster a culture of collaboration and partnership with the shared aim of building a workforce equipped with the knowledge, skills and abilities needed to underpin our economic development.

5.3.5 Different types of collaboration

Greater opportunities for industry-relevant research training can be provided through a range of approaches, including:

- HDR candidates working on research with a potential industry application

- HDR candidates working on an industry-defined research problem

- HDR candidates undertaking part of their training within an industry setting

Most stakeholders believed that the vast majority of candidates are already undertaking research that has a potential industry application. The level of collaboration in the second approach above could range from an industry partner simply agreeing that the problem being investigated is of interest, to producing a research project that solves a particular problem for them. The final approach requires candidates to undertake their research in an industry setting and necessitates a high level of ongoing involvement from industry partner.

In finding ways to improve industry collaboration within HDR training it is necessary to consider the different ways an industry partner might be involved. A range of different types of industry participation in HDR training is required because of disciplinary differences and the varying needs and capacities of industry partners.

5.3.6 Disciplinary differences

It was clear from stakeholder interviews that the aspirations and actions relating to increasing collaboration in HDR training between

universities and industry need to consider disciplinary differences. Stakeholders from across a range of disciplines all recognised the importance of an end-user focus when considering research projects, but noted that positive commercial outcomes are more likely from some disciplines, while others offered better opportunities for improving health outcomes, the environment, or national cultural enrichment. The full spectrum of benefits from industry-university collaboration needs to be recognised and encouraged, as this will benefit a wider range of HDR candidates as well as the nation more broadly.

5.3.7 Collaborating with industry and continuing support for basic research

Discussions with stakeholders on increasing collaboration with industry and ensuring greater benefits flow from investment in public research revealed three important but related points.

- Australia's low level of performance in terms of capitalising on its research outcomes, and low levels of industry collaboration with public sector research organisations, including universities, must be improved.

- There must be room and support for curiosity-driven basic research. This stock of knowledge is the foundation on which future discoveries are made. Australia's high quality basic research capacity is at the heart of our global research reputation, and needs to be protected to ensure this reputation is maintained.

- The independence and integrity of universities to direct their research mission needs to be maintained.

5.3.8 Awareness of opportunities

Throughout the consultation process it was clear that one of the issues preventing better collaboration and greater industry involvement in HDR training was the difficulty in discovering existing opportunities for such involvement. Many researchers were excited about the possibility of working with industry partners and end users to solve real-world problems but do not have the necessary connections with appropriate partners and are unsure how to establish them. A similar issue was apparent within some industry groups, who found it difficult to navigate the university system, were unsure what researchers could offer them, and had trouble locating researchers with whom they could potentially collaborate.

This problem extends to HDR training, with some industry participants within the consultation process unsure how HDR candidates could bring benefits to their organisation. Many industry participants had little awareness of how funding for HDR training works, what developing a research training collaboration opportunity would involve, and who to approach to develop these opportunities.

For some industry partners, particularly SMEs, the fact that a Research Doctorate takes 3–4 years presents a significant disincentive to collaboration as they need solutions to their research problems in a shorter timeframe.

5.3.9 Usability of results and intellectual property

Intellectual property is discussed further in section 6.3.6 in relation to industry placements for HDR candidates, but the difficulties of intellectual property arrangements was raised as a barrier to enabling greater industry involvement in HDR training. Some industry partners had concerns that HDR candidates working with them on an industry research problem would be seeking to publish the results of the research, a situation which could erode the industry partner's competitive advantage. HDR candidates had similar concerns. They feared they would be unable to publish the results of their research, an achievement which is essential for developing an academic research career, and thereby putting themselves at a career disadvantage.

5.4 Encouraging a flexible approach to involve industry in HDR training

Through the consultation process participants were asked what proportion of Australia's research training effort should be directed towards industry-focused research, that is, research aimed at solving industry problems. There was a wide range of responses, with the majority of participants unsure of current levels of collaboration but wanting to see increased collaboration opportunities. As already noted, many participants felt that a large proportion of research already qualified as industry-focused, but that the research was usually undertaken without the direct involvement of an industry partner.

The challenges of bringing together university and industry partners to develop research training opportunities mean that flexibility is crucial to improving collaboration in research training, and it would be inappropriate to expect similar levels or types of collaborations across all projects and disciplines. University and industry stakeholders agreed that achieving deep levels of engagement and collaboration in research training would take some time, with relationships needing to develop and the barriers described earlier overcome. As such, a pragmatic approach that encourages different levels and types of industry collaboration in research training should be taken.

Improving industry–university collaboration must be a high priority. Benchmarking should be undertaken to determine what proportion of industry–university HDR training collaboration opportunities are taking place in nations in the top 25 per cent of OECD industry collaboration league tables. This benchmark should become the lower-end target for Australia's HDR training system. Funding mechanisms should be utilised to raise the proportion of Australian Government

research training opportunities that include at least one of the following components:

- an industry-defined research problem
- provision of training in industry settings
- provision of an industry supervisor for the project

The definition of industry should be broad and include any end-user of research, including businesses, governments, government business enterprises, non-government organisations, not-for-profit groups and community organisations.

In the long term this approach should help improve industry-university collaboration in general, as ties to the end users of research are built at the early stage of researchers' careers. As partnerships are developed it should be possible to further embed industry partners within research training and provide enhanced training opportunities.

5.5 Key finding 5

Australian industry-university collaboration performance lies close to bottom in terms of the international comparators reported by the Organisation for Economic Cooperation and Development. Industry-university collaboration would be greatly improved if there was increased engagement at the HDR level. Australia should be aiming for its level of industry-university collaboration during HDR training to be in the top 25 per cent in the OECD, and further research will be needed to determine appropriate indicators of this benchmark. Increased industry engagement will require a greater proportion of HDR training opportunities to be focused on an industry-defined research problem, take place in industry settings, or involve an industry supervisor for the project. Funding mechanisms should be used to drive the significant change required.

Section 6
Enabling industry placements in research training

6.1 Introduction

Section 4 describes the importance of broader transferable skills training for HDR candidates, as well as barriers to conveying or understanding the skills and benefits that HDR graduates could bring to employers. Section 5 emphasises the important role that HDR candidates can play in improving industry engagement and collaboration with universities. This section looks at how Industry placements of HDR candidates can address both of these issues by providing an environment for further skills development and by facilitating ongoing relationships between industry and researchers.

With a majority of HDR graduates heading into careers outside academia, providing candidates with an opportunity to collaborate with industry partners can help improve their future employability in non-academic settings (Borrell-Damian, 2009; Manathunga et al., 2011). Where HDR candidates have collaborated with industry partners on projects, they have reported that the experience was rewarding and they are more likely to pursue a career in industry (Manathunga et al., 2011; Council of Australian Postgraduate Associations, 2012). The benefits of collaborations for HDR candidates can include access to equipment, training and expertise that might not be available in academic settings. For industry partners the benefits can include gaining a capable researcher willing to undertake a cutting-edge research project relevant to their business priorities.

However, there can be significant barriers to delivering meaningful industry placements from the perspective of both HDR candidates and industry partners. Governments and universities have important roles to play in building on successful examples of industry placement schemes, and enabling more HDR candidates to undertake them.

6.2 Industry placements: delivering industry-relevant research training

Access to industry placements can help HDR candidates gain a range of skills, as well as first-hand insights into how research skills can be applied outside of academia and a greater awareness of business practices. Employers that offer placements gain insights into how a highly qualified researcher can bring benefits to their organisation, and build connections with research organisations. There was strong recognition within the stakeholder consultation process of the benefits that industry placements can bring for HDR candidates. Being able to demonstrate good levels of business acumen through engagement in an industry placement is highly attractive to prospective employers.

Overall there is enthusiasm from stakeholders for HDR candidates undertaking industry placements as part of their HDR training, recognising that such placements could offer candidates additional opportunities for broader skill development. Submissions also indicated the importance and potential of such placements to increase collaboration opportunities and connections between universities and industry (University of Newcastle, 2015; Australian Technology Network, 2015).

Industry placements can be flexible, from short internships through to longer placements working on bigger projects, depending on the needs and desires of the candidate and industry

partner. Submissions to the Review suggested that placements have the potential to add value to the structure of HDR programs and could form part of other potential reforms to the research training system more broadly (Deakin University, 2015; National Tertiary Education Union, 2015). For most disciplines the inclusion of industry placements can improve the development of valuable skills and capacities of HDR candidates (Southern Cross University, 2015). Working on real-life problems as part of a diverse team in a work placement increases the ability of HDRs to transition from research training settings to successful engagement in the labour market (University of Newcastle, 2015).

6.2.1 International case study of industry placements in research training: Mitacs Accelerate

Mitacs is a not-for-profit, national research organisation funded by the Government of Canada, provincial governments, academic partners and research partners. Through its Accelerate program it supports graduate candidates (including HDR candidates) and post-Doctoral fellows from over 60 universities in Canada to apply their research skills to a business-related research challenge. The scheme provides an industry internship for the candidate allowing them to bring a new perspective to a problem faced by an industry partner. During the program, interns spend approximately half of their time on-site with an industry partner, and the rest of the time at the university advancing their research under the guidance of their supervisor.

The program is open to all disciplines and all industry sectors. In 2014–15, Accelerate supported approximately 3200 placements, and to date has supported over 8800 projects and provided over CA$80 million in research funding (Mitacs, 2015).

The Mitacs Accelerate program is very flexible, with projects ranging from four months through to multi-year, multi-intern, multi-university collaborations. The Accelerate Standard program is a scalable four month internship that can be combined to accommodate longer projects. The costs are shared between the industry partner and Mitacs on a 1:1 co-investment principle. For example, the industry partner puts forward $7500, which is matched by Mitacs to produce a $15,000 research grant. From this a $10,000 stipend is provided to the intern and $5000 is provided for project expenses.

The benefits of the program for universities and the candidate include a quick turnaround in applications (4 to 6 weeks), an environment where research candidates apply the latest tools and innovations to real issues, and the provision of funding to support their research. Companies benefit through increased innovation, gaining novel solutions to challenging problems, leveraging an investment through matching funding, and increased company access to university expertise.

Mitacs uses a national, cross-sector platform to encourage and support long-term industry-university collaborative relationships, for which HDR candidates serve as the conduit.

International examples of other industry engagement programs for HDR training are shown in Box 10.

6.2.2 Australian examples of industry engagement programs

There are a number of excellent examples of industry placement programs in Australia, with the Australian Mathematical Sciences Institute (AMSI) Intern program held up as a particular example of a successful initiative. Similarly, the recently established Industry and PhD Research Engagement Program (iPREP WA), organised by a consortium of universities in Western Australia, is generating enthusiasm amongst universities, industry and HDR candidates.

Some examples of industry placement programs in Australia are briefly explored in Box 11.

Box 10: International examples of industry engagement programs for HDR training

UK's UK's CASE studentship

The UK's Collaborative Awards in Science and Engineering (CASE) studentships allow industry to take the lead in arranging projects with an academic partner of choice. Partner organisations can be from industry, government or not-for-profits, and the approach applies across all disciplines. The CASE studentship program was established as part of a wider response by the UK government to make publicly funded research more responsive to the needs of industry and government (Demeritt and Lees, 2005). CASE studentships are supported by the different UK research councils and across all disciplines.

The CASE studentships work differently in different disciplines. One example is the Natural Environment Research Council (2015) Industrial CASE Studentship Competition. Here the academic and industry partners put forward an Industrial CASE Studentship project proposal, and awards are made based on merit. The proposal must demonstrate excellent science research and show the potential of the research for societal or economic impact through strong collaboration with the industry partner. The academic partner must contribute to the research training of the candidate, including a financial contribution to enhance the research training experience through a 3–18 month placement.

The CASE model is used across different disciplines, and is not restricted to business partners, with the emphasis on delivering societal or economic impact. The competitive nature of the program shows its desirability and helps ensure scholarship funding is directed to the candidate and projects with the most potential. With the industry partner responsible for setting out the project's relevance to the organisation within the project proposal, there is an assurance that the student will be working on a real-world project that has the potential to have wider impact.

Denmark's Industrial PhD Program

Denmark's Industrial PhD program consists of 3-year industrially focused Research Doctorate projects, open to all disciplines and managed by Innovation Fund Denmark. Candidates are employed full-time by a company and enrolled at a university concurrently.

The program has a long history within Danish research training, commencing in 1988 but with roots dating back to 1971. Between 1988 and 2009, over 1200 research Doctoral candidates participated in the program.

Each project's requirements determine the time spent between industry and academia. The company involved must provide facilities and financial support for the duration of the entire project and provide a supervisor.

Up to 50 per cent of the candidate's salary is subsidised, with the expectation that the company matches this subsidy amount. The company can also receive a significant subsidy for associated travel, accommodation and professional development activities for the candidate. The university also receives a subsidy, 85 per cent of which is paid out at the project's commencement and the remainder when the candidate graduates.

The project must have significant commercial potential for the company involved, and should be developed with a view to supporting the company's business activities. The university is responsible for approving and conferring the Research Doctorate once it has been accepted and a public thesis defence is completed.

Box 11: Domestic examples of industry engagement programs for HDR training

Research Doctorate Research Engagement Program (IPREP WA)

iPREP WA is a partnership between the five Western Australian universities. This program embeds interdisciplinary teams of candidates with an industry partner during the thesis examination period (Australian Council of Graduate Research, 2015).

Universities broker a 6-week placement with industry partners for candidates whose theses are currently undergoing examination. The desirability of this time period was raised repeatedly in submissions to the Review and during consultations as a very appropriate opportunity for HDR candidates to undertake industry placements, without delaying completions. Costs are shared equally between the industry partners and the university, with the candidates being provided APA-equivalent income support for the six week period by the university.

iPREP WA is still very small scale, with generally fewer than five placements per institution per year, but may offer a useful model to expand on for this type of shorter industry placement. Since its inception in 2015, iPREP WA has supported about 60 industry placements. The program aims to support 60 placements per year, split across 20 separate projects.

Advance Queensland PhD Industry Experience Program

The Queensland Government is supporting a program similar to iPREP WA that includes nine Queensland-based universities. The Advance Queensland PhD Industry Experience program offers placements for HDR candidates of 4–6 weeks with industry partners. Businesses register their projects with the program, and HDR candidates can apply at any time for a placement with a business of their choice following their confirmation of candidature.

The Queensland Department of Science, Information Technology and Innovation administers this program, acting as an intermediary to broker connections between industry partners and HDR candidates. There is no funding provided under the PhD Industry Experience program. Placements do not offer any income support for the HDR candidates, and program guidelines state that "any costs to the student or university will be met by the student and/or university" (Queensland Government, 2015b).

AMSI Intern

AMSI Intern is an intermediary organisation that links industry with researchers to coordinate 4- to 5-month industry placements for HDR candidates across all disciplines, run by the Australian Mathematical Sciences Institute (AMSI). AMSI Intern recently entered into a partnership with eight universities in Victoria and New South Wales to significantly expand their services, and now provides 100 placements per year.

HDR candidates from AMSI member institutions, which include 28 universities across Australia, can apply through AMSI Intern to undertake an industry placement project. These projects can either be advertised by AMSI Intern directly, or developed in partnership between the HDR candidate, their supervisor or academic mentor, and AMSI Intern's staff, who connect to a range of potential industry partners. HDR candidates can receive stipends of $3000 per month for the duration of their placement. Industry partners are required to provide funding for this stipend, as well as a $5000 non-salary payment to the candidate's academic mentor, which counts as research income through the host university, and a $5000 administrative fee to AMSI Intern—making the total cost to industry partners $22,000–$25,000 (AMSI Intern, 2016).

Joint Research Engagement (JRE Engineering Cadetships)

The Joint Research Engagement Engineering Cadetships scheme was inspired by traditional industry internships. The idea was that businesses could identify a problem directly related to their business, and then employ a cadet to work on that problem. The Cadetships scheme aims to:

The scheme is administered as a university block grant, and a total of 265 commencing places are allocated annually on the basis of relative performance of the participating institutions, using the same allocation as the JRE base grant.

Cadets undertake a combination of HDR training in science or engineering with R&D activities undertaken as an employee of a business that is registered for the R&D Tax Incentive Scheme. Cadets are also supported through the RTS and are eligible to receive an APA scholarship. Universities receive a top up amount per Cadet ($5000), to assist in customising research training to benefit both the business and the candidate's future career in industry. In 2015, $4.4 million was allocated to the JRE Engineering Cadetships scheme.

The 2015 *Review of Research Policy and Funding Arrangements* led by Dr Ian Watt found that the JRE Engineering Cadetships scheme has been largely unsuccessful in its implementation. According to the Review, "Universities have indicated that the scheme is not cost effective as it provides a very small amount of funding, is resource intensive to administer and it is difficult to find appropriate cadetship placements" (Watt, 2015, pp. 22–23). Further, the Review found that the scheme is too complex, and imposes excessive requirements on the participants, including candidates, industry partners and universities. The Review concluded that the JRE Engineering Cadetship scheme should be retired, with funding shifted to a new model for industry placements, discussed further in Section 6.4.1 (Watt, 2015, p. 24).

6.3 Barriers to widespread uptake of industry placements

Existing industry placement programs in Australia are generally small in scale and scope, with AMSI Intern currently offering the greatest number of industry placements at around 100 per year. There would be significant benefit from a more coordinated national approach on a larger scale, such as reducing the hurdles for businesses to participate and improving administrative efficiencies. The benefits of scale and a consistent national approach to enabling industry collaboration with researchers are discussed in detail in the 2014 report *The role of science, research and technology in lifting Australian productivity* (Bell et al., 2014, pp. 74–82). It takes time to establish trusting relationships with industry partners, and for the benefits of HDR candidate placements to become recognised. Increasing the scale and scope of industry placements will need to occur progressively and in a coordinated manner.

Significant barriers exist which need to be overcome to enable the broader adoption of industry placements for HDR candidates.

6.3.1 HDR candidates need flexibility

Flexibility needs to be introduced into the rules governing APA scholarships so that candidates undertaking industry placements are not disadvantaged. This includes the ability to easily suspend scholarships when candidates take up paid industry placements, and the ability to combine any income gained during the placement with their scholarship income, for example. These issues are also identified in the 2015 *Review of Research Policy and Funding Arrangements*, which observed that "current arrangements create impediments to greater use of industry placements during Research Doctorate courses—a key strategy for generating greater commercial interests among PhD students" (Watt, 2015, p. 24).

Restrictions on APA scholarships might inhibit the take up of placement opportunities, particularly where there are tax implications for the candidate.

6.3.2 Focus on completions

The RTS funding model for research training is based on the number of HDR completions that a university achieves (see Department of Education and Training, 2015g). There is a strong incentive in the system for universities to ensure that candidates complete their research training within four years.

There are concerns that introducing industry placements (along with coursework or other skills development requirements) would have implications for HDR completion times and resources (Regional Universities Network, 2015; Southern Cross University, 2015). In particular, submissions mentioned that industry placements that are not aligned with the HDR candidate's research project are not likely to be supported by their supervisor if it takes time away from their Doctoral studies (Regional Universities Network, 2015). This system provides a disincentive for universities to establish, candidates to pursue, and supervisors to support research training in industry settings if such training is perceived as delaying a candidate's completion time. Efforts to increase the uptake of industry placements may be hampered without broader structural changes to how research training is funded and managed, and will also require a change in supervisory culture so candidates are encouraged to pursue placement opportunities.

6.3.3 Funding for industry relevant research training

In addition to the impact on completion time, which may be managed by encouraging placements to be taken between thesis submission and examination as illustrated above, Review participants considered that additional resources would be required to develop appropriate industry placements.

Some businesses have stated that the financial cost of introducing HDR placements in their business is too high and they are unlikely to offer such placements without support. For such businesses a financial incentive might be required to secure their participation, or

alternatively access to external administrative support and coordination to reduce this burden on their staff.

There are a range of funding-related barriers that inhibit the expansion of industry placements in research training, and a corresponding range of approaches that could be used overcome these.

RTS block grants provide universities with a great deal of autonomy in terms of how they design and structure research training. Within this system there appears to be little in the way of an incentive to use RTS funding to work with industry partners to develop enhanced training opportunities. As research has shown that RTS funding does not cover the full cost of research training (Deloitte Access Economics, 2011), universities might be apprehensive about introducing new components that could increase the cost of research training provision.

In contrast to the funding system used in Australia, UK government support for research training is distributed by research councils. These councils have the ability to make strategic decisions on how research training should be structured, which has in some instances included providing dedicated funding for research training places that involve an industry partner.

The 2015 *Review of Research Policy and Funding Arrangements* also recognises the importance of this issue, recommending that a sector-wide discussion is required to find workable industry placement models to help universities adopt industry placements within their research training programs—an outcome echoed by participants in the stakeholder interviews and in submissions to this review (Flinders University, 2015; Watt, 2015, p. 55).

6.3.4 Regulation hindering the development of industry placements

Submissions have highlighted the difficulties that are sometimes experienced when trying to establish industry placement programs. These include managing the regulatory requirements in the Fair Work Act (*Fair Work Act 2009* and *Fair Work Regulations 2009*), state regulation such as Queensland's *Education (Work Experience)*

Act 1996, the conditions in which APA awards are made, tax implications for candidates, visa implications for international students, and the enrolment status of candidates during their thesis examination period (University of Queensland, 2015; University of Tasmania, 2015).

6.3.5 Lack of coordination of collaboration opportunities

Although there are a number of successful examples of industry-based research training in Australia, these appear to be small in scale and limited in scope when compared with international examples. AMSI Intern would appear to be the closest Australia has to a national coordination of industry placement opportunities for HDR graduates. For small and medium sized enterprises this can prove a significant barrier as opportunities to collaborate with universities to develop mutually beneficial training opportunities can be difficult to find.

6.3.6 Intellectual property arrangements

The negotiation of intellectual property (IP) issues emerged from consultations as a significant barrier to industry partners establishing more HDR candidate placements. Industry stakeholders emphasised the need for a business-relevant outcome from these placements as a requirement of their implementation, which can be undermined by uncertainties around ownership of IP. It is worth noting that IP issues can present a barrier to broader industry-university collaboration as discussed in the government's IP Toolkit for Collaboration (Department of Industry, Innovation and Science, 2015b), however the focused nature of HDR candidate placements should present a more limited context to address this issue.

Industry stakeholders in different sectors may have different IP requirements, but a national approach with relevant guidelines would provide at least a common starting point for universities, HDR candidates and industry partners from which to negotiate. Where possible, this approach should include the default position that IP rights generated as part of an HDR industry placement

be retained by the placement provider, without unnecessarily prejudicing the ability of the candidate to publish work resulting from the project.

A nationally consistent, default approach to IP in industry placements could be usefully facilitated by intermediary organisations. A broader, national approach to industry placements for HDR candidates would help to address the barrier of complex IP negotiations between universities and industry partners.

Intellectual property and publishing research results

There are a number of areas which can impede collaborations between HDR candidates and industry partners, including ownership of intellectual property arising from collaborations. These impediments can restrict a researcher's ability to publish the results of their research, a practice that is crucial for advancing academic careers. The UK NERC CASE study approach requires that details of how this challenge is to be managed be agreed before the project starts (Natural Environment Research Council, 2015). In the Mitacs Accelerate program all parties involved are bound by the intellectual property terms of the university where the candidate is enrolled (Mitacs, 2015).

6.4 Approaches to expanding utilisation of industry placements in research training

6.4.1 A National Industry Placement Scheme

The 2015 *Review of Research Policy and Funding Arrangements* recommended funding of $12.5 million per year to support universities to deliver a new Research Doctorate business placement initiative, designed to support an additional 700 6-month placements per year, at $18,000 per placement, on top of the various small schemes currently in operation (Watt, 2015). This funding would provide candidates with income support

at APA stipend rates for a further six months, cover additional costs for businesses associated with supervision or training of the placement candidates, and cover costs to universities in order to administer placement programs and find relevant placement opportunities. The provision of income support to candidates is an important factor—which would allow candidates to undertake placements without impacting the completion time of their Research Doctorate, by either taking a leave of absence from their scholarship or undertaking the placement following thesis submission. At 2016 APA rates, this funding proposal would leave approximately $5000 per placement to cover research and training expenses for candidates as well as administrative expenses for universities.

This breakdown of funding is broadly comparable to both the Canadian Mitacs Accelerate program and the AMSI Intern program. In contrast to these schemes, the approach recommended by the *Review of Research Policy and Funding Arrangements* does not require financial investment by the industry partner to support placements, and funding would be distributed and administered directly through universities with no coordinating intermediary based on research block grant funding formulas (Watt, 2015).

A risk to this approach is that available funding becomes diluted across individual institutions, each with their own administrative overheads. Matching candidates to appropriate industry partners requires significant attention—if done well, solving this could have profound effects on the utilisation of industry placements in research training. The *Review of Research Policy and Funding Arrangements* notes that:

> *"Implementation of the new programme requires selection of Research Doctorate candidates in relevant areas and matching the candidates to businesses with the capacity to benefit from the placement."*
>
> Watt (2015, p. 54)

The role played by intermediaries, such as AMSI Intern, in matching research candidates with industry partners should not be underestimated. Given the success of the Canadian Mitacs

Accelerate program and the AMSI Intern program, this Review considers that a nationally consistent approach to HDR industry placements would best be delivered through a similar intermediary organisation, rather than by individual universities. This approach would provide businesses and HDR candidates with a single location to register their interest, reduce administrative burdens on universities and industry partners, and enable the connection of researchers with appropriate placement opportunities across Australia. It may also help to avoid some of the problems experienced by the JR Engineering Cadetship scheme. Additionally, this funding should be leveraged to support a greater number of placements through industry co-investment, such as in the Mitacs Accelerate program. A single responsible organisation would provide the scale and accountability required to deliver the desired increase in HDR industry placements.

A default approach to intellectual property arrangements

The terms and conditions of the AMSI Intern placements program, agreed to by HDR training institutions and industry partners, require that IP generated as part of a student placement be owned by the industry partner (Australian Mathematical Sciences Institute, 2015). This approach is also suggested by the 2015 *Review of Research Policy and Funding Arrangements* (Watt, 2015). However, the agreement also includes provisions to ensure this position does not unfairly impede the student's ability to publish papers or their thesis. By providing a standardised, default position, this arrangement removes the need to renegotiate IP arrangements for each placement and encourages industry partners to participate in the program.

This approach acknowledges that the primary benefit to the student from undertaking industry placements is not in generating IP from the project, but rather lies in the skills and experience obtained. Given the investment of industry partners in placement programs, it is reasonable that any IP generated be retained by the partner. Clarity over default arrangements removes a significant barrier to expanding HDR placements.

A broader national program of HDR industry placements should adopt a default approach to IP, while maintaining flexibility to reach different arrangements if mutually desired.

Implementation pathway

To achieve the increase in industry placements described, industry partners must be willing to engage and offer appropriate opportunities. That is, there must be sufficient 'pull' from industry for HDR placements. Implementing a nationally consistent HDR placement scheme which offers administrative and funding support to industry partners has the potential to remove some of the most significant limitations on the number of industry placement opportunities available. The HDR training sector needs to engage industry in a dialogue about the advantages of HDR placements. There is an opportunity for Industry Growth Centres to play a role in this regard, and they could be well placed to work with stakeholders to identify and promote industry placement opportunities. This Review concurs with the opinion of the *Review of Research Policy and Funding Arrangements*, that:

> "…an implementation plan should be developed in 2016 so that the new programme can start at the beginning of 2017"
>
> Watt (2015, p. 55).

Such an implementation plan must engage with existing schemes to develop a consistent national approach, and avoid attempts to 'reinvent the wheel.'

A national placement scheme must also have sufficient scale and stability to build engagement between industry and universities. The Canadian Mitacs Accelerate program has been in operation for over a decade to reach its current output of 3200 placements. A national approach needs to be scaled up over time in order to develop momentum and ingrain the benefits of industry-university collaboration.

Expanding the scale of industry placements in research training requires a consistent, national scheme for HDR candidates, delivered through a national organisation to facilitate the matching of industry partners with appropriate researchers. Further, university and government regulations governing the employment and tax status of HDR candidates need to be streamlined to give candidates the certainty to take on these opportunities.

6.5 Key finding 6

HDR candidates benefit from industry placements, and there would be value in building a national industry placement scheme of significant scale and scope through a national coordinating body. No such at-scale Australian placement system currently exists, although there are several small-scale, unaligned schemes. Other countries have been successful in developing large-scale industry placement systems, from which Australia can learn international best practice. Placements should not be mandated, but every HDR candidate who wishes to undertake a placement should be encouraged to do so. Placement schemes must balance the interests of HDR candidates appropriately with their industry partners and enhance the HDR training program.

Complex intellectual property arrangements with universities are a barrier preventing prospective industry partners from providing HDR placements. A national approach to HDR industry placements could help to address this problem by developing a simple, uniform default approach to intellectual property arising from placements, in which industry partners retain ownership.

4

Improving the HDR training system

Introduction to Chapter 4

This Chapter explores the actions needed to ensure Australia's HDR training system remains world class and makes best use of resources available. Firstly, it looks at how to measure system performance and understand the added value that investment in HDR training is delivering. Secondly, it suggests ways in which Australia can remain internationally competitive by benchmarking against the best HDR training systems in the world. Thirdly, it explores current assessment practices to ensure that the outputs of HDR training, the research and the researcher, are of high-quality. Fourthly, it looks at the need to maintain high quality supervision standards. Finally, it sets out the need to improve participation from under-represented groups in HDR training, and in particular focuses on increasing the number of Indigenous HDR candidates.

Section 7: Measuring and articulating the added value of HDR training

The current performance of HDR training in Australia appears to be good but data is lacking in key areas. Graduates report a high level of satisfaction with their HDR training experience, and have good employment outcomes. The absence of performance data at the institutional and disciplinary level makes it difficult to identify where the system is performing well and where it can be improved.

This section focuses on the need to collect data in key areas so that the performance of the HDR training system can be assessed over time. This includes collecting data on levels of investment being made in HDR training, graduate satisfaction, career outcomes, completion times and completion rates, and reporting this at the institutional and disciplinary level.

Section 8: International benchmarking of HDR offerings

To produce high-quality, internationally competitive graduates, and to continue attracting the best and brightest from overseas, Australia's HDR training system needs to remain competitive with the best training systems in the world.

This section discusses ways to internationally benchmark Australia's HDR training system. In particular it suggests that Australia's HDR training system should be compared to the best in the world both quantitatively and qualitatively, and at the disciplinary level. Such benchmarking would help to determine relative performance, as well as the components that are driving quality in different disciplines in different research systems.

Section 9: Assessment of both candidate and thesis

The current assessment process for research degrees does not necessarily align well with the aims of contemporary HDR training. The primary outcome of HDR training is no longer seen as the thesis per se, but also includes the skilled professional researcher and the skills they have gained. However, assessment of research degrees in Australia tends to focus exclusively on the thesis and does not includes an assessment of the candidate's broader research competencies and transferable skills are typically not made or documented.

This section explores the potential for other approaches to assessment such as oral examinations, the development of a research skills portfolio, seminar presentations and the better use of candidature milestones and how they could be better employed to provide the evidence base for a statement of the broader skills gained during HDR training.

Section 10: Evaluation of supervisor competency and performance

High quality supervision plays a central role in producing positive HDR training outcomes. This section demonstrates that although supervisory experience is generally improving, the quality of supervision is variable between individuals and disciplines, and possibly between institutions. Improving supervision will require sustained investment in supervisory training along with increased support for supervisors. To ensure the quality of supervision improves, ongoing monitoring and evaluation of supervisor performance is needed, and universities have a responsibility to act where performance falls below expected performance levels.

Section 11: Under-represented groups in HDR training

There are a number of under-represented groups in HDR training including Indigenous candidates, candidates with a disability, candidates from a low socio-economic background, and those from regional and remote areas. Based on consultations with stakeholders, improving the participation of Indigenous candidates in the HDR training system was seen by stakeholders as a priority area where effective action is most urgently needed.

This section finds that the barriers to increasing participation of Indigenous HDR candidates in research training include lower levels of Indigenous participation at the undergraduate level, an absence of academic Indigenous role models and HDR supervisors, a lack of cohort support networks in some universities, and financial pressures. A range of actions is needed to overcome these barriers including better acknowledging Indigenous rights and culture, providing better supervision training, providing greater financial support for Indigenous HDR candidates, and introducing system incentives.

Section 7
Measuring and articulating the added value of HDR training

7.1 Introduction

This section focuses on the data needed to measure and drive performance improvement in areas relating to HDR graduate satisfaction, career outcomes, and completion times and rates.

This section sets out the current performance of HDR training in Australia. Although overall performance outcomes appear to be good, data is lacking in key areas. It then looks at how with more robust data collection performance can be improved further. Finally, it sets out how data should be collected, reported and communicated to improve the delivery of HDR training.

Although not explored in this section, it should be noted that there are also a number of other areas where the research training system could be improved, but a lack of data hinders progress. This includes details on the number of candidates engaged in industry placements; undertaking research training with an industry partner; coursework opportunities offered to HDR candidates; and professional development opportunities.

7.2 Improving performance of the research training system

Ensuring that Australia has a world-class research training system requires an understanding of the resources available for research training, and an assessment of whether these resources are being most effectively utilised.

7.2.1 Resourcing the research training system

There are a number of different ways that the input of resources into research training might be measured. As this Review was asked to investigate ways of making best use of current resources invested in HDR training, the Review has focused on the need to better understand the current financial investment being made. This is because the overwhelming majority of activities associated with providing research training have a financial cost associated with them, and changing the balance of those activities or demonstrating value for money of existing activities requires an understanding of cost.

There are a number of different sources of financial investment in HDR training, including Australian Government and state government investment, international candidate tuition fees, philanthropic donations, university sponsorship, industry sponsorship, and collaboration contributions. It has not been possible to determine the exact level of resources currently invested in HDR training and to retrospectively do this would require access to data not currently reported. However, it is possible to identify the different sources of financial investment in HDR training, and data is available on the largest single investor, the Australian Government.

Financial investment in HDR training by the Australian Government

The majority of the Australian Government's investment in HDR training is made through Higher Education Research Block Grants. In

2016 investment through the block grants in research training will be close to $1 billion (Department of Education and Training, 2016). This amount represents a lower bound figure of the total Australian Government investment in HDR training, as additional investment is made through a number of additional smaller schemes and programs funded by multiple Australian Government departments and agencies. A summary of Australian Government HDR investment programs is provided in Table 10.

The Review found it difficult to quantify the total investment in HDR training as details on many smaller programs are not available. For example, the Australian Research Council estimates that it is directly supporting the research training of over 2000 HDR candidates each year, but the agency's data collection arrangements are unable to give an accurate figure on the number of places and value of this support. A similar situation is encountered when looking at other programs.

Financial investment in HDR training from other sources

State governments sometimes invest in HDR training. A recent example of this includes the Advance Queensland Research Doctorate Scholarships which provide funding of up to $45,000 over three years to support candidates undertaking a Research Doctorate (Queensland Government, 2015a). Industry partners also invest in HDR training by providing scholarship support to employees or candidates, or through in-kind support, such as access to infrastructure and additional training. Industry also provides support for HDR training through financial and in-kind support to the CRC program, the ARC Industrial Transformation Centres, and through ARC Linkage Grants. Universities provide a number of stipend scholarships and tuition fee waivers for international and domestic candidates. In addition to this, there are a number of philanthropic schemes that provide financial support for HDR training.

A significant financial contribution is made by international candidates paying tuition fees. Universities are free to set tuition fees, and fees vary between disciplines, with the total tuition cost for a Research Doctorate often being between $120,000 and $185,000 (for example see Australian National University, 2016b; University of New South Wales Australia, 2015a). However, the Review heard from stakeholders that a large number of international candidates have their fees waived through university bursaries or other means. As such, making calculations on the number of fee-paying international HDR candidates is difficult.

Although each of these examples of HDR training investment might be relatively small compared with the quantum of investment made by the Australian Government, collectively they represent a significant investment and demonstrate the wide range of stakeholders who have an interest in ensuring high quality HDR outcomes. The total quantum of this funding

Table 10: Sources of Australian Government support for HDR training

Department/Agency	Program
Department of Education and Training	Higher Education Research Block Grants (RTS, APA, IPRS)
Department of Education and Training	Endeavour Scholarships and Fellowships, and Endeavour Mobility Grants
Australian Research Council	Support for HDR candidates via scholarships delivered through ARC research grants
National Health and Medical Research Council	Support for HDR candidates via scholarships delivered through NHMRC research grants Direct award HDR scholarships
Department of Foreign Affairs and Trade	Australia Awards Scholarships and Australia Awards Pacific Scholarships
CSIRO	Postgraduate scholarships

has not been possible to determine within this Review, as the data is not currently collected. The effort it would take to compile such data is beyond the capacity of this Review.

7.2.2 Performance of the Australian HDR training system

The Review examined and heard suggestions from a number of stakeholders about a wide range of different measures that could be used to assess the performance of the HDR training system. These include measuring the type of facilities provided, the reputation of the Australian HDR training system overseas, and a range of citation analyses of HDR outputs. As this Review has already outlined, there are three areas where HDR training must make a positive impact: supporting research candidates, delivering benefits to the nation, and improving the research training system. Each of these areas is explored below to show how the current research training system is performing, and to outline the current limitations of existing performance data.

Supporting research training candidates—graduate satisfaction with HDR training

This Review suggests that the most useful measure of the impact of HDR training on individuals is to ask HDR graduates about their level of satisfaction with their training. This should include overall satisfaction, satisfaction with specific components of their training, and satisfaction with how their training has helped them meet their goals.

Current performance

Overall satisfaction of HDR graduates with their research training experience is high and has been improving over the last ten years. Each year until 2015, Graduate Careers Australia through the PREQ has surveyed recent HDR graduates three months after graduating to find out their level of satisfaction in different aspects of their HDR training (for details see Lindsay, 2015). Participants in this survey were asked their level of agreement with a positive statement about different areas of their training, including supervision, intellectual climate, skill development, infrastructure, thesis examination, goals and expectations, and overall satisfaction. The results from this survey between 2000 and 2014 are shown in Figure 12. Detailed results of the 28 Likert-type items underpinning the seven PREQ scales are provided in Figure 13.

The results show there is a high degree of satisfaction with HDR training experiences, with overall satisfaction at 86.8 per cent. However, in some areas there is room for improvement. The lowest area of satisfaction is with intellectual climate, at 67.5 per cent, and within this area the lowest satisfaction was scored for questions on research ambience, integration into a department's community, and the opportunity to become embedded within the broader research culture of a department. There is potential to explore using ARC ERA data to inform assessments of the performance of the HDR training by helping to show the relationship

Figure 12: 2000 to 2014 Postgraduate Research Experience Questionnaire mean percentage agreement scores
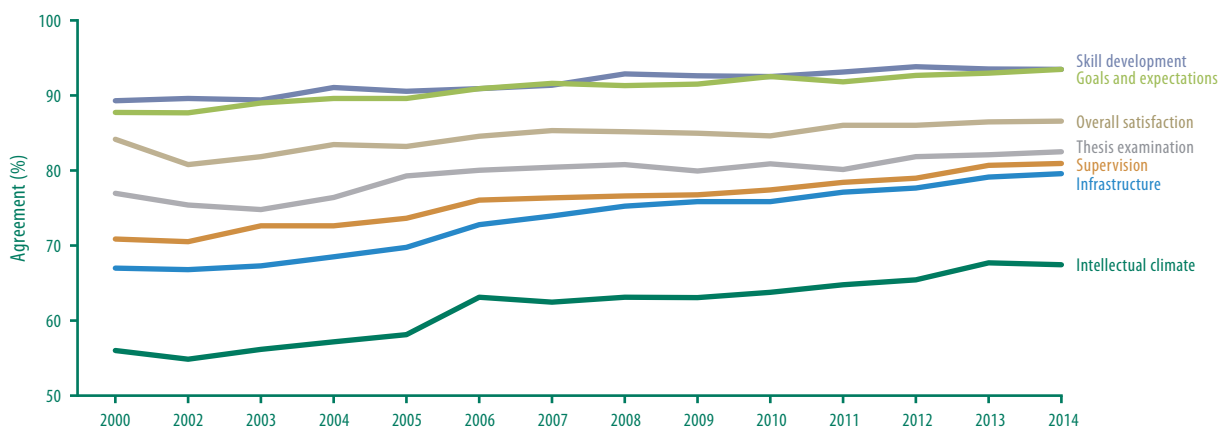
Reproduced from Lindsay (2015).

between the strength of research within a particular field of research at a university and its relationship to graduate satisfaction with the intellectual climate.

While the PREQ survey does gather data on skill development, the composite question (see Figure 13) does not include a graduate's satisfaction with transferable skills, such as teamwork, experience on multidisciplinary projects, project management, project budgeting, and communication skills.

Satisfaction varies between different disciplinary areas. As can be seen in Table 11, for HDR candidates overall satisfaction is highest in health disciplines at 91 per cent and lowest in Creative Arts at 84 per cent. The differences are greater for Research Masters graduates compared with

Research Doctorate graduates; overall satisfaction for architecture and building Research Masters graduates is only 66.7 per cent whereas in agriculture, environmental and related studies it is 92.9 per cent. There is notable variation in satisfaction for some of the satisfaction scales. For example, only 60.4 per cent of creative arts candidates are satisfied with the intellectual climate, compared with 72.2 per cent of engineering and related technologies candidates.

It is notable that, in general, social science and humanities disciplines scored lower levels of satisfaction with intellectual climate than the science, health and engineering disciplines. One reason for this difference might be the stronger tradition of aligning candidate HDR topics to projects and work programs that extend beyond

Figure 13: 2014 Postgraduate Research Experience Questionnaire scale and item mean percentage agreement scores

Scale / Item	Agreement (%)
Supervision	81.1
Supervision was available when I needed it (PREQ01)	86.8
My supervisor/s provided helpful feedback on my progress (PREQ21)	85.7
My supervisor/s made a real effort to understand difficulties I faced (PREQ07)	83.3
My supervisor/s provided additional information relevant to my topic (PREQ13)	82.7
I was given good guidance in topic selection and refinement (PREQ17)	75.4
I received good guidance in my literature search (PREQ24)	72.6
Intellectual climate	67.5
The department provided opportunities for social contact with other postgraduate students (PREQ05)	75.0
A good seminar program for postgraduate students was provided (PREQ22)	70.7
The department provided opportunities for me to become involved in the broader research culture (PREQ16)	65.7
I was integrated into the department's community (PREQ09)	64.3
The research ambience in the department or faculty stimulated my work (PREQ23)	61.9
Skill development	93.7
My research sharpened my analytic skills (PREQ14)	95.6
My research further developed my problem-solving skills (PREQ06)	94.9
I learned to develop my ideas and present them in my written work (PREQ10)	95.0
Doing my research helped me to develop my ability to plan my own work (PREQ20)	92.6
As a result of my research, I feel confident about tackling unfamiliar problems (PREQ26)	90.4
Infrastructure	79.7
I had access to a suitable working space (PREQ03)	84.6
I was able to organise good access to necessary equipment (PREQ12)	84.2
I had good access to computing facilities and services (PREQ18)	82.5
I had good access to the technical support I needed (PREQ08)	79.3
There was appropriate financial support for research activities (PREQ27)	68.2
Thesis examination	82.6
The thesis examination process was fair (PREQ02)	89.9
I was satisfied with the thesis examination process (PREQ15)	84.0
The examination of my thesis was completed in a reasonable time (PREQ25)	73.8
Goals and expectations	93.7
I understood the required standard for the thesis (PREQ11)	93.9
I developed an understanding of the standard of work expected (PREQ04)	93.4
I understood the requirements of thesis examination (PREQ19)	93.8
Overall satisfaction	86.8
Overall, I was satisfied with the quality of my higher degree research experience (PREQ28)	86.8

Reproduced from Lindsay (2015).

the individual thesis in the STEM disciplines, resulting in candidates being more integrated into a department. Further research would need to be undertaken to investigate the relationship between satisfaction with intellectual climate and the level of alignment between a candidate's HDR topic and the broader projects and work programs within the candidate's faculty or department.

The evidence suggests that overall the HDR training experience has been positive for most graduates, and satisfaction has been increasing. Furthermore, satisfaction levels of HDR training in Australia are comparable to those reported in a similar survey undertaken in the UK (see Turner, 2015). Nevertheless, HDR candidates are not as satisfied with intellectual climate compared with the other areas, and along with quality of supervision, these are the largest drivers of overall satisfaction (Lindsay, 2015). Institutions should look to see how they can improve HDR candidates' experiences in these areas, particularly in some disciplines.

Delivering benefits to the nation —HDR Career outcomes

The value of HDR training can be considered in terms of additional skills gained, research problems solved, and increased resilience and ability to respond to grand challenges. Each of these areas is difficult to express quantitatively. This Review suggests that the most effective way to demonstrate the added value of HDR training to the nation is to consider the career outcomes of HDR graduates. It should be possible to compare the career outcomes of HDR graduates with other cohorts (such as Bachelor graduates, or other postgraduates), and quantify the benefits delivered. Gathering such data about career outcomes would also help provide an understanding of how and where different research skills are being used within the economy (see Section 1). Specifically, data showing salaries, employment rates and career destinations for HDR graduates would help quantify system performance.

Table 11: Postgraduate Research Experience Questionnaire scale mean percentage agreement scores by broad field of education

		Natural and Physical Sciences	Information Technology	Engineering and Related Technologies	Architecture and Building	Agriculture, Environmental and Related Studies	Health	Education	Management and Commerce	Society and Culture	Creative Arts
Research masters	Supervision	71.4	76.6	78.7	73.6	81.0	84.5	78.9	81.5	78.3	78.3
	Intellectual Climate	67.3	70.0	71.9	66.0	55.4	62.8	58.8	74.3	55.0	57.2
	Skill Development	89.5	92.2	94.1	95.0	81.4	91.2	90.6	93.6	88.8	89.2
	Infrastructure	75.6	83.5	81.7	74.0	84.6	74.2	63.6	85.7	67.1	69.2
	Thesis Examination	80.6	80.2	83.0	80.6	73.8	79.9	73.3	76.2	75.8	74.1
	Goals and Expectations	89.2	93.7	92.4	91.7	90.5	93.2	92.7	91.7	86.7	86.0
	Overall Satisfaction	75.0	83.8	90.7	66.7	92.9	87.6	82.0	82.1	81.7	76.7
Research doctorate	Supervision	78.7	81.8	81.4	81.6	82.4	84.5	86.2	83.2	80.4	82.3
	Intellectual Climate	71.7	68.3	72.2	71.3	67.8	71.6	65.0	69.3	62.1	60.4
	Skill Development	95.4	94.1	93.8	95.4	94.4	95.2	93.4	93.1	93.2	93.3
	Infrastructure	83.6	84.1	84.0	72.3	82.1	82.8	76.7	82.0	76.3	71.4
	Thesis Examination	82.9	82.2	84.9	86.2	83.5	84.1	87.5	85.0	81.1	80.0
	Goals and Expectations	94.1	96.7	94.2	91.8	93.4	95.3	95.1	94.7	93.8	93.2
	Overall Satisfaction	86.6	90.5	88.8	88.1	89.0	91.0	89.7	87.4	84.8	84.4

Reproduced from Lindsay (2015).

HDR graduate salaries

Data gathered from the Beyond Graduation survey shows that relative to Bachelor level graduates, HDR graduates have much higher salaries both 3–9 months and 3 years after graduation (Figure 14). Salary levels for HDR graduates are similar to the postgraduate population as a whole. This indicates that HDR training is having a positive impact on economic activity, through the higher salaries earnt by graduates. However, many HDR graduates have a greater amount of work experience than Bachelor graduates and this also contributes to their higher salaries.

The career salary premium that a Research Doctorate offers graduates has also been shown in a UK study (Casey, 2009). Here it was shown that males with a Bachelor degree earn 14 per cent more than those who could have gone to university but decided not to, and that the earnings premium for a Research Doctorate is 26 per cent. The premium for a Masters degree was shown to be 23 per cent. These results are similar to the Australian data in showing an earnings potential premium for all postgraduates over Bachelor graduates.

HDR graduate employment

Three years after graduation, a slightly lower proportion of HDR graduates who are available for full-time employment are employed full-time than Bachelor graduates and Postgraduates (see Figure 15).

Figure 14: Median salary of Bachelor graduates, postgraduates, and HDR graduates in full-time employment
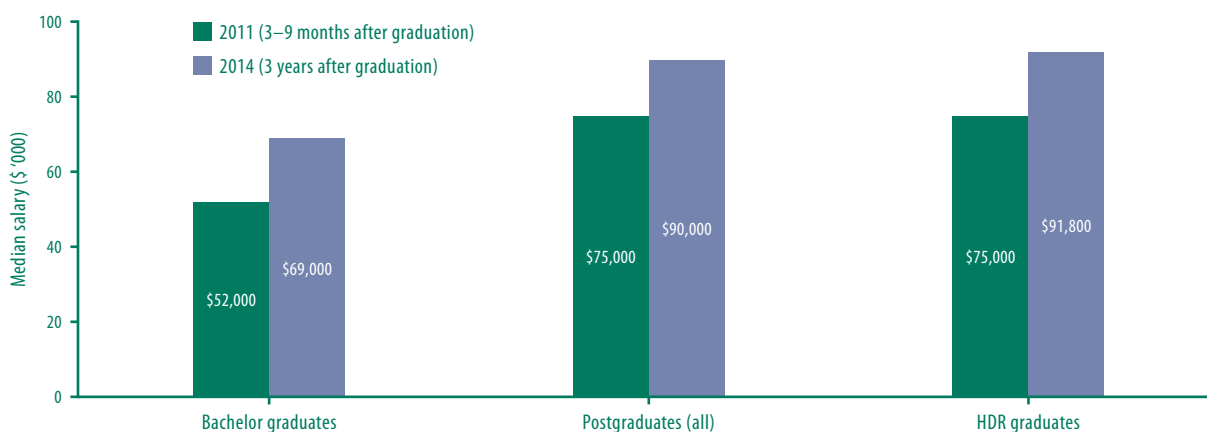
Adapted from data from the Beyond Graduation survey and custom data from Graduate Careers Australia.

Figure 15: Bachelor graduates, postgraduates, and HDR graduates working full-time, as a proportion of those available for full-time employment
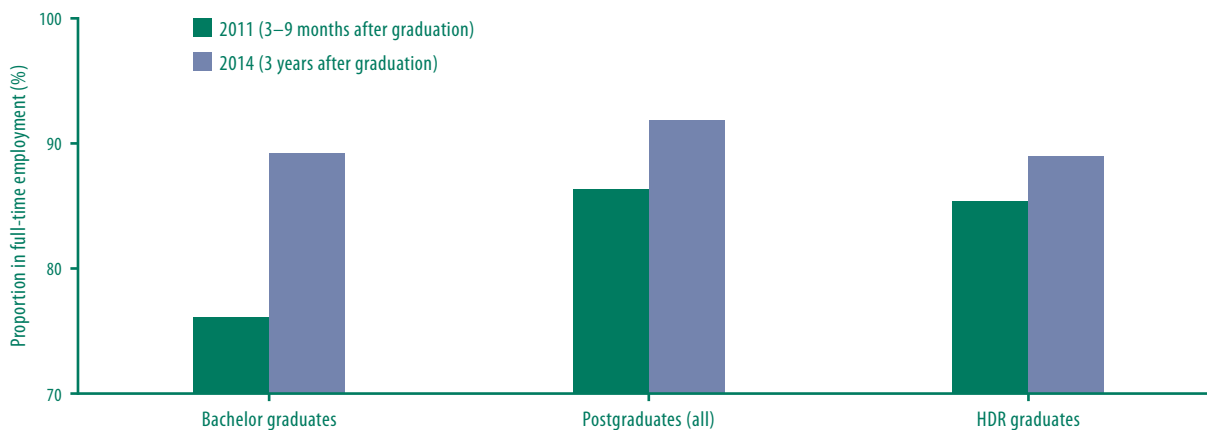
Data adapted from the Beyond Graduation survey and custom data from Graduate Careers Australia.

More comprehensive data on employment is available through the ABS Census. This data shows employment throughout the whole population rather than a sample of graduates surveyed, as is the case with Figure 15. This can be seen in Figure 16 which shows that among the whole population of graduates who are available for full-time employment, those with a Doctoral degree have the highest level of full-time employment, but it should be noted that all graduates have high levels of employment. The high level of employment of doctoral graduates is a reliable indicator that HDR graduates have good employment outcomes and are contributing to the broader economy.

ABS census data also shows that from graduates who are available to work, those with a Doctoral degree are more likely to be working full-time than Masters or Bachelor graduates, as can be seen in Figure 17.

HDR graduate career destinations

Census data shows the occupation of all employed doctorate holders (see Table 12). The most common occupation for doctorate holders is tertiary education teacher (a role that in many cases will include a research component too), with 25.2 per cent of doctorate holders. Natural and physical science professional was the second most common occupation, at 17.6 per cent. While these two occupations are considered traditional career pathways for HDR graduates it is notable that 57 per cent of the employed doctorate population in Australia are working outside of these roles in a range of other careers.

Figure 16: Employment status of Doctoral, Masters and Bachelor degree graduates who are available for full-time employment
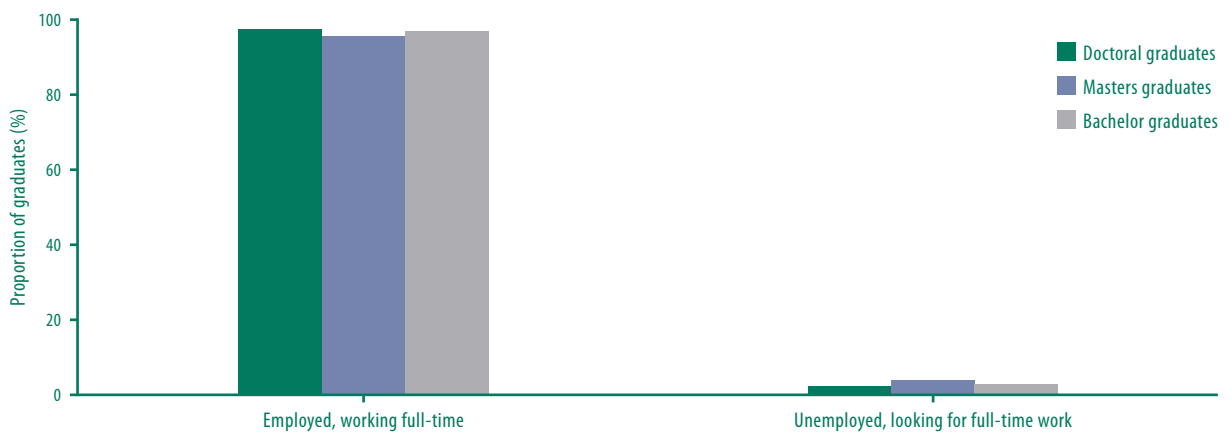
Adapted from 2011 ABS Census data.

Figure 17: Employment status of Doctoral, Masters and Bachelor degree graduates who are available for full-time or part-time employment
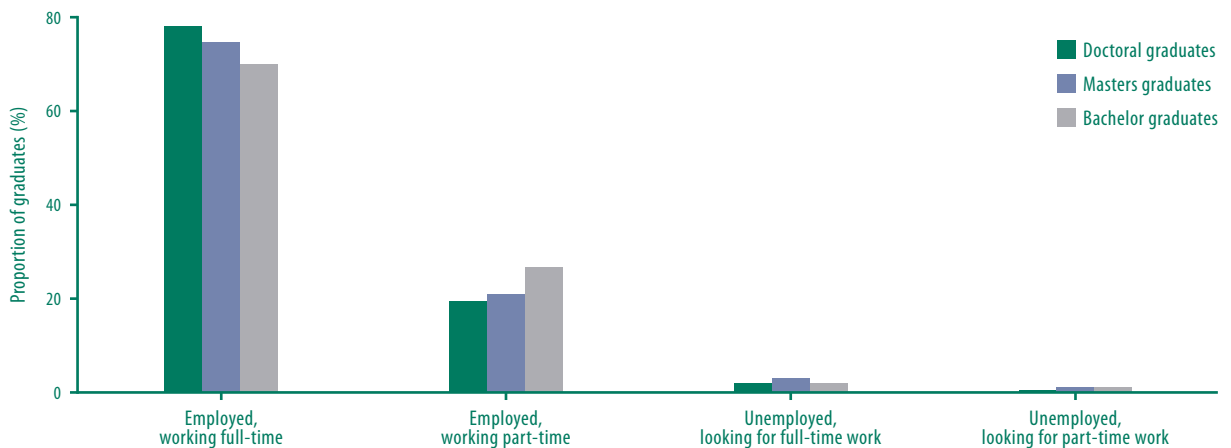
Adapted from 2011 ABS Census data.

Table 12: Most common occupations among the doctorate population, Australia 2011

Occupation type (OCCP)	Number employed	Share of employed doctorate population (per cent)	Proportion of all employees in occupation who have a doctorate (per cent)
Tertiary Education Teachers	20,864	25.2	26.2
Natural and Physical Science Professionals	14,539	17.6	17.8
Professionals not further defined	5847	7.1	18.2
Social and Welfare Professionals	4334	5.2	4.5
Medical Practitioners	3486	4.2	5.0
Information and Organisation Professionals	3378	4.1	2.9
Engineering Professionals	2754	3.3	2.6
Business Administration Managers	2562	3.1	2.2
Chief Executives, General Managers and Legislators	1807	2.2	1.9
School Teachers	1743	2.1	0.5
Education, Health and Welfare Services Managers	1552	1.9	2.7
Business and Systems Analysts, and Programmers	1425	1.7	1.6
Miscellaneous Education Professionals	1078	1.3	2.0
Health Therapy Professionals	1019	1.2	1.8
Contract, Program and Project Administrators	906	1.1	0.9
Miscellaneous Specialist Managers	895	1.1	1.6
All other occupations	14,512	17.5	0.2
Total	82,701	100.0	0.8

Source: ABS Census data.

Improving the research training system —HDR completion times and rates

There is no routine reporting of HDR completion times and rates in Australia. As discussed in Section 3, there have been a handful of past small-scale studies that looked at completion data at the institutional level. Bourke et al. (2006) showed that at one university 51 per cent of candidates completed in 4 years, 66 per cent within 5 years, and 70 per cent within 6 years, and after 6 years, the remaining 30 per cent of candidates discontinued. Similar results were found by Palmer (2016) in a more recent study and are displayed in Figure 8. However, there are no published national data on average completion times, or the average number of candidates that go on to complete their HDR training, let alone institutional data on which comparisons could be based.

Similar completion times have been estimated in England. Data investigated by the Higher Education Funding Council for England uses recent patterns of completions to make projections on future completion rates. This exercise provides a useful comparison against the relative performance of the Australian research training system. The projected 7-year completion rate for all research degrees is 72.9 per cent in England (Higher Education Funding Council for England, 2013), which is broadly similar to findings in Australia (see Bourke et al., 2006; Palmer, 2016)

7.2.3 Summary of performance of the Australian HDR training system

• Overall, HDR graduates report a high level of satisfaction with their research training experience, but data is not available at the institutional level.

• Overall, HDR graduates have good employment outcomes, but more comprehensive data is needed to show the long-term impact of HDR training on career outcomes.

• It is not possible to measure the efficiency and effectiveness of HDR training using HDR completion data as data is not collected and reported is a useable way.

7.3 Driving improved performance

HDR training appears to be delivered at a good standard in Australia. Performance against the measure of graduate satisfaction is good, and appears to be good in terms of career outcomes. However, how effectively the research training system is performing as measured by HDR completions is unclear. The Australian research training system, like most research training systems throughout the world, faces limitations in developing a full picture on system performance because of an absence of available data. Without a full picture of where the system is at, it is difficult to identify problems, determine actions needed, and understand whether those actions are effective or not. This sentiment was expressed by a number of stakeholders who were frustrated with the absence of important performance data.

"If you give me the measurement I will find ways to improve the result. It is impossible to drive change without first understanding where you are at, where you want to be, and how you will know when you get there. Doing this requires performance data, and the data we have doesn't let us do this."

Stakeholder interview, university

7.3.1 The need for robust data

Robust data on the performance of the HDR training system is needed to:

- ensure value for money is being gained from the substantial annual investment by the Australian Government

- help drive future performance improvements within the research training system

- assist prospective HDR candidates in making decisions about HDR training (as discussed in Section 1).

7.3.2 Ensure value for money

The Australian Government currently invests more than $1 billion annually in postgraduate research training through research block grants, research councils, and other departments and agencies. Government investment has increased over the last 20 years, to increase the number of HDR completions, in anticipation of the need for more research skills within a growing economy, and to respond to anticipated workforce renewal needs within the academic workforce (Hugo and Morriss, 2010; Access Economics, 2010; Department of Innovation, Industry, Science and Research, 2011b; Larkins, 2011). As with any substantial investment of public funds, there is an expectation that value for money is being delivered and benefits to the community can be demonstrated.

7.3.3 Using data to improve performance

Examining whether a system as large as the research training system is delivering value requires robust data on how the system is performing in different areas. It is difficult to articulate the case for ongoing public investment in HDR training without being able to show how the current system is performing. Understanding how a system is performing requires benchmarking, and using data to identify areas of good practice and areas that need improving.

Measuring the performance of the research training system against the three main domains this report is considering, (supporting HDR candidates, delivering benefits to the nation, and improving the research training system), is needed to ensure value for money and performance improvements, and to assist potential candidates in making informed choices (see Section 1). The remainder of this section sets out how data could be used to improve the system in these areas, as well as highlighting the barriers and limitations that currently prevent this from occurring.

Improving candidate satisfaction with HDR training

The data collected on graduate satisfaction through the PREQ provides a useful national snapshot of satisfaction with HDR training, although further reporting on candidate's satisfaction with transferable skills training is needed. This could be incorporated in the Graduate Outcomes Survey which is anticipated to succeed the PREQ in 2016.

Institutions are able to see their own results and therefore are able to benchmark against sector averages to identify areas for improvement. Data is not published by institution, making it impossible for others to identify areas of strength and where there is room for improvement. Although individual universities are able to see their own results and can compare these to the national picture, there is no tracking of improvement measures undertaken by universities. Mandating that universities meet specific benchmarks in the Graduate Outcomes Survey which will begin in 2016 would ensure performance improvements are taken seriously. There are difficulties with publishing such data, particularly at the disciplinary level, as sample sizes can sometimes be too low to provide meaningful comparison.

Ensuring the nation benefits from HDR training

While the data appear to show satisfactory career outcomes for HDR graduates, there is an absence of comprehensive data that would demonstrate the value of HDR training to the nation. There is a lack of longitudinal data that tracks HDR career outcomes, including graduate salaries, employment rates, and career destinations. This makes it difficult to show the substantial economic benefits delivered by HDR graduates over the course of their careers.

The limited information that is available can be found through Census data and small scale annual surveys such as the Beyond Graduation survey. The Beyond Graduation survey provides information 3 years after graduation, which is an improvement on traditional graduate

surveys. Unfortunately, the survey does not track graduates beyond this point, and results for HDR graduates are not published separately from the results for all postgraduates, and are based on a relatively small sample size. Many graduates would still fall within the post-Doctoral phase of their career at this point, and given the high number of candidates who leave academic research shortly after this point this does not give a meaningful picture of career direction. Understanding how HDR graduate careers progress over a longer time frame, such as at 5 and 10 years after graduation, would provide valuable data to show the economic contribution of HDR training to the nation, as well providing useful information to prospective candidates.

The Census provides richer data, but the publicly available data have some limitations. The available data does not distinguish between respondents who graduated a short time ago versus those who graduated decades ago. This data deficit makes it difficult to determine the more recent contribution of HDR training to the economy. This matter is particularly important, given the increased investment in HDR training in recent years.

There is no available data showing the employment outcomes for HDR graduates by university. As outlined in Section 1, prospective HDR graduates should be able to find out further information on their future employment prospects by reviewing the employment outcomes of past graduates. This would help institutions identify their own competitive advantage (for an example see University of California, 2014) or, where necessary, improve their training to support better employability of their graduates.

Raising the performance of the research training system

Looking closely at the inputs (resources provided) and outputs (HDR graduates produced) provides a good starting point to understand how performance varies between different institutions, and to identify where performance

can be improved. It is not possible for this Review to make a determination on the total value of the investment in HDR training made each year by the Australian Government and other stakeholders. At a minimum, it would be useful for the financial inputs into HDR training from all Australian Government-funded programs, particularly the ARC and NHMRC, to be reported.

In terms of the outputs from the research training system, there is data on the number of enrolling, continuing and graduating HDR candidates. Once resourcing is better understood, this data can provide a snapshot of investment relative to HDR training outputs. However, this data does not provide a useful indicator of efficiency or indicate performance. Each year Australian universities report the number of enrolling, continuing, and completing HDR candidates to the Department of Education and Training, making it possible to know exactly how many HDR candidates graduate each year. Despite the extensive statistical reporting by universities to the department, the way this data is reported makes it difficult to reliably determine average length of candidature, and the proportion of candidates who graduate.

The United Kingdom now uses completion rates and candidature length as system performance indicators, in response to past low completion rates and long completion times. Institutions that fail to achieve an average 4-year submission rate of 60 per cent become ineligible to receive new doctorate studentships funded by research councils (for example, see Economic and Social Research Council, 2015). Within Australia, the completion rate for HDR candidates, and candidature length, have been recognised as indicators of the quality of research training environment for some time within research block grant allocations (see Department of Education and Training, 2015g). The importance of this incentive was recently confirmed in the *Review of Research Policy and Funding Arrangements* (Watt, 2015). Given the role that completion incentives already play, there is the opportunity for completion data to further drive system performance.

This Review contends that the current situation—where about half of all candidates have not completed within 4 years and one-third after 5 years—could be improved. Candidates beginning HDR training should do so with a realistic understanding on how long their training will take, with the expectation formed on evidence rather than stated course lengths put forward by universities or in AQF guidelines. Some stakeholders suggested that if completion times were monitored more closely, and the Australian Government provided funding incentives based on completion times[1], this would drive improvements to the quality and delivery of HDR training. It was suggested that for the research doctorate institutions and candidates should aspire to ensure the research thesis is submitted within 4 years. This would provide a significant performance incentive to ensure candidates complete in a timely fashion.

At present, even if the existing data held within the higher education data collection could be more easily interrogated to show completion rates and completion times, there are concerns that the data reporting mechanisms would need to be improved to ensure consistency in how data is collected across the system. As Palmer (2016) notes, different institutions are collecting and reporting data in different ways to the Higher Education Data Collection (Palmer, 2016). Adequately reporting completion times should be possible within the higher education data collection, and an agreed reporting methodology and framework should be developed. This would need to include a sector-wide agreed definition on the start and completion points of a research degree when measuring completion times.

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1. Care must be taken when talking about research degree completions, as Palmer (2015, 11) notes, "Research degree 'completion can be an ambiguous term, and can be used to refer to a range of steps or *enrolment events* as part of a completion process (Palmer, 2014) including (but not limited to): 1. Submitting a thesis for examination; 2. The final date of enrolment; 3. Receipt of final thesis examination reports; 4. Satisfaction of all requirements for conferral of a degree; 5. Degree recorded as conferred by the education provider." The preferred definition in this report is to see completion as the point of submitting a thesis for examination, given the variability in how long it can take for the examination process to take place.

7.4 Propositions for ensuring the delivery of improved HDR training

Improving the delivery of HDR training requires the collection and reporting of data at both the institutional and the broad disciplinary level. Data needs to be collected for three distinct core indicators to enable system performance monitoring and evaluation: graduate satisfaction, career outcomes, and HDR completions. A summary of the proposed data collection requirements is provided in Table 13.

7.4.1 Collecting the data needed

System inputs

The detailed reporting by the Australian Government on the level of investment in HDR training through the research block grants should continue. The ARC, NHMRC and Commonwealth Scientific and Industrial Research Organisation (CSIRO) should collect and report on the level of financial investment they make in HDR training, as well as the number of places they support.

Collecting data on HDR graduate satisfaction

Current HDR graduate satisfaction data was collected through the PREQ by Graduate Careers Australia. It is anticipated that the Questionnaire will be replaced by a Graduate Outcomes Survey from 2016, with the results to be reported through the Quality Indicators for Learning and Teaching website in a similar fashion to undergraduate satisfaction. There is an opportunity for stakeholders to consider what additional data on HDR graduate satisfaction might be useful to collect, such as data relating to transferable skills. The survey could also be expanded to include non-completing candidates. This would improve the range of useful information that would drive performance improvements and help enable candidate choice.

Collecting data on HDR graduate career outcomes

Currently available data on the career outcomes of HDR graduates is inadequate, and fails to show the value of HDR training to the nation. The value of HDR training could be demonstrated by tracking the career pathways of a representative sample of HDR graduates. Career outcomes need to be reported at different stages of a graduate's career, such as 5 and 10 years post-graduation. Such longitudinal data would help prospective candidates understand the range of academic and non-academic careers available to them. This would allow a more definitive understanding of how many HDR graduates exit academia, and at what point post-graduation.

Reporting career outcomes at the disciplinary level requires a comprehensive survey to ensure sample sizes are large enough to enable meaningful reporting, and this is a more difficult undertaking. Options to explore linking individual census data and anonymised tax data should be pursued. Although there are upfront costs and privacy considerations, the economic benefits that would be gained by better utilising existing administrative datasets have been shown to be substantial, with the potential to transform how policies and services are delivered (Productivity Commission, 2013; Department of Prime Minister and Cabinet, 2015b). While maintaining contact with specific individuals is difficult in any longitudinal survey, it is important to track individuals over time to see the long-term impact of HDR training.

Collecting data on HDR graduate completions

There are concerns that existing data on completions within the Higher Education Data Collection is unreliable (Palmer, 2016). Despite data limitations, it has been shown in the United States (Hoffer and Welch, 2006) that completion data can be accurately collected,

and within England that it can be done in a way that accounts for the differing circumstances of institutions (Higher Education Funding Council for England, 2013). Working with universities, the Department of Education and Training could better define how completion data is collected within the Higher Education Data Collection. This reform would ensure consistency and accurately quantify how many candidates go on to complete their research training, and the timeframe in which they do this.

Summary of data collection requirements

A summary of the different performance indicator areas, the data required and the action needed to collect the data required to help drive system performance improvements is given in Table 13.

Where sample sizes allow data for the three indicators should be reported at the institutional level and the disciplinary level. To overcome the problems with small sample sizes it might be possible to provide rolling averages across a specified timeframe.

Table 13: Summary of proposed data collection requirements

Performance indicator area	Data required	Action
System inputs	Accurate information on the level of investment being made in HDR training by the Australian Government across different programs	Continued reporting of Australian Government investment through research training block grants. Agencies including ARC, NHMRC and CSIRO to report the level of investment and the number of HDR awards made in HDR training each year. Investment in HDR training by CRCs to be reported by CRCs to the Department of Industry and Science.
HDR graduate satisfaction	Satisfaction levels with the following components of HDR training: • supervision • intellectual climate • skill development, including transferable skills • infrastructure • thesis examination • goals and expectations • overall satisfaction • transferable skills	Stakeholders to work with the Graduate Outcomes Survey to collect satisfaction data.
HDR graduate career outcomes 5 and 10 year post-graduation	• labour force participation • industry of employment • occupation • salary • relationship between research training and career	An expanded version of the Beyond Graduation survey targeted specifically at HDR graduates to be designed. Supplementary questions on industry of employment to be added. Survey undertaken 5 and 10 years post-graduation. Assess the feasibility of linking individual census, tax and graduate data.
HDR graduate completions	Completion data for institutions and disciplines including: • proportion of candidates completing within 4 years • proportion of candidates submitting within 7 years • median completion time	Department of Education and Training, Higher Education Statistics Collection.

7.4.2 Producing a report card for HDR training and setting minimum performance standards

To improve benchmarking, drive performance improvements, and assist future HDR candidates make choices, HDR training report cards should be developed to detail institutional performance against different indicators. Such report cards could include, but not necessarily be limited to, the key performance indicators identified:

- satisfaction with research training experience

- career outcomes

- proportion of candidates graduating within a specified time

- quality and critical mass of research environment as measured through the ARC ERA

- level of industry engagement as measured through future iterations of the ARC ERA.

These report cards would best be produced at the two and four-digit field of research level, and also for each institution, to enable comparisons of disciplines and institutions.

7.4.3 Future research and evaluation

This report has been able to draw on past high quality research to help determine where and how the research training system could be improved. Continued research into the research training system will be needed to aid ongoing performance improvements. The increased availability of the data outlined in Box 10 will assist researchers in identifying where and how performance can be improved. This will include undertaking research and evaluation exercises to determine the impact of changes made following the implementation of this Review's recommendations.

7.5 Key finding 7

Currently available data is inadequate to determine the performance of the research training system and its value to Australia's economic and social wellbeing. Longitudinal data on HDR course satisfaction, course completions and career outcomes needs to be collected and reported in a nationally consistent and statistically robust fashion. The absence of this data prevents effective performance monitoring and evaluation and the development of institutional performance incentives. Data gaps could be filled by making changes to some existing data sources and collector methods, exploring opportunities associated with administrative data linkage, and introduction of a specialised fit-for-purpose longitudinal survey. Research training system performance data should be longitudinal, reported by institution and discipline at the two- or four-digit field of research level as appropriate, and used to drive performance improvements as well as aid prospective HDR candidates in making decisions about HDR training.

Section 8
International benchmarking of HDR offerings

8.1 Introduction

To produce high quality, internationally competitive graduates, and continue attracting the best and brightest from overseas, Australia's HDR training system needs to remain competitive with the best training systems in the world. The absence of high quality performance data makes it difficult to identify how best to improve the HDR training system and addressing this lack of data should be a priority. While the absence of performance data is a hindrance, improvements can still be made by benchmarking Australia's HDR training system at the disciplinary level against systems that are perceived to be among the best in the world. A quantitative and qualitative benchmarking exercise would allow Australia's relative performance to be better understood, and the specific components of the world's best HDR training systems to be identified and where appropriate implemented in Australia.

8.2 Ensuring Australia's HDR training system remains among the best in the world

8.2.1 The need to remain competitive

HDR training in Australia must continue to be among the best in the world for the following reasons.

- Australian HDR graduates will be competitive for employment in research positions.

- The research system will continue to have access to high quality local and international graduates to secure the research workforce pipeline.

- HDR training is seen as an attractive proposition to the very best and brightest prospective domestic and international candidates.

- The nation will benefit from the high quality research being produced, and from having greater research skills within the workforce.

Section 7 shows that overall career outcomes for HDR graduates are good. However, some concerns were raised in the consultation process that Australian HDR graduates are not competitive compared to those trained overseas when it comes to academic appointments within some discipline areas. As one stakeholder commented, if Australia cannot demonstrate that its training is of sufficient quality to enable candidates to be competitive for academic careers, then Australia will be a less attractive place for the best and brightest Bachelor graduates and international candidates to undertake HDR training.

Australia will only continue to be a top higher education destination for international HDR candidates if its reputation remains among the highest in the world. The international recruitment market for HDR candidates is very competitive and it is in Australia's interests to continue to attract the very best and brightest candidates.

8.2.2 Staying competitive

For the Australian HDR training system to remain competitive it needs to continue to embrace change and evolve. Research training systems around the world are undergoing constant renewal. Moves to improve preparatory training through entry pathways, embed coursework opportunities within the Research Doctorate, enhance cohort training opportunities, and provide industry placement opportunities have been pursued to varying degrees by HDR training systems overseas. Many of these initiatives are explored in this report. Remaining competitive will mean ensuring that candidates in the Australian HDR system have access to these enhanced training opportunities.

8.3 International benchmarking—areas of consideration

8.3.1 Absence of system performance data

Objective performance measures are an important part of enabling improvement in any system, and this is no different for the HDR training system. They also enable international comparisons to be made with other high performing systems. The lack of high quality performance data for the Australian HDR training system at the national and institutional level makes assessing the competitiveness of the system difficult. Similar difficulties are also apparent in overseas research training systems, compounding the data availability problem and inhibiting benchmarking exercises.

As outlined in Section 7, measures need to be taken to resolve this deficit. Longitudinal system performance data will provide a better picture of the relative performance of the Australian research training system internationally, but will take some time to collect. Nevertheless, it should be possible to implement improvements in the short term to enable Australia's HDR training system to maintain its international reputation and competitive edge.

8.3.2 Using the ARC ERA to benchmark quality

Future benchmarking of the Australian research training system could make use of ARC ERA data. The ARC ERA is a comprehensive research assessment exercise that assesses Australia's university research system relative to world standards. ERA is a university's presentation of its best case for research quality at the 4-digit field of research and shows research excellence is found throughout the university sector. It should be possible to benchmark against world standards the quality of the intellectual climate where research training is taking place using published data from ERA, and additional data currently collected but not reported, such as the number of full-time equivalent staff and the number of research outputs along with additional data on

the number of HDR candidates. Future iterations of the ARC ERA are likely to include a measure of industry engagement (Department of Education and Training, 2015c; Watt, 2015), which will provide a useful indication to prospective HDR candidates on the different types of research and industry engagement opportunities available.

8.3.3 Recognising that multiple approaches are needed across disciplines to improve HDR training

While all stakeholders acknowledged the importance of ensuring Australia's HDR training system offers a research training experience amongst the best in the world, what this experience should look like is less clear. Many stakeholders expressed the view that a one-size-fits-all approach to research training needs to be avoided.

> *"There is no one-size-fits-all approach to research training—disciplines have different requirements and systems of operating and it will be critical to identify and account for different disciplinary needs"*
>
> Australian Academy of Humanities (2015, p. 1)

> *"A one-size fits all approach for Australian HDR graduates is both unachievable and undesirable."*
>
> Regional Universities Network (2015, p. 4)

> *"A 'one size fits all' research training approach would be poorly suited to producing the diverse and resilient research capacity Australia needs."*
>
> Southern Cross University (2015, p. 1)

These concerns were explored further in stakeholder consultations, and participants were keen to stress the importance of disciplinary differences. As one stakeholder remarked, "engineering is not the same as theology and rather than treat them the same it would be of benefit to tailor the improvements needed to the discipline and what the candidate wants to achieve." While stakeholders were keen to point out that they wanted to avoid a one-size-fits-all approach, many stakeholders believed that the current system is too homogenous, and already acts in this way.

> *"The current one-size fits all funding model and standard program length can restrict genuinely innovative programs, as well as the ability to incorporate aspects of overseas*

programs that have proven highly effective (e.g. extensive coursework training) where such practice is deemed desirable."

Australian Business Deans Council (2016, p. 1)

8.4 Proposition—discipline benchmarking

In the long term, developing and collecting adequate longitudinal performance data on Australia's HDR training system should be prioritised, as described in Section 7, with this data being used to help drive performance improvements across the system. However, the need to ensure Australia's research training system remains competitive means that actions are needed in the short term.

The need to take different approaches to research training within different disciplines necessitates looking at the four-digit field of research disciplinary level for options to strengthen research training. This will involve identifying research training systems that are deemed to be among the best in the world, identifying top-performing universities and the research training system components that have ensured their high performance, and then comparing them to how HDR training is undertaken in Australia. A large part of this exercise will entail qualitative and quantitative benchmarking where different training concepts are compared alongside each other, along with the outputs they produce.

There are some difficulties in undertaking such an exercise given the absence of comparable data, and the lack of consensus about which systems and institutions are deemed to be among the best in the world. Disciplinary associations should be involved at an early stage to provide advice on the reputation of different overseas research training systems, and to identify appropriate institution comparator groups. Different disciplines will need to benchmark against different sets of comparator universities, depending on where the highest quality HDR training is perceived to be in their discipline. This work could be undertaken by a consortium of universities, disciplinary associations, or learned academies, as appropriate to the specific discipline.

The headline indicators against which Australia should be benchmarking its HDR training system include investment in HDR training, HDR candidate numbers, HDR completion times and rates, graduate satisfaction, and employment outcomes including, labour force status, occupation, industry of employment, and career earnings. ARC ERA data can also be utilised to provide an overview of the quality of research environments where research training is taking place. Care needs to be taken to find common definitions, particularly around HDR completion times and rates, to avoid gaming of the system and unintended consequences.

Undertaking such an exercise will necessitate some 'data pragmatism' given the limited availability of data and that data will have been collected in different ways in different research systems. However, it is better to start utilising less than ideal data, than no data at all, so that trends can at least be identified. Such an exercise would need to be qualitative as well as quantitative in nature to help identify how specific initiatives undertaken overseas have led to changes in outcomes within HDR training systems. For example, this would compare initiatives such as the introduction of coursework, the different types of research methods training, the length and timing of industry placements, different types of research outputs, examination practices, and compare this at the disciplinary level to programs on offer in Australia.

This approach allows for actions to improve training to be identified at the disciplinary level, and this is likely to be more successful than mandating system wide changes to course structure across all disciplines.

8.5 Key finding 8

HDR training could be improved by institutions benchmarking their HDR training against that offered by institutions with outstanding international reputations. This benchmarking should be undertaken at the four-digit field of research level.

Section 9
Assessment of both candidate and thesis

9.1 Introduction

Many stakeholders consider that the Australian research training system would benefit from greater emphasis being placed on the assessment of the candidate and the skills gained, rather than focus predominately on the assessment of the thesis. There are a range of ways to achieve this, including the use of an oral examination, candidature milestone assessment, the production of a skills portfolio, and seminar presentations.

9.2 HDR assessment— current practice

9.2.1 The current examination system

The examination of the thesis plays a major role in ensuring a high quality HDR training system. Examination of research degrees in Australia involves two or more examiners of international standing reviewing a research thesis, providing detailed reports, and providing a recommendation as to whether the thesis is of sufficient quality to be awarded a research degree.

9.2.2 Benefits of the current approach to HDR examination

The current examination system offers a number of benefits that should not be overlooked when considering making changes to the examination system. Kiley (2009) outlines four major observable benefits of the existing examination system:

- The external examination process provides a (generally international) validation of candidates' work (Bourke, 2005).

- A level of objectivity is provided, with the examiners being unknown to the candidate and to one-another (Kiley and Mullins, 2004; Mullins and Kiley, 2002).

- The system produces reliable results regarding the quality of the thesis (Bourke et al., 2006)

- The provision of written reports from the examiners, which are often extensive and generally of considerable value in terms of contributing to the further refinement and development of the research (Johnston, 1997).

The Australian examination process differs from many other systems in that it relies solely on external examination reports from examiners of international standing, and there is not usually an oral component. Many stakeholders saw the use of examiners of international standing as an advantage, as it provides a high level of assurance that thesis quality is of international standard, and concluded that this is a feature of the research training system that should be retained (Queensland University of Technology, 2015; RMIT University, 2015; University of Wollongong, 2015; Regional Universities Network, 2015; Macquarie University, 2015b; Deakin University, 2015).

9.2.3 Candidature milestones

In addition to the formal examination of the thesis, candidates are usually required to successfully progress through period milestones during their candidature. These milestones provide a mechanism to ensure enough progress has been made for the candidature to continue, and provide an opportunity for feedback and reflection on progress made to date (Monash University, 2016). In general these milestones include confirmation of candidature, mid-candidature, and pre-submission seminar/review (for example, see University of Queensland, 2014).

9.3 Opportunities to assess and record HDR graduate skills

9.3.1 Drawbacks of the current approach to HDR Examination

Based on a review of Australia's Doctoral examination system, it has been suggested that the current process does not align with the aims of the contemporary doctorate (Kiley, 2009). The current examination system has not been adjusted to reflect the increased focus on producing high quality researchers, in addition to high quality research outputs. The present examination system in Australia does not allow for an assessment of the candidate and other skills gained during the development of the thesis (Curtin University, 2015b). This is particularly significant given the increasing importance of transferable skills development for employment in a range of industries.

Participants in the consultations suggested ways in which candidate assessment could be broadened. This included increased use of oral examinations, the evaluation of a skills portfolio, and through better use of candidature milestones.

9.3.2 Oral examinations in Australia

Calls from some stakeholders to introduce an oral examination

An oral examination has been suggested by some consultation participants as one way in which broader skills assessment can take place (University of Queensland, 2015; Australasian Council of Deans of Arts, Social Sciences and Humanities, 2015) and a number of stakeholders expressed support for their introduction (Deakin University, 2015; James Cook University, 2015;

Charles Sturt University, 2015; Queensland University of Technology, 2015; Dean of Creative Industries, Queensland University of Technology, 2015). In contrast to most other HDR training systems, Australia does not routinely utilise oral examinations as part of its thesis assessment.

Most universities already allow for the use of an oral examination under defined circumstances and many express a view that this capacity should be retained (for example, Australian Council of Graduate Research, 2015), but it is also recognised that this option is rarely used (Kiley, 2009). In general, an oral examination is usually only used in Australia to resolve cases where there is doubt over whether a thesis has met the required standard.

The aims of an oral examination are outlined in Box 12. Of particular note for this Review, two of the most frequently cited issues raised by stakeholders concerning the current examination system relate to assessing the researcher's skills in addition to the research output, and to ensuring the authenticity of the thesis.

Box 12: The stated aims of an oral examination

Within the literature (for example, see Carter & Whittaker, 2009; Grabbe, 2003; Holbrook et al., 2015; Lovat et al., 2015; Smith, 2014; Trafford & Leshem, 2008) the aims of an oral examination are to:

- provide a defence of the thesis
- agree on required changes to the thesis
- assess knowledge and understanding
- assess the researcher as well as the research
- clarify complex issues
- establish authenticity
- provide a finishing point
- demonstrate mastery and intellectual exchange
- develop the researcher
- act as a celebratory function
- offer an opportunity for the candidate to engage with experts in the field

Source: Adapted from Holbrook et al. (2015) and Kiley (2015).

A recent ARC-funded cross-national study examined the relative impact of the oral component on Research Doctorate examination quality, language and practice (Holbrook et al., 2015). The study found that, overall, the inclusion of a face-to-face oral exam would not make a significant difference to Australian Research Doctorate examination results, but it could bring about other benefits such as greater closure for the candidate and opportunity for collegial exchange and networking. As the candidate examination outcomes would be unlikely to be different, many stakeholders do not see a need for change, particularly given the additional financial cost, logistical challenges, and potential loss of existing benefits within the current examination system.

Barriers to introducing an oral examination

One of the major barriers to introducing an oral examination component in Australia is the associated cost involved, given the relatively greater distances that examiners would need to travel to undertake oral examinations, when compared with other nations (for example, see University of Wollongong, 2015), and that it could only be introduced should additional resources be provided (Australian National University, 2015).

The cost of an oral examination could be overcome to some extent through the use of technology, allowing examiners to participate remotely (Victoria University, 2015; Australasian Council of Deans of Arts, Social Sciences and Humanities, 2015). There are some logistical concerns with this approach, such as the need to account for examiners in different time zones and the availability of high quality video conferencing facilities for all involved (Griffith University, 2015; James Cook University, 2015). In addition, having multiple people located in different places participate in a rigorous examination process via video conferencing may not provide a satisfactory experience for the candidate and the examiners (Griffith University, 2015; James Cook University, 2015).

Concerns were raised that the current examination process can take too long, making it hard for candidates to progress their careers (name withheld, 2015). The PREQ reports that 73.8 per cent of respondents felt that their thesis was examined in a reasonable time. Adding oral examinations could impact on the timeliness of this process. It could either act as an incentive for examiners to work towards a set examination date, or it could extend the length of the process overall due to logistical challenges.

9.3.3 Utilising candidature milestones

Some of the benefits of an oral examination described in Box 12 could also be achieved by better utilising candidature milestones.

Oral presentations

In most universities candidates can demonstrate their presentation skills through the use of candidate milestone seminars (for example pre-submission or exit seminars) (for example, see RMIT University, 2015; Western Sydney University, 2015). Most candidates are already required to present their research at departmental or faculty seminars, which provide a formal opportunity for the formal assessment of presentation skills, as well as intellectual exchange. The successful completion of such presentations at different stages of candidature could also be made a condition for candidature progression as already occurs in many Australian universities.

Researcher development framework

Neither current examination practices nor an oral examination adequately assess the broader skills gained during candidature. Using a researcher development framework (as outlined in Section 4) can help candidates gain and demonstrate a wide range of skills gained that are not currently assessed during the examination process. In addition to undertaking formal periodic evaluations of academic progress at the different candidature milestones, also evaluating progress in developing a skills portfolio could be made a prerequisite for progression to the next stage of candidature.

9.3.4 Australian Graduation Higher Education Statement

Participants at the public forum events and in the stakeholder interviews were asked whether it would be advantageous to record the disciplinary and transferable skills and knowledge gained on the Australian Graduation Higher Education Statement, which each candidate receives upon graduating. The majority of participants were in favour of this as it would provide graduates with a mechanism to demonstrate to employers the skills and knowledge gained during research training.

9.4 Key finding 9

The current examination system ensures Australia's HDR outputs are of high quality, but a statement of the skills and knowledge gained by the candidate is also needed. The Australian Higher Education Graduation Statement provides a potential vehicle for such information, the evidence base for which can be built through HDR milestones (confirmation of candidature, mid-candidature, and final), preparation of a skills portfolio, seminar presentations, industry and international placements, and oral examinations.

Section 10
Evaluation of supervisor competency and performance

10.1 Introduction

High-quality supervision plays a crucial role in producing positive HDR training outcomes, and universities have a responsibility to ensure all HDR candidates receive high quality supervision. Quality supervision is also central to ensuring the HDR training system remains internationally competitive. Survey data shows that although supervisory experience is generally good, quality is variable between supervisors, disciplines and possibly between institutions.

This section looks at the supervision experiences of HDR candidates and finds that while it is generally of a high standard there is some variation. It explores some of the issues relating to improving supervision experience, and puts forward suggestions to enhance the professionalisation of supervisory practices. Providing high-quality supervision is critical to ensuring positive HDR candidate outcomes. Universities must ensure sufficient long-term resourcing and management of supervisor training and support, implement initiatives for encouraging high quality supervision, and ensure effective monitoring and public documentation of supervisor performance.

10.2 Supervision experiences of HDR candidates

The PREQ shows that satisfaction of supervisory experience for HDR candidates has been steadily increasing over the past 14 years, as shown in Figure 12. In 2014, the mean percentage agreement score of supervisory experience was at 81.1 per cent for HDR candidates, which is a 10 per cent increase since 2000 (71 per cent),

as shown above in Figure 13. Mean percentage agreement scores reflect the distribution of response in the 'agree' and 'strongly agree' response categories and can therefore be interpreted as the proportion of responses that fall within these categories.

Although the mean percentage agreement score of supervisory experience was high, it also means that almost 1 in 5 graduating candidates were not satisfied with their supervisory experience. These candidates either 'neither agreed nor disagreed', 'disagreed' or 'strongly disagreed' when answering questions on the quality of supervision they received. In addition, there is variability in mean percentage agreement scores for detailed qualities of supervision, as shown above in Figure 13. The highest scoring supervision experience was 'supervision was available when I needed it' (86.8 per cent), whereas the lowest was 'I received good guidance in my literature search' (72.6 per cent). The variability in scores between specific supervision quality questions and that 18.9 per cent of HDR candidates were not satisfied with their supervisory experience shows there is room for improving supervision quality in some areas. The data suggests that universities have an opportunity to improve the supervisory experience and provide further support for the minority of candidates that are currently not enjoying a positive supervision experience.

Further to this, the questionnaire shows a correlation between the level of satisfaction of HDR graduates' supervisory experience and their work status. Research graduates who obtained full-time work after graduation recorded the highest mean percentage agreement score for supervision (82 per cent), compared with graduates who were working part time (80.3 per cent) or still looking for work (76.9 per cent).

Finally, the level of satisfaction of supervision varies between disciplines as shown in Figure 18. From the 30 largest disciplines (by 4-digit Field of Education codes), Rehabilitation Therapies scored the highest at 90.1 per cent mean percentage agreement, and Behavioural Science scored the lowest at 76.6 per cent.

10.3 Key issues relating to improving the quality of HDR supervision

10.3.1 Inconsistent or lack of training

Inconsistent and sometimes absent training of supervisors may be one of the causes of supervisor performance issues. HDR training alone does not adequately prepare graduates for the role of supervision. A large number of written submissions that the Review received noted that an expectation of a high quality graduate is that they are able to mentor and supervise others (for example, see Macquarie University, 2015b; Deakin University, 2015; Queensland University of Technology, 2015; Australian Council of Graduate Research, 2015). However, for many new supervisors, the only examples they have

on which to base their current practice are those they received as an HDR candidate. Hence, without formal training, candidates who received poor quality supervision will be at a disadvantage in preparation for becoming supervisors and might be more likely to perpetuate poor supervisory practices.

Despite the candidate–supervisor relationship being one of the most important elements of the HDR experience, there are no nationally consistent training requirements to become a HDR supervisor (Kiley, 2011; Deakin University, 2015; Pearson, 2012). The single most important factor in HDR candidate decisions to continue or withdraw is their relationship with their supervisor (Golde, 2000; Kiley, 2011). Within the written submissions and in the interviews stakeholders stated that owing to an absence of training, supervisors can sometimes lack awareness on the current employment outcomes for candidates, which in turn affects their effectiveness as supervisors (National Aboriginal and Torres Strait Islander Higher Education Consortium, 2015). Higher education institutions must therefore address how to supervise and support candidates to encourage timely completions and a broader work readiness (Flinders University, 2015; Gill and Burnard, 2008).

Figure 18: Mean percentage agreement scores of candidates' supervisory experience for the 30 largest 4-digit Fields of Education for 2014
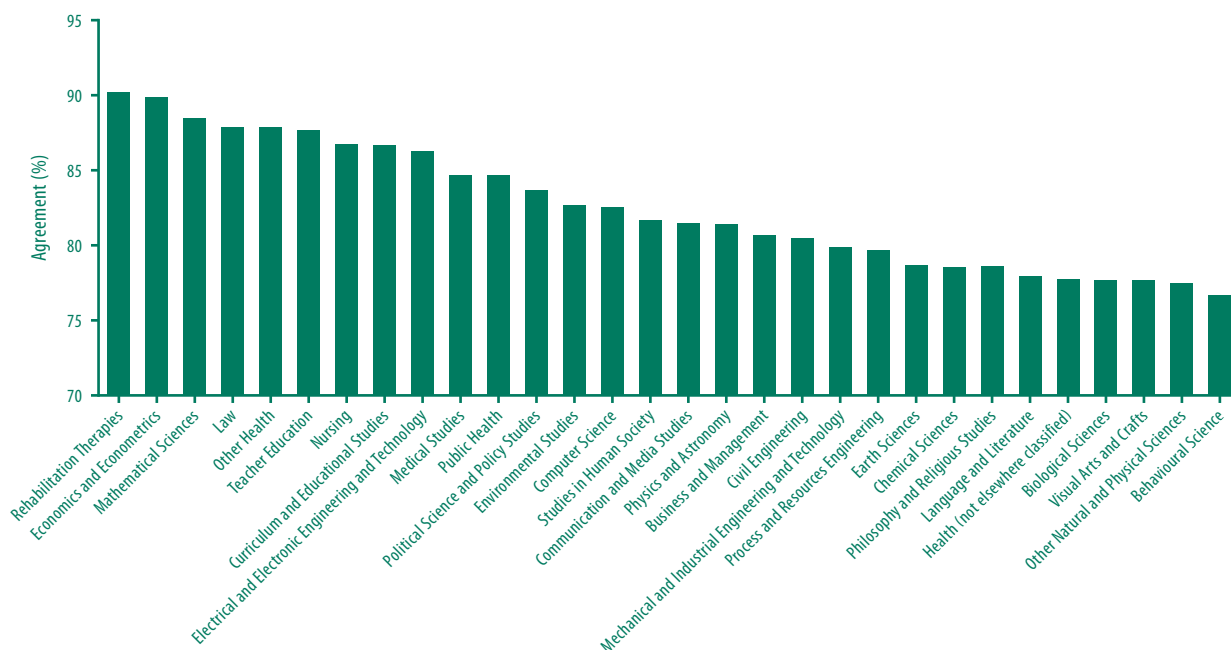
Data was obtained from the 2014 Postgraduate Research Experience Questionnaire, Graduate Careers Australia (2015b).

Kiley (2011) conducted a study on the Group of Eight universities and found that training programs varied considerably between the eight institutions. Training ranged from 3-hour induction sessions to fully structured programs, which at the end gave accreditation for supervision to staff members. Training also varied substantially in the form in which programs were presented, from predominantly online training to face-to-face workshops (Kiley, 2011). Kiley (2011) also noted that there appeared to be a lack of training programs for experienced academics. Universities are assuming that supervisors with years of experience do not require training, which is not necessarily the case, especially as the research training system, the needs of candidates and the workforce landscape are constantly evolving (Pearson and Brew, 2002). Many universities have sought to develop training frameworks for HDR supervisors and on the whole standards of supervision are high. However, the large variation in the level and form of training raises issues on the consistency, quality and coverage of training across Australian universities.

10.3.2 Structural issues affecting quality of supervision

Supervision is a difficult and time-consuming role, and the value and commitment is often underestimated within universities. Stakeholders argued that the increasing lack of job security among academics—including supervisors—is a major problem in the provision of high-quality supervision (National Tertiary Education Union, 2015). There is a growing trend of casualisation of the sector, which may lead to generational transition problems for future HDR supervisors (Flinders University, 2015).

10.3.3 Unclear involvement of supervisory panels

The Higher Education Standards Framework (Tertiary Education Quality and Standards Agency, 2015) stipulates that a HDR candidate must have a research-active principal supervisor and at least one co-supervisor (making a panel). Most universities and faculties have moved away

from the traditional one-on-one relationship between a candidate and supervisor (Green and Bowden, 2012). Stakeholders of this Review agreed that panel supervision is superior to one-on-one supervision.

> *"The traditional reliance on a single HDR supervisor guiding the development of the candidate is less consistent with expectations and requirements of both the future workforce and the graduate."*
>
> University of Newcastle (2015, p. 5)

Candidates have different needs at different times and one supervisor alone cannot fulfil all those needs throughout the entire length of candidature (Green and Bowden, 2012). However, even though panel supervision is a requirement, comments from written submissions and consultations suggest there may still be institutions or faculties that allow candidates to have only one supervisor or do not monitor or set minimal requirements regarding the involvement of co-supervisors (Australasian Council of Deans of Arts, Social Sciences and Humanities, 2015; Australian Catholic University, 2015; RMIT University, 2015; University of Newcastle, 2015; University of Tasmania, 2015).

10.3.4 Lack of quality assurance mechanisms

The research training system currently has no consistent method for identifying excellent research training, despite most universities having supervisor of the year awards. Many stakeholders during public forums expressed their concern that there is an assumption that a high quality researcher equates to a high quality supervisor, but there is no systematic evidence to support this assertion.

10.4 Professionalisation of HDR supervision

The professionalisation of HDR supervision through recognition of excellence, driving metrics, and provision of high quality training and development will underpin the standard of Australia's research training system as a whole.

Professionalisation would also ensure that our research training system is internationally competitive and produces high quality HDR graduates (Deakin University, 2015). To encourage accountability and promote higher-quality supervision, universities should document and make public the quality of supervision that is offered at their institution. Providing clear information on supervision would assist prospective candidates in understanding what efforts universities and supervisors are undertaking in this area.

10.4.1 Supervisory training

Stakeholders agreed that ongoing professional supervisor development needs more investment (Defence Science and Technology Group Department of Defence, 2015; Faculty of Education QUT, 2015). Supervisor training better prepares supervisors to provide career development support and advice to candidates and builds supervisor awareness, to take account of the macro as well as the micro dimensions of candidature (Centre for the Study of Research Training and Impact, 2015).

A supervisor quality training framework, which is implemented across the sector, would encourage supervisors to develop a wider range of skills (University of Tasmania, 2015; University of South Australia, 2015). Such a framework should be flexible, so that universities and research disciplines can tailor it towards the needs of their candidates and staff (Pearson and Brew, 2002). The framework would ensure that supervisors engage effectively with their candidates, so that there are clear mutual expectations of the relationship and the research training goals between the supervisor and candidate (Gill and Burnard, 2008).

> "Universities should be encouraged to implement more structured and rigorous training programmes for PhD supervisors to ensure a baseline standard of supervision competency across the university."
>
> Australian Academy of Humanities (2015)

Within the stakeholder interviews and at the public forums there was agreement that ongoing supervisory training is vital for both new and experienced supervisors. In order to keep up-to-date with evolving research training practices and requirements, training should continue throughout a supervisor's career. Many institutions already deliver induction and orientation training to new supervisors to prepare them for their new roles (National Tertiary Education Union, 2015; Kiley, 2011), however, few have a requirement for ongoing training (Kiley, 2011).

Ongoing supervisor training would be particularly useful for encouraging industry engagement and broader transferable skills training. As highlighted in Section 5, many supervisors fear that industry engagement could result in reduced academic outputs and they sometimes can resist supporting candidates to work on collaborative projects with industry. Supervisors sometimes are reluctant for candidates to undertake additional skills training or industry placements owing to the potential to extend completion times. Supervisory training would be an excellent platform for communicating to academic supervisors the value of industry collaboration for both the candidate and the supervisor. To ensure consistency in supervision quality, it is vital that industry partner supervisors also participate in ongoing training.

Many universities have already developed and refined supervisory training initiatives (Kiley, 2011). For example, Swinburne University, University of Southern Queensland, Edith Cowen University, Central Queensland University and Victoria University worked together to develop an online toolkit for academic staff who are new to HDR supervision (see Figure 19). The toolkit, which is open-access, provides real-time, readily available resources and advice for supervisors (see Blass and Bertone, 2013). Despite most if not all universities providing at least some level of training for new supervisors, there is no standard way of publicly articulating the type and level of training provided (Kiley, 2011). For the benefit of future candidates and supervisors, and as a mechanism for encouraging quality supervision at the institution level, universities should be required to publicly report on their HDR supervisor training.

Figure 19: Screenshot of the Research Supervision Toolkit website

RESEARCH SUPERVISION **TOOLKIT**

Search   Toolkit   Social   Discussion   About   +

Welcome

Welcome to the newly designed Research Supervision Toolkit website.

A Selecting for Success

B Setting Expectations

C Achieving Confirmation

D Doing the Research

E Finalising the Thesis

F Managing Progress

G Managing the Relationship

H Supervisor Development

I Early Exit Strategies

J Completion and Career

^ RST eBook

Support for this project has been provided by the Australian Government Office for Learning and Teaching. The views in this project do not necessarily reflect the views of the Australian Government Office for Learning and Teaching. Final Report

Available online at <http://researchsupervisiontoolkit.com>.

10.4.2 Improving support for supervisors

It is important that institutions recognise the value of their HDR supervisors and provide better support to them (National Comittee for Physics, Australian Academy of Science, 2015). This can be done by improving long-term career pathways for researchers and providing employment security for those involved in research training (National Tertiary Education Union, 2015). It is particularly important that supervisor support is well resourced, as stakeholders commented that without adequate support, supervision can fail very rapidly (National Tertiary Education Union, 2015). Initiatives such as well-resourced ongoing training, setting out clear promotion criteria,

recognising and rewarding effective supervision, and accommodating academic workloads would provide encouragement and support to supervisors, and ultimately lead to higher-quality supervision.

10.4.3 Consistency in the role of supervisory panels

Supervisory panels are a requirement of HDR supervision. They provide candidates with the opportunity to broaden their research skills and understanding, provide a framework for industry and interdisciplinary involvement and also enable supervisors to have a more manageable workload by sharing the commitment (Australian Council of Deans of Arts, 2015; University of

Melbourne, 2015; Association of Australian Medical Research Institutes, 2015). In addition, panels allow for complementary levels of skills and experience, several avenues of complaint resolution for candidates and enable different levels of engagement. To reduce the occurrence of one-on-one supervision, it would be worth setting guidelines on the minimal requirements of involvement from co-supervisors, including involvement at all milestones.

Another approach to providing HDR candidates with diverse supervision is through jointly awarded higher degrees by research. This approach involves candidates undertaking their HDR training at multiple universities/institutions, and therefore under multiple supervisors. It can even involve partnerships with international universities, with candidates splitting their time between their Australian university and their international university. These types of programs have a limited, but important presence currently within the Australian HDR training system.

Diverse supervisory panels are also important for HDR training involving multi- and interdisciplinary research, whether or not this includes multiple awarding universities. Multi- and interdisciplinary research is becoming increasingly important in tackling more and more complex problems. The HDR training system must be able to effectively accommodate multi- and interdisciplinary research projects.

10.4.4 Monitoring supervisor performance

Universities have a responsibility to monitor supervisor performance and drive excellence in HDR supervision through recognition mechanisms and performance management. A number of participants in the stakeholder interviews felt that research training would benefit from a national model for monitoring and accrediting supervisor quality. Monitoring supervisor performance will require institutions to improve their performance data and to develop performance measures. Performance data should be collected at not only the individual level, but also at the level of

supervisory committees. Performance measures could include candidate evaluations, completion times and rates and career outcomes of HDR graduates (Gill and Burnard, 2008), allowing for legitimate breaks for the candidate; and recognising additional benefits gained, such as candidate publications (University of Queensland, 2015). The Australian Government could work with universities to form accreditation criteria for researchers to become registered supervisors (for example, see University of Adelaide, 2015).

Performance data should be collected at the 4-digit field of research code level, to capture research training differences between disciplines. One option is to incorporate the supervision performance data within ERA. An alternative is to include measures of supervisor performance into Quality Indicators for Learning and Teaching (QILT), whereby candidates are asked questions about supervisor quality. As is discussed in Section 1 and Section 7, this data would not only assist universities, faculties and disciplines to create a clear picture on performance and develop improvement measures, it would also assist potential candidates in making an informed choice.

Benchmarks, based on national data and expectations of supervisors throughout a HDR's candidature, should be identified and implemented. Incentives, such as awards and recognition in promotion criteria, can be put in place to reward and/or acknowledge supervisors who meet or exceed these benchmarks. Monitoring supervisory quality will also help identify when supervisors are not performing, and who should either be removed as supervisors or be provided with additional training and support. There should be consequences for poor supervision, which can be embedded into a performance framework. Universities should ensure that they have a clear and non-judgemental complaints process, such as a supervisor ombudsman, for candidates who are experiencing problems with supervision. A complaints system would further assist in the collection of supervisor performance data to help monitor supervisor quality.

The Higher Education Standards Framework (Threshold Standards) provides a framework of the minimum acceptable requirements for the provision of higher education in or from Australia. The framework, which was updated in 2015, includes a section on research training and supervisory arrangements shown in Box 13.

The Australian Code for the Responsible Conduct of Research contains more detailed guidelines and standards for supervision (National Health and Medical Research Council et al., 2007). Although the Framework and the Code provide useful baselines from which to work, neither provides minimum standards or performance measures for quality supervision. The Australian Council of Graduate Research has produced best practice principles for graduate research supervision (Australian Council of Graduate Research, 2014).

Most universities already have minimum standards for HDR supervision, such as being research active and having a good track record of completions with minimal complaints. In addition, a number of institutions have developed their own mechanisms for monitoring supervisor performance.

The University of Adelaide for example has developed The Supervisor Classification and Reporting System for monitoring the quality of registered supervisors, through a ranking system. Researchers who wish to undertake HDR supervision must be approved by the university to become a registered supervisor. The system uses a 7-year measurement period and takes into account the number of completions, time taken for candidates to complete, and the number of withdrawals, appeals and complaints against a supervisor (University of Adelaide, 2015). The university sets a minimum score threshold which supervisors must meet, and if not met, are then not allowed to supervise any further candidates (University of Adelaide, 2015).

Queensland University of Technology (QUT) has also created a university-wide supervisor accreditation scheme and a schedule of quality assurance milestones (Faculty of Education QUT, 2015). Correspondingly, the University of Newcastle (2016) has embedded HDR supervision needs into its performance review. Together, these initiatives could be used as examples for developing a broad national supervisor performance model to standardise expectations, guidelines and performance measures for HDR supervision. To improve accountability of universities, universities should also be required to publicly articulate their minimum standards for a researcher to become a HDR supervisor.

Box 13: Supervision section for research training standards, in the Higher Education Standards Framework

Each research candidate is supported by continuing supervisory arrangements, including:

- A principal supervisor who holds a Doctoral degree, or has equivalent research experience, and who is active in research and publishing in, or otherwise making original contributions to, a relevant field or discipline.
- At least one associate supervisor with relevant research expertise.
- The principal supervisor is a member of the staff of the higher education provider, or has a relevant adjunct appointment, or is otherwise formally contracted and accountable to the provider for supervisory duties.

Source: Tertiary Education Quality and Standards Agency (2015).

10.5 Key finding 10

Universities have a responsibility to provide ongoing high quality HDR supervisory training, and a responsibility to act where supervisory performance falls below expected performance levels. Outstanding HDR supervision should be recognised and reinforced by universities through the application of professional standards and rewards for performance.

Section 11
Under–represented groups in HDR training

11.1 Introduction

Actively encouraging diversity within research training will produce a more equitable system, provide a greater scope for new knowledge, improve cohort experience, strengthen the research system, and will help advance Australia towards an innovative and prosperous future. This section examines the poor representation of equity groups within the research training system, with a particular focus on Indigenous participation. After consulting with stakeholders, it was clear that the low levels of participation in HDR training by Indigenous people are of significant concern within the sector.

As the recent *Closing The Gap Report* (Department of the Prime Minister and Cabinet, 2016) highlights, there is still a large gap between Indigenous and non-Indigenous people in relation to education, employment and health. Potential Indigenous HDR candidates must have the same opportunities and feel as encouraged and supported as non-Indigenous candidates. Initiatives to encourage Indigenous people to undertake HDR training would not only benefit individuals and communities, but would also have a significant benefit to the research system and the nation's prosperity and well-being.

It is important to note that this review provides greater focus on the under-representation of Indigenous people within HDR training than other under-represented groups. The Review recognised that participation levels for most under-represented groups are flat, but for Indigenous people are in decline. As such, the Review provides only brief comment on other under-represented groups. The groups that are acknowledged further on in this section include people with disability, people from low

socio-economic status backgrounds, people from regional and remote areas, culturally and linguistically diverse people, mature-age people, and off-campus and part-time candidates. There was widespread agreement in the stakeholder interviews and public forums that the research system would be greatly strengthened by recruiting and retaining HDR candidates from a more diverse range of backgrounds.

11.2 Participation and attainment of Indigenous HDR candidates

Indigenous candidates are significantly under-represented in the research training system. There is universal acknowledgement that the system is underperforming in this area and must improve. Although Indigenous people comprise 3 per cent of Australia's overall population (Australian Institute of Health and Welfare, 2015), they account for less than 1.4 per cent of HDR enrolments and approximately only 0.55 per cent of HDR completions as shown in Figure 20 (Behrendt et al., 2012). Figure 20 also shows that there is an ongoing and widening gap between Indigenous HDR commencements and completions.

Figure 21 highlights the significant disparity between the percentage of Indigenous HDR candidates compared with the entire Indigenous domestic population and the percentage of non-Indigenous HDR candidates compared with the entire non-Indigenous domestic population. A lower percentage of Indigenous people commence or continue HDR training compared with the percentage of non-Indigenous people.

The disproportion is more pronounced when focusing only on doctorate candidates and continuing candidates.

As further evidence, ratios can be used to indicate whether candidates from different equity group backgrounds are under- or over-represented in the Research Doctorate population by taking the performance indicator rate for the equity group and dividing this by an equity reference value for that indicator. Such ratios allow comparisons to be made between the equity group and a suitable benchmark. A ratio of less than 1.00 indicates poor representation, whereas ratios of 1.00 and greater indicate good representation.

Data for some under-represented groups are presented to provide an overview of the current landscape of equity group participation in Doctoral training, as shown in Figure 22. Care must be taken when looking at these data given the lower sample size of the Doctoral population when compared with the whole candidate population, and as such it is useful to look at the data over multiple years.

The participation ratio for Indigenous Doctoral candidates is poor. The sample size is small with only 54 new Indigenous Doctoral candidates commencing in 2013, and 321 candidates in total. The year in which the ratio was highest was in 2009 when there were 64 commencements, and 304 candidates in total. This shows that, although the number of Indigenous Doctoral candidates has grown in absolute terms, the participation ratio has done down (see Figure 22). In part, this

Figure 20: Indigenous HDR candidates as a proportion of all domestic HDR commencements and completions
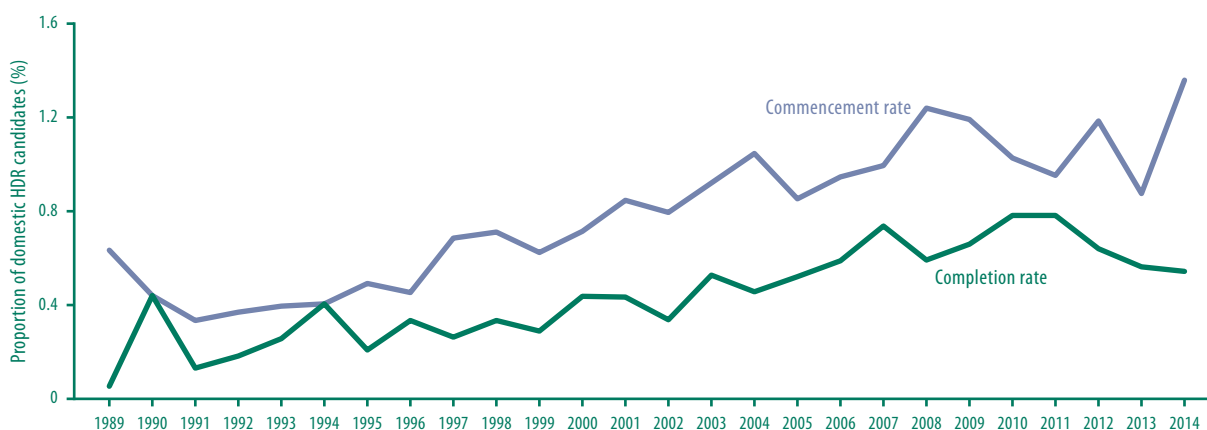
Source: Department of Education and Training (2015b).

Figure 21: Percentage of Indigenous and non-Indigenous people undertaking HDR training in 2014, as a percentage of the total Indigenous or non-Indigenous population in 2011
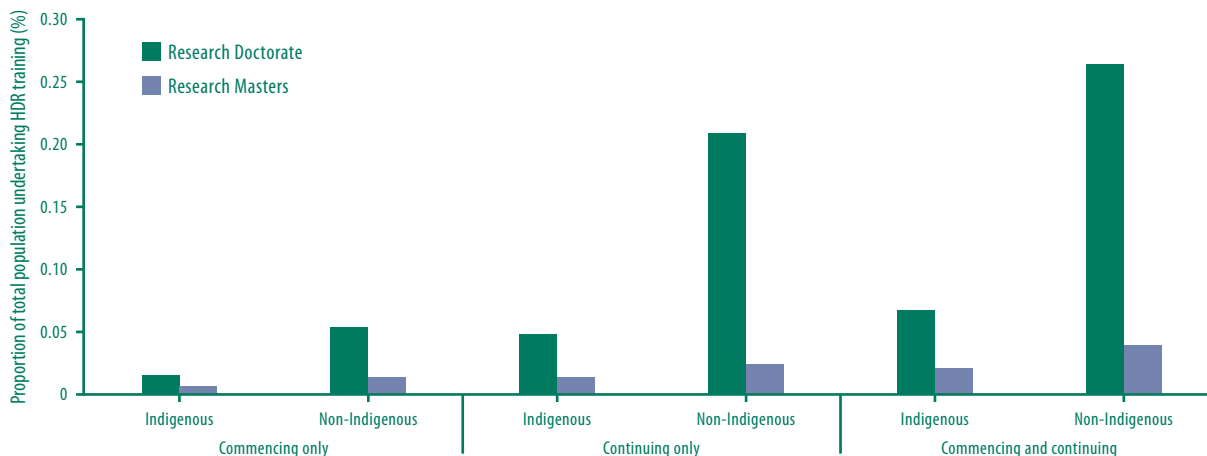
Data obtained from the Department of Education and Training (2015h) and from the Australian Bureau of Statistics (2012).

is because there has been greater growth in total Doctoral candidate numbers, and this growth is occurring at a rate which is faster than the rate of growth for Indigenous candidates. This data highlights that the gap between Indigenous and non-Indigenous research candidates is widening, contrary to the commitment by the Council of Australian Governments (COAG) to Close the Gap between education outcomes for Indigenous and non-Indigenous people (Department of the Prime Minister and Cabinet, 2016).

11.3 Key areas that affect participation and attainment of Indigenous HDR candidates

According to a report conducted by Universities Australia (2011), the number of Indigenous HDR candidates would need to increase by over 600 per cent in order to reach population parity. This increase would now need to be even greater, as the Indigenous population is growing at a faster rate than the non-Indigenous population (Australian Institute of Health and Welfare, 2015). The Universities Australia (2011) report identified that the main areas that need to be addressed to improve participation of Indigenous HDR candidates are the pipeline of incoming and graduating Indigenous HDR candidates, culturally-sensitive supervision, cohort support, cultural awareness within institutions and financial support.

11.3.1 The pipeline

A parity participation ratio for Indigenous Doctoral candidates will only be achieved if there is a strong pipeline of school and undergraduate Indigenous students. Despite increases in the overall percentage of Indigenous school and undergraduate students (Department of the Prime Minister and Cabinet, 2016), the number of Indigenous school students going on to undergraduate study and the number of undergraduate students progressing to HDR study is still disproportionality low (Department of Education and Training, 2015h; Australian Bureau of Statistics, 2012). For example, Figure 23 shows that the percentage of undergraduate students has steadily increased since 2001, for both Indigenous and non-Indigenous people. However, the discrepancy between the proportion of Indigenous and non-Indigenous candidates undertaking undergraduate studies has remained constant since 2001.

It should be noted that while most research candidates are under 30 years old (see Table 4), the majority of Indigenous candidates are older, between 35-54 years old (Department of Education and Training, 2015e). In addition, while female candidates made up 54 per cent of the entire domestic research candidate population in 2013, 65 per cent of Indigenous research candidates were female in 2014 (Department of Education and Training, 2015e).

Figure 22: Participation ratios of Australian domestic Doctoral HDR candidates from non-traditional backgrounds
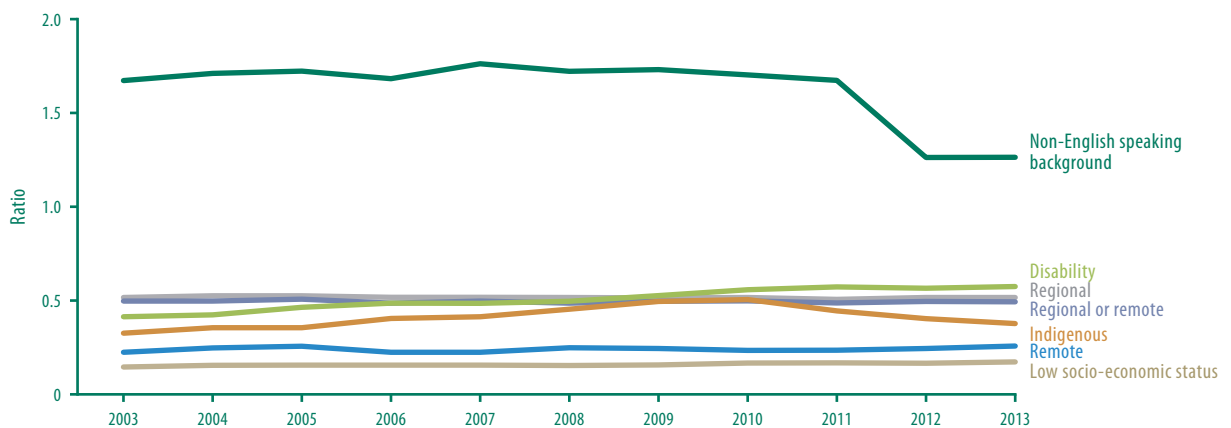
Source: Department of Education (2015) Higher Education Data Collection—custom analysis. Regional and remote is defined using the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) classification. The definition of the equity performance ratios is adapted from Department of Education and Training (2013a).

It is also important to consider the pipeline for Indigenous HDR graduates into academic roles. Indigenous people are underrepresented as employees in Australian universities at all levels (Aboriginal and Torres Strait Islander Higher Education Advisory Council, 2015). Although the proportion of Indigenous academic staff at senior levels has been trending upwards, the proportion of Indigenous lecturers (Level B) has remained relatively stable and the proportion of Level A academics has been on an overall decline since 2001 (Figure 24). Although the entire cohort of Level A academics is declining overall, as Figure 24 shows the proportion of all Level A academics, this suggests that Indigenous Level A academics are declining faster than the overall rate of decline.

11.3.2 Effective and high quality supervision

Adequate candidate supervision is crucial to a positive experience while undertaking research training. Both Indigenous and non-Indigenous candidates can experience poor quality supervision, and this can give rise to issues such as a lack of candidate support and candidate engagement in their training (see Section 10).

Supervisory needs for Indigenous candidates can differ from non-Indigenous candidates, and as such it is important for supervisors to receive appropriate training so they are equipped to support Indigenous candidates (Trudgett, 2011). As there is a relative absence of academic Indigenous role models and HDR supervisors it

Figure 23: Time series showing the percentage of domestic Indigenous and non-Indigenous people undertaking an undergraduate degree in Australia, as a percentage of the total Indigenous or non-Indigenous population respectively
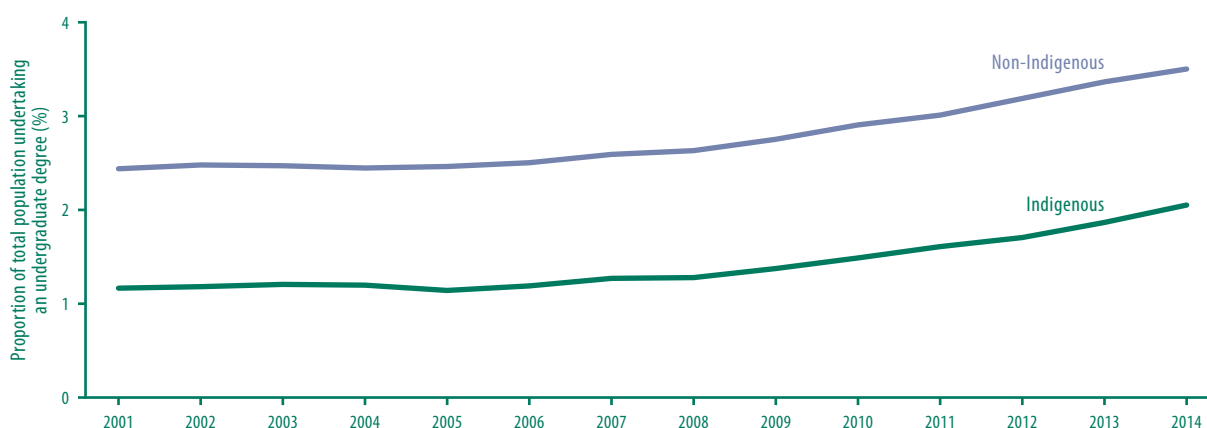
Data was obtained from the Department of Education and Training (2015h) and from the Australian Bureau of Statistics (2012).

Figure 24: Indigenous academic staff as a proportion of all academic staff at Australian universities
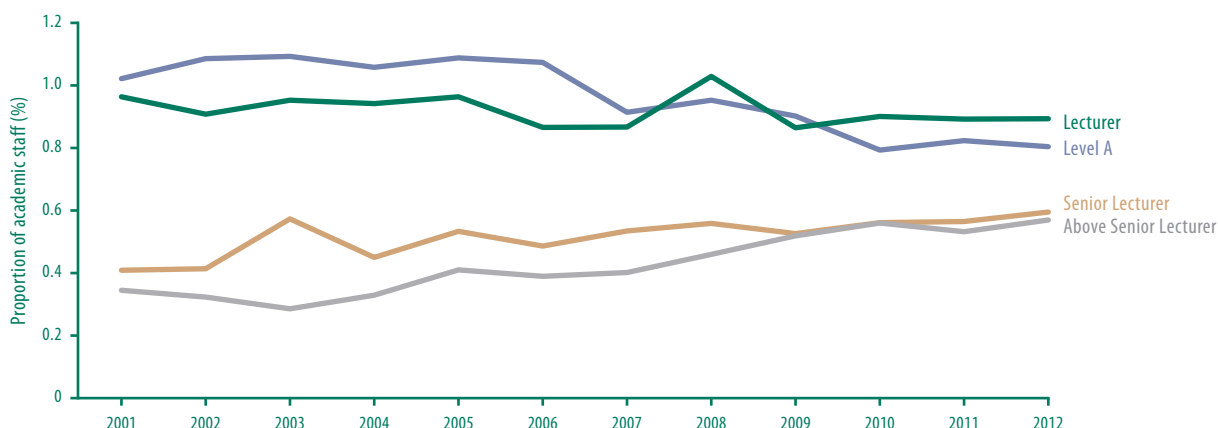
Source: Department of Education and Training (2015b).

can be difficult for Indigenous HDR candidates to find the supervisory support they need (Trudgett, 2011). Supervisors without adequate Indigenous HDR supervisory training can sometimes be ill-equipped to appreciate the merits of Indigenous research methodologies, knowledges and protocols (Queensland University of Technology, 2015). Supervisors have in the past expressed concern about the lack of guidance in their role as mentors and supervisors for Indigenous research trainees (Dunbar et al., 2004).

11.3.3 Cohort support and cultural safety

In 2011, only eight out of 38 Australian universities had processes in place to encourage research training by Indigenous staff and candidates (Universities Australia, 2011). This number has likely increased since 2011, with a number of written submissions to this review highlighting initiatives that universities have put in place to support Indigenous candidates (for example, see Queensland University of Technology, 2015; National Indigenous Research and Knowledges Network, 2015; Griffith University, 2015).

Many Indigenous candidates have a long gap between completing their undergraduate degree and undertaking research training. A great number of potential Indigenous candidates are of mature age and can often have career and family responsibilities that make taking up HDR training opportunities more difficult. Any initiatives that are implemented to encourage greater participation of Indigenous people into research training need to consider the likely mature age, background and gender of Indigenous research candidates.

Submissions to the Review of Higher Education Access stated the importance of capacity-building courses, master classes and mid-degree support to assist existing HDR candidates, and building a pipeline of candidates better equipped for HDR training (Behrendt et al., 2012). Consultations in the Behrendt et al. (2012) review showed that HDR candidates experienced a sense of isolation relating to time spent on research. Feelings of isolation can be common among all

HDR candidates, but for Indigenous candidates this can be compounded as they are often the only, or one of just a few, Indigenous HDR candidates at their institution.

Cohort support for Indigenous candidates could be improved by developing models that integrate candidate and supervisor development across a university-wide network which draws together a number of fields and disciplines (RMIT University, 2015; Flinders University, 2015).

11.3.4 Financial pressures

Financial pressures can be particularly acute for Indigenous candidates (Bexley, 2013). Often, Indigenous candidates have community and family responsibilities, some are their family's main income earner and many live in remote locations and must relocate for their studies (National Tertiary Education Union, 2015; Queensland University of Technology, 2015). Further to this, stakeholders that the Review consulted with during the stakeholder interviews and public forums stated that Indigenous professionals are highly sought after in industry, making a PhD a less attractive option. Finally, the indirect taxation of the ABSTUDY program was said by some in the stakeholder interviews to discourage prospective Indigenous candidates. The restrictive earnings capacity and exclusions of other scholarship income (see Department of Social Services, 2016) reduces the beneficial impact of ABSTUDY support. These issues can limit the financial incentive for Indigenous people to undertake research training.

11.4 Improving participation and attainment of Indigenous HDR candidates

The positive impact that Indigenous HDR candidates and graduates can have for the nation should be acknowledged and utilised. Increasing Indigenous HDR candidate numbers would result in a more equitable system, and make a significant contribution to the nation, to Indigenous communities and to individual circumstances.

Improving participation and attainment for Indigenous HDR candidates requires a series of sustained initiatives. The key areas for action identified by Behrendt et al. (2012) relate to improving supervision, improving cohort capacity building and cohort support, and using funding and policy mechanisms to improve Indigenous candidate recruitment and attainment.

11.4.1 Acknowledging Indigenous rights and culture

In making recommendations to improve participation it is important to address and reject deficit models where actions are targeted just at Indigenous HDR candidates, and instead take a rights-based additive approach. Such an approach means recognising that Indigenous HDR candidates have a right to be different, and universities need to explore ways to ensure that Indigenous people's identities, strengths and agency are recognised and respected. Establishing a representative body for Indigenous HDR candidates would support a dialogue with candidates, institutions and policy makers and provide a means for effectively implementing and managing initiatives for improving Indigenous HDR participation. Indigenous HDR candidates are a significant national asset, in terms of their cultural, economic, social, academic and applied benefit, and their contribution must be recognised and valued.

11.4.2 The pipeline

The provision of pathways into diverse careers within research can be facilitated through working with faculties, academics, Indigenous centres, Indigenous institutions and community groups (National Aboriginal and Torres Strait Islander Higher Education Consortium, 2015; Curtin University, 2015b). Indigenous academics from faculties and institutions can be utilised to act as role models and promote the benefits of HDR training to prospective Indigenous candidates. In particular, to help produce a sustainable pipeline of Indigenous research candidates more effort needs to be undertaken to identify and nurture high-achieving Indigenous undergraduates and to promote research careers to Indigenous students.

Many Indigenous organisations, including NIRAKN (2015) have developed their own programs and activities to attract and retain potential Indigenous HDR candidates. However, they have limited time and funding; NIRAKN's funding finishes at the end of 2016, the Lowitja Institute Cooperative Research Centre in June 2019 and the Aboriginal and Torres Strait Islander Higher Education Advisory Council, which was established in 2012 to provide Indigenous higher education policy advice to the government was abolished in December 2015. Continuity of Indigenous organisations is critical to achieving higher attainment and retention of Indigenous research candidates (Behrendt et al., 2012).

Outreach programs in communities are needed to show Indigenous Australians that undertaking a research degree is worthwhile. The support of the community and family of the Indigenous candidate is an important stimulus to Indigenous HDR participants. New Zealand, for example, utilises a range of engagement initiatives that are directed towards the community, to show the value of research training. An Australian example of effective Indigenous community engagement is from the Australian Football League (AFL), which has developed a range of outreach programs (Australian Football League, 2016). As a result, 9 per cent of all AFL players are Indigenous, significantly higher than the total population percentage of Indigenous people (3 per cent). A nationwide approach that learns from, utilises, and enhances existing initiatives would have a significant long-term impact on creating a sustainable pipeline of Indigenous HDR candidates.

When making recommendations, it is vital to look at the entire pipeline, to consider how the sector can develop better pathways into the research training system and result in sustainable academic careers. A number of participants in the stakeholder interviews illustrated the value of engaging with industry, to develop partnerships and collaborative career opportunities for Indigenous HDR candidates. For example, as the health sector is the biggest employer of Indigenous people, partnerships could be established between a university, local health or medical service and a local Indigenous community.

Further to this, engaging with Indigenous professionals, who are looking to move out of professional practice, would further improve participation and attainment of Indigenous HDR candidates. Research fields within education, health sciences and visual and performing arts have the potential to obtain high-performing and experienced Indigenous candidates if the right support structures are put in place. Measures such as allowing for flexibility of entry pathways and recognising professional practice in the selection process would encourage Indigenous professionals to pursue careers within research. There needs to be an emphasis on awareness of research as a career choice, and adequate funding, to encourage Indigenous people to undertake research training through HDR education.

11.4.3 Improving supervisory experience

The pool of Indigenous supervisors required for effective supervision of Indigenous candidates needs to increase. Supervisors from outside of universities may be required to meet the needs of Indigenous research candidates (Macquarie University, 2015b). Incidents of poor quality supervision can be minimised by improving peer networks with other supervisors to share learnings and approaches. In addition, training in Indigenous research methodologies and the ethics of working with Indigenous people and communities should be made mandatory for all researchers who are on the supervisory panel of an Indigenous HDR candidate or for a candidate working in Indigenous research or in an Indigenous community. Optional cultural competence training should be made available to all supervisors. Supervisory training will help build the pool of supervisors who can effectively supervise Indigenous research candidates undertaking Indigenous related research (Trudgett, 2011). The number of non-Indigenous supervisors is much higher than the number of Indigenous supervisors, and training will enable supervisors to think about the ways they teach and supervise candidates, and to reflect on their own biases (Trudgett, 2011).

The Lowitja Institute has developed a comprehensive guide: *Supporting Indigenous researchers: a practical guide for supervisors* (Laycock et al., 2009).

The guide describes good supervision of emerging Indigenous researchers, including:

• regular professional supervision of the research

• awareness of the issues that are specific to being an Indigenous researcher researching Indigenous knowledge and worldviews

• working relationships based on reciprocity and two-way learning

• use of practical, culturally safe strategies to support Indigenous researchers

• one-on-one guidance and development based on individual background, strengths and skills

Laycock et al. (2009)

More recently, a framework for best practice supervision of Indigenous Doctoral candidates has been developed by Trudgett (2014), as shown in Figure 25.

Behrendt et al. (2012) recommends that universities incorporate Indigenous HDR supervision within their internal training for HDR supervisors, and where appropriate consider using flexible co-supervision arrangements for Indigenous supervisors who are not necessarily academic staff. Institutions are becoming more mindful of the cultural issues faced by Indigenous HDR candidates and many have developed their own cultural awareness programs. For example, the Graduate Research School at the University of Technology Sydney (UTS) runs Indigenous ethics and supervision workshops as part of their supervisor training schedule (National Aboriginal and Torres Strait Islander Higher Education Consortium, 2015). This, along with other measures including the provision of scholarships and internships, has resulted in a substantial increase in the number of Indigenous HDR candidates at UTS (University of Technology Sydney, 2015).

Figure 25: Framework for best practice supervision of Indigenous Doctoral candidates

Encourage the candidate to publish and assist accordingly.

Encourage confidence in the student through a personalised approach.

Emphasise the importance of academic rigour and support the student with necessary skills and training to ensure that this is achieved

Provide constructive criticism that is open and honest.

Schedule regular meetings.

Provide thoughtful feedback.

Commit to the student.

Academic skills-based support from supervisor

Personal reflection of supervisor

Prioritise the relationship with the student (develop rapport).

Acknowledge Indigenous Australians as respected knowledge holders.

Reflect on own position of power.

Be flexible in terms of community or family commitments.

Understand external pressures placed on students.

Be culturally sensitive.

Be respectful to student.

Acknowledge importance of kinships.

Acknowledge the impact that colonialism has had on Indigenous Australians.

Provide peer networking opportunities for Indigenous students.

Publish a handbook that informs Indigenous doctoral students about the process and procedures governing doctoral studies.

Ensure that all Indigenous students have information about national initiatives that will support their research capacity—most notably the National Indigenous Research & Knowledge Network, and the Indigenous Studies Research Network.

Responsibilities of national bodies

Responsibilities of the university

Be open to involving community members in an advisory role (and recompense them for their time).

Be aware that Indigenous students may have preferences in terms of supervisor's gender and cultural background.

Provide experienced and appropriate supervisors.

Ensure the supervision is culturally appropriate.

Create an environment where Indigenous students can feel safe and comfortable.

Provide excellent resources to give the best opportunity for success.

Source: Trudgett (2014).

11.4.4 Improving cohort support and capacity building

One approach for dealing with feelings of isolation in Indigenous candidates is introducing a requirement that all research graduates undertake training in Indigenous methodologies, and ethical requirements for working with Indigenous peoples and communities (National Aboriginal and Torres Strait Islander Higher Education Consortium, 2015).

The Behrendt et al. (2012) Review noted how, in New Zealand, a key part of support for Māori and Indigenous HDR candidates is through the Māori and Indigenous program, which builds capacity of these candidates while providing a means to connect with the candidate cohort nationally. The success of this program is demonstrated by the increasing numbers of Māori and Indigenous New Zealanders with Research Doctorates in the past 20 years (Behrendt et al., 2012).

The ARC-funded National Indigenous Research and Knowledges Network (NIRAKN) is working to address many of the problems faced by Indigenous researchers and has established a national research capacity building program. The program builds the capacity of Indigenous researchers to succeed across all career stages through mentoring, training and providing opportunities to undertake cross-institutional and multidisciplinary research that will benefit communities (Australian Research Council, 2015b). This program alone cannot overcome the deficiencies in Indigenous research capacity across the country, and it is noted that there are few dedicated research capacity building initiatives being offered by universities (National Indigenous Research and Knowledges Network, 2015). Addressing these issues will require resources to be directed towards Indigenous research capacity building, including at the HDR level. There are different ways to achieve this, which could include taking up the recommendations in the Behrendt (2012) report and through targeted research training programme funding for Indigenous HDR programs and activities (University of Newcastle, 2015).

The Australian higher education system is beginning to advance from a model that focuses on enabling recruitment and building participation of Indigenous candidates, to a holistic organisational structure that focuses on the involvement of specialist Indigenous centres to support candidates. Australian models for overcoming isolation of Indigenous HDR candidates include the NIRAKN (2015) Postgraduate Network, the Lowitja Institute (2016), Indigenous Studies Research Network at the Queensland University of Technology (2015), the Innovative Research Universities (IRU) Aboriginal and Torres Strait Islander HDR Network (Flinders University, 2015) and The University of Melbourne's Graduate Certificate in Indigenous Research and Leadership (University of Melbourne, 2009). These networks aim to address the underrepresentation of Indigenous candidates in the HDR population. By developing a cohort of Indigenous HDR candidates, the models provide supportive networks of candidates, staff and resources additional to the support already in place for candidates (Innovative Research Universities, 2015; Queensland University of Technology, 2015).

11.4.5 Policy and funding support

Specific and sustained funding for Indigenous research training and clear accountability to targets would help to improve the number of Indigenous people commencing and completing research degrees (National Aboriginal and Torres Strait Islander Higher Education Consortium, 2015). Any changes to policy and funding should allow for flexibility in the system, but also include a performance metric regime, to ensure accountability.

Increasing scholarship amounts

Income support for Indigenous HDR candidates should be expanded to alleviate the financial pressures and disadvantages that many Indigenous people face. The majority of Indigenous candidates mature female candidates who can have substantial financial responsibilities and would need to step out of their careers to undertake a research training degree. Within the stakeholder interviews participants stated that

the current scholarships are inadequate to cover the living expenses of Indigenous candidates. Furthermore, a review of ABSTUDY is needed, to consider if the conditions of ABSTUDY should align with APA scholarships. Removing or alleviating current earnings and exclusions from other scholarship support will make research training a more attractive option for Indigenous people (see National Indigenous Research and Knowledges Network, 2015).

Many universities now provide scholarships for Indigenous research candidates. For example, University of Technology Sydney (2015) offers a Doctoral scholarship and a university top up to $50,000 per annum. There was a general consensus from participants in the stakeholder interviews and public forums that the value of stipend scholarships should be increased (see also Centre for the Advancement of Indigenous Knowledges, 2015). This could work by allocating a portion of the Australian Government's investment in research training for Indigenous HDR candidates.

A popular suggestion with stakeholders during consultations was that there should be funding for new academic positions for high potential and high performing Indigenous HDR candidates. Such positions would support candidates to take on more of a faculty role while undertaking their HDR training. A number of stakeholders highlighted that academia often misses out on prospective high-achieving Indigenous research candidates, owing to the more financially secure and stable long-term career options outside academia (Macquarie University, 2015b). Thus, a scholarship specifically for Indigenous candidates that ran for 5 years would provide an opportunity to build a career and to be treated as an academic staff member. Candidates would then be offered a competitive salary, similar to an entry-level academic salary, and would be given opportunities for mentoring and teaching.

Weighting funding

The proposal to weight Indigenous completions within the research training block grants at a higher value was viewed as an idea that has considerable merit (Aboriginal and Torres Strait Islander Higher Education Advisory Council,

2015). Increasing completion funding by three times for Indigenous HDR candidates would encourage university support for the recruitment and retention of Indigenous HDR candidates (Queensland University of Technology, 2015). The weighting of the research training block grants would leverage institutional action and commitment, provide an incentive for completions, and recognise the greater investment required to support Indigenous completions compared with other research candidates. The additional investment could, for example, be applied to university-wide Indigenous support programs, additional research training scholarships, bursaries to supplement stipends, support for fieldwork, accommodation support and supervisor training.

A similar mechanism was established in 2002 by the Australian Government, called the Primary Health Care Access Program (PHCAP). PHCAP loaded additional funding for Medicare by taking into account the barriers that restricted access to healthcare for Indigenous people, such as remoteness, poverty and cultural and social issues (McDonald, 2003). Although the program was discontinued, it was seen as one of the most effective measures that addressed Aboriginal and Torres Strait Islander health inequalities (Rosewarne and Boffa, 2004). Weighting funding in this way would give greater recognition of additional challenges to recruitment and the additional resources that might be needed to enhance Indigenous HDR research training experiences.

New Zealand implemented a similar approach for improving participation from Māori people, and it was suggested that increased weighting for Indigenous candidates in the funding formulae would be an effective option for the Australian system (RMIT University, 2015). In the New Zealand approach, the university funding program encourages universities to recruit Indigenous candidates by doubling completion income if the candidate is Māori (Australian Council of Graduate Research, 2015). New Zealand universities consulted during this review highlighted that weighting Māori completions forced universities to focus on the issues faced by Māori candidates, which in turn encouraged

cultural change throughout the system. If such a model is introduced in Australia, the additional funds that universities receive through research training block grants for Indigenous completions should be reinvested to support Indigenous candidates.

Setting targets

Setting ambitious but realistic targets for increasing Indigenous HDR candidate numbers is seen by stakeholders that the review consulted with as a positive towards achieving equity in the system. Targets need to be set at both the institutional and system level, with institutional targets on Indigenous recruitment and completion being tied to weighting of funding. Targets for Indigenous participation have already been set across a range of areas, including that by 2018, 3 per cent of all Australian Government employees must be Indigenous. Setting a similar target for Indigenous HDR candidates is practicable, as long as clear actions to achieve the goal are set out and implemented.

Most Closing the Gap targets for improving Indigenous education and health are not being met (Department of the Prime Minister and Cabinet, 2015). The limited progress towards meeting these targets highlights the need for well thought-out and managed actions and implementation programs. The Behrendt et al. (2012) Review recommended that targets be agreed between the Australian Government and universities for the increased participation of Indigenous HDR candidates. To ensure effectiveness of these targets, research training program funding could be allocated to universities based on their agreed target to support Indigenous HDR training. Furthermore, the viability of targets would depend on universities articulating their strategies for achieving targets and regularly reporting on achievements (Behrendt et al., 2012).

Providing flexibility and incentives for candidates and institutions

There was agreement that the system needs more flexibility, to encourage and support Indigenous people in undertaking a research degree (National Indigenous Research and

Knowledges Network, 2015; Macquarie University, 2015b; Griffith University, 2015; Australian National University, 2015; Centre for the Advancement of Indigenous Knowledges, 2015). The APA allocation process can place potential high-quality Indigenous candidates at a disadvantage, as many have not previously had the opportunities to succeed in a high quality education environment. It is therefore important to ensure that flexible entry pathways are in place (National Aboriginal and Torres Strait Islander Higher Education Consortium, 2015).

Other areas where support for Indigenous candidates could be improved include making ABSTUDY more flexible so it provides more effective support to postgraduate research candidates (National Indigenous Research and Knowledges Network, 2015). The value of ABSTUDY should align with future APA scholarship amounts, so that candidates who are not in receipt of a research training program scholarship are not disadvantaged (Aboriginal and Torres Strait Islander Higher Education Advisory Council, 2015).

Finally, the stringent requirements associated with cross-institutional completion funding for research block grants should be made more flexible to enable multi-institutional supervision arrangements to be developed for Indigenous candidate and projects (National Indigenous Research and Knowledges Network, 2015). Flexible co-supervision arrangements would provide Indigenous candidates with valuable support from relevant Indigenous experts for their thesis (Behrendt et al., 2012) and would ease cultural issues that Indigenous candidates experience, especially when they have no Indigenous mentors at their university.

11.5 Other under-represented groups

11.5.1 Participation and attainment of other under-represented groups

As was shown in Figure 22, other equity groups that are under-represented in the research training system include:

- People with disability
- Low socio-economic backgrounds
- People from regional and remote areas
- People from a non-English speaking background

Participation by candidates from a non-English speaking background is good, with ratios well above 1 for most of the reporting period, but with a notable decline in the last two years (Figure 22). Participation by Doctoral candidates with a disability increased steadily over the reporting period, whereas participation by people from low socio-economic backgrounds and people from regional and remote areas remained more or less steady over the past decade (Figure 22).

Further to these under-represented groups it is important to consider gender imbalances, as well as disadvantages faced by mature age, off-campus and part-time students. A greater proportion of domestic HDR candidates are female, whereas a greater proportion of international HDR candidates are male (see Table 14). Over the last 10 years there has been a notable increase in the proportion of domestic female HDR candidates, with women now in the majority at 54 percent of all candidates. Over the same period there has been a slight increase in the proportion of international female HDR candidates, up to 42 per cent.

Table 14: Gender distribution of HDR candidates

		Percentage of enrolled HDR candidates		
		2003	2008	2013
Domestic	Male	49	47	46
	Female	51	53	54
Overseas	Male	60	57	58
	Female	40	43	42

Source: Department of Education and Training (2015h).

Although overall more women than men undertake research training, the number of women within the research workforce is significantly reduced by the time a senior level is reached. Currently women hold only 17 per cent of senior academic positions in Australian universities and research institutions (Australian Academy of Science, 2015; SAGE, 2016). The loss of these highly-trained women in research is a waste of expertise, talent and investment, and impacts on performance and productivity of the research system.

From these figures it can be concluded that women could be seen as under-represented candidates for information technology, engineering and related technologies, whereas men could be seen as under-represented candidates in health and education.

11.5.2 Barriers for other under-represented groups

Financial pressures are said to be the greatest barrier for participation by under-represented groups (Queensland University of Technology, 2015; University of Notre Dame Australia, 2015). The current system of support disadvantages part time candidates, as APAs are generally offered on a full-time basis except in restricted circumstances, as part-time stipends potentially incur a tax

liability for the recipient when combined with other income. The current arrangements act as a disincentive to participation from under-represented groups because part-time stipends are most likely to be taken up by those with parental and caring responsibilities, particularly women, and mature age candidates (University of Melbourne, 2015; Australian Mathematical Sciences Institute, 2015), people with disabilities, or those with caring responsibilities (Regional Universities Network, 2015).

11.5.3 Improving participation and attainment of other under-represented groups

Together, the findings on under-represented groups highlight the need for a flexible research training system, which does not discriminate and encourages participation from people from all backgrounds.

To improve access to research training, dedicated scholarships should be made to candidates from under-represented groups (National Tertiary Education Union, 2015; Southern Cross University, 2015), and more adequate stipends could be provided for mature candidates or those with dependents (Australian National University, 2015). Alternatively, recognising that different candidates have different financial needs,

Table 15: Gender distribution of HDR candidates by broad Field of Education

Field of Education	Proportion of enrolled HDR candidates (%)	
	Male	Female
Natural and physical sciences	52	48
Information technology	71	29
Engineering and related technologies	74	26
Architecture and building	52	48
Agriculture environmental and related studies	51	49
Health	36	64
Education	34	66
Management and commerce	54	46
Society and culture	42	58
Creative arts	43	57
Total	49	51

Source: Department of Education and Training (2015g).

support could be provided through customised support packages (Deakin University, 2015). Such initiatives would either require further investment or diverted investment, and it is remarked in one submission that if the Government values increased participation by candidates from equity groups it should provide additional resources (Regional Universities Network, 2015).

Programs such as the Science in Australia Gender Equity program which is designed to improve gender equity and diversity in Science, Technology, Engineering, Mathematics and Medicine (SAGE, 2016), could be further developed and expanded across disciplines, and to promote diversity in the research training system. Other specific mechanisms suggested for improving participation by candidates from under-represented groups included providing candidates with academic skills preparation, strong mentoring, and building cohort approaches to avoid feelings of isolation (Deakin University, 2015).

11.6 Key finding 11

Indigenous researchers have much to offer the nation and their communities, but participation by Indigenous candidates in HDR training and employment of Indigenous people remains low. Targets and specific measures, such as increased weighting for Indigenous HDR completions through the Research Training Scheme block grant, have the potential to acknowledge the value to the nation and the universities of Indigenous participation in HDR training. Incentives are also needed to support the training of Indigenous HDR candidates such as higher value stipend scholarships and real-wage competitive fellowships. To ensure accountability, performance outcomes of targets and measures should be regularly reported. Increasing Indigenous participation in HDR training will require the pipeline of Indigenous high school and undergraduate students to be strengthened. Providing a welcoming, supportive and culturally safe environment, including culturally competent and high quality supervision, would help to create a positive university experience for Indigenous HDR candidates.

Expert Working Group

John McGagh FTSE (Chair)

John McGagh has over 35 years of industrial experience spanning a range of commercial and technical Global roles. He currently serves as Chief Digital Officer for the Snowy Hydro energy group and most recently served as Head of Innovation for Rio Tinto. John is recognised for pioneering the introduction of advanced technologies spanning robotics, remote operations, big data modelling and decision support into the industrial landscape in order to significantly improve performance outcomes. John most recently served as the Australian Chair of the Institute of Chemical Engineers and serves as Vice President IChemE. He is a fellow of Australian Academy of Technology Science and Engineering and an adjunct professor in the University of Queensland Sustainable Minerals Institute.

Professor Helene Marsh FAA FTSE (Deputy Chair)

Helene Marsh is Distinguished Professor of Environmental Science and Dean, Graduate Research at James Cook University. Her research group focuses on the ecology and conservation biology of tropical coastal marine megafauna, especially dugongs, and includes ecological research on life history, reproductive ecology, population dynamics, diet, distribution, abundance and movements. This research has been instrumental in advancing the scientific understanding and management of coastal marine megafauna in the global topics, including the Great Barrier Reef World Heritage Area. Her research, which is strongly cross-disciplinary and problem-focused, has contributed to policy outcomes in Australia and other tropical countries and has been recognised by several international awards. Helene is also Australia's longest serving Graduate Dean (since 1994) and has served two terms as convenor of the Australian Council of Dean and Directors of Graduate Studies (2003–04 and 2010–11). She has supervised or served on the advisory committees of 54 completed PhD students, 13 Masters by Research students, 5 Masters of Applied Science students, and 20 other students at Masters, Honours and Graduate/Postgraduate Diploma level.

Professor Mark Western FASSA (Deputy Chair)

Mark Western is Director of the Institute for Social Science Research (ISSR), at The University of Queensland, and a Fellow of the Academy of Social Sciences in Australia. Mark is a sociologist whose research covers a number of topics including inequality and socioeconomic disadvantage, social science methodology, sociology of education, and social networks and social wellbeing. He is a Chief Investigator on the ARC Centre of Excellence for Children and Families Over the Life Course and has a number of other research projects involving partners in government and the community sector. Mark was Deputy Chair of the Steering Committee for the joint Academies of Humanities and Social Sciences project, Mapping the Humanities, Arts and Social Sciences in Australia, and was also a member of the Steering Committee for the ATSE project, Research Engagement for Australia.

Professor Michael Barber FAA FTSE (Program Steering Committee Chair)

P Professor Michael Barber retired as Vice-Chancellor of Flinders University in 2014 after over twenty-five years in senior executive roles in universities and CSIRO. Educated at the University of New South Wales and Cornell University in the USA he is internationally recognised for research in statistical mechanics, material science and computational mathematics and has made important contributions to the development of Australian science and innovation policy. Currently he chairs the Program Steering Committee for the public policy research program, Securing Australia's Future, being managed by the Australian Council of Learned Academies. He is an adjunct professor in the UTS Business School and serves on several boards including chairing the Advisory Board of the National Computational Infrastructure.

Professor Majella Franzmann FAHA

Professor Franzmann was Pro-Vice Chancellor Humanities at Curtin University from 2010–15, after previous positions as Associate Dean (Research) and Chair of Academic Board at the University of New England (2004–06), and Pro Vice-Chancellor Humanities and Professor of Religious Studies at the University of Otago (2008-early 2010). She gained her PhD at the University of Queensland in 1990 and while a

Doctoral student spent time at the University of Tübingen on a German Academic Exchange Service (DAAD) scholarship. After receiving her Doctorate she was the recipient of a Humboldt Fellowship at the same university from 1992–93, and renewed her Fellowship in 1995 and in 2007. She has worked as a sole researcher or as a member of research teams on four Australian Research Council Discovery Grants (1996–98; 2000–02; 2002–04; 2005–09). She has been a member of several academic assessment panels, including for the accreditation of Australian undergraduate and postgraduate courses in Theology (1993–2007), for the Australian Research Council (1998–2007), and for the Excellence in Research for Australia research assessment exercise (ERA; 2010 and 2012). She has authored or co-authored eight books and monographs and published over 50 journal articles and book chapters.

Professor Franzmann was elected a Fellow of the Australian Academy of the Humanities in 2001. In 2003 she was awarded the Australian Centenary Medal for services to Australian society and the humanities in philosophy and religion. She served on the Council of the Australian Academy of the Humanities in 2007, and in 2010 was elected as Head of the Academy Section for Philosophy, Religion and the History of Ideas. In 2013 Professor Franzmann was elected as a member of Council for a term of three years.

Emeritus Professor Cindy Gallois FASSA

Professor Cindy Gallois is Emeritus Professor of Psychology at the University of Queensland. She served as Executive Dean of the Faculty of Social and Behavioural Sciences (2008–09, Deputy Executive Dean 2006–07), and was Associate Dean (Research) from 2003–07. Professor Gallois was founding Director of the Centre for Social Research in Communication from 2002–05, after finishing her term as President of the UQ Academic Board (1998–2000; Deputy President 1997). Her research focuses on intergroup language and communication, especially in health, organisational, and intercultural contexts; she has published more than 200 articles, chapters, and books on these topics, as well as supervising 40+ PhD students in psychology, health, communication, and related disciplines to successful completion. Over the past 20 years, she has contributed to the development and extension of Communication Accommodation Theory, the leading theory of intergroup communication, in these contexts.

Professor Stephen Garton FAHA FASSA

Professor Stephen Garton was appointed as the Provost and Deputy Vice-Chancellor of the University of Sydney in August 2009. He is a graduate of the University of Sydney (BA) and the University of NSW (PhD) and is a Fellow of the Australian Academy of the Humanities, the Academy of Social Sciences in Australia and the Royal Australian Historical Society. Together with the Vice-Chancellor, Professor Garton is responsible for the general management of the University of Sydney, provides strategic leadership for the delivery of the academic programs of the University, is responsible for the general performance of the faculties, and

oversees the conduct, coordination and quality of the programs and the planning of their future development.

Professor Garton's area of research expertise is Australian history, although he has also published extensively in the fields of American and British history, and the history of psychiatry, crime, poverty, social policy, eugenics, policing, masculinity and returned soldiers. More recently he has published on the history of parole in the American South and the emergence of criminal psychiatry in New York State.

Professor Garton has been a member of the Editorial Board of the Australian Dictionary of Biography, the Executive Committee of the Australian Historical Association and on the Council of the Australian Academy of the Humanities. He was a Steering Committee member on the Mapping the Humanities, Arts and Social Sciences in Australia project and in 2009 was the National Academies Forum (NAF) representative on the Research Workforce Strategy Reference Group, a high-level reference group formed to advise the then Government on higher degree HDR training.

Professor Jim McCluskey FAA FAHMS

Jim McCluskey trained in Perth as a physician and pathologist before working at the National Institutes of Health (US). Periods at Monash University, Flinders University and the Australian Red Cross Blood Service preceded him taking a Chair in Microbiology and Immunology at the University of Melbourne in 1997. He has held positions as Associate Dean (Research) in the Faculty of Medicine Dentistry and Health Sciences, Pro Vice Chancellor Research Partnerships. He is currently Deputy Vice Chancellor Research and Redmond Barry Distinguished Professor at The University of Melbourne. He has published more than 300

scientific articles on how genes control immunity. He received the Parr Prize from the Australian Rheumatism Association; the Rose Payne Medal from the American Society for Histocompatibility and Immunogenetics; Ceppellini Award from the European Federation of Immunogenetics; an Australian Museum Eureka Award; the International Roche Organ Transplantation Fund Recognition Prize for Excellence in Organ Transplantation Research; and the GSK Research Excellence Award. He has previously been a director on two CRC Boards, the Burnet Institute, Florey Institute for Neuroscience and Mental Health, and St Vincent's research Institute. He is currently a director of the Walter & Eliza Hall Medical Research institute, the Bionics Institute, UoM Commercial, Nossal Institute Ltd, the Victorian Comprehensive Cancer Centre and Australian Friends for ASHA for Slums Ltd. He has consulted for the Australian Red Cross Blood Service for more than 20 years. He was Editor-in-Chief of the journal *Tissue Antigens* for 15 years and Past President of the Australasian Society for Immunology; Australia Pacific Histocompatibility and Immunogenetics Association and the International Histocompatibility Workshop Group. He has recently led the development of the $207M Peter Doherty Institute for Infection and Immunity, a joint venture between The University of Melbourne and Melbourne Health. His former research students work in industry, academia, publishing, IP law, commercialisation and research management.

Professor Robyn Owens FTSE

Robyn Owens is the Deputy Vice-Chancellor (Research) at the University of Western Australia, where she has responsibility for research policy development and general oversight of the University's research activities, postgraduate education, industry liaison, intellectual property and commercialisation.

Through her previous role as Pro Vice-Chancellor (Research & Research Training) at the University of Western Australia (UWA), Professor Owens led the development and HDR training of over 1900 research students. Prior to taking up that position, she was Head of the School of Computer Science & Software Engineering at UWA.

Professor Owens is recognised widely for her scholarship, for her productive collaboration with researchers and practitioners from other disciplines and for her leading contribution to system-wide excellence in research and research policy.

Project Managers

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Australian Academy of Technology and Engineering

Dr Peter Thomas
Research Manager
Australian Academy of Science

Dr Matt Wenham
Executive Manager, Policy and Projects
Australian Academy of Technology and Engineering

Evidence gathering

Stakeholder consultations

The Review conducted two major rounds of stakeholder consultation, comprising a call for written submissions and a series of workshops and interviews conducted in major capital cities around Australia. This was supplemented with numerous phone conversations and other stakeholder meetings. The Review also consulted closely with Dr Ian Watt during the conduct of the parallel *Review of Research Policy and Funding Arrangements*.

Written submissions

The Review received 80 written submissions during its call for input in August 2015. These can be accessed at <www.researchtrainingreview.org.au>. Six of these submissions were confidential.

List of submissions received

Association of Australian Medical Research Institutes

Australasian Council of Deans of Arts, Social Sciences and Humanities

Australian Academy of Health and Medical Sciences

Australian Academy of the Humanities

Australian Anthropological Society

Australian Business Deans Council

Australian Catholic University

Australian Council of Deans and Directors of Creative Arts

Australian Council of Engineering Deans

Australian Council of Graduate Research

Australian Mathematical Sciences Institute

Australian Medical Association

Australian National Data Service

Australian National University

Australian Research Council

Australian Technology Network of Universities

Bruce Chapman

Centre for the Advancement of Indigenous Knowledges, University of Technology Sydney

Centre for the Study of Research Training and Impact (SORTI)

Charles Sturt University

College of Arts and Social Sciences, Australian National University

Cooperative Research Centre for Mental Health

Council of Australian University Librarians

Council of Private Higher Education Providers

CRC Association

Curtin University

Deakin University

Defence Science and Technology Group Department of Defence

Early- and Mid-Career Researcher Forum

Faculty of Education, Queensland University of Technology

Flinders University

Griffith University

Innovative Research Universities

James Cook University

La Trobe University

Macquarie University

Margaret Kiley

MATRIX and ARC Centre of Excellence for Mathematical and Statistical Frontiers

Minerals Council of Australia

Monash University

National Aboriginal and Torres Strait Islander Higher Education Consortium

National Committee for Physics, Australian Academy of Science

National Indigenous Research and Knowledges Network

National Tertiary Education Union

Nigel Palmer

Paul Giles

Per Davidsson

Pharmaceutical Society of Australia

Queensland University of Technology

QUT Dean of Creative Industries

Regional Universities Network

Research Australia

RMIT University

School of Economics and Finance, Queensland University of Technology

Simon Barrie

Southern Cross University

The Council of Australian Postgraduate Associations

The Group of Eight Australia

The University of Newcastle

The University of Notre Dame Australia

The University of Queensland

The University of Sydney

Universities Australia

University of Canberra

University of Melbourne

University of Melbourne Graduate Student Association

University of South Australia

University of Tasmania

University of Technology Sydney

University of Western Australia

University of Wollongong

UNSW Australia

Victoria University

Western Sydney University

Consultation workshops

Consultation workshops were held through October and November 2015 in Adelaide, Melbourne, Brisbane, Perth, Canberra, and Sydney, as well as at the Universities Australia meeting of Deputy Vice Chancellors of Research, and the Australian Council of Graduate Research annual conference.

List of workshop attendees

Adelaide

Malcolm Bond
Flinders University

Pat Buckley
The University of South Australia

Emily Davis
Office of Graduate Research,
Flinders University

Nel Duffield
University of Adelaide

Donna Gould
University of Adelaide

Karen Jacobs
Flinders University

Rebecca Law
Australian Technology Network

Diane McInnes
The University of Adelaide

Ashleigh Merriel
Flinders University

Kelsey Newell
The University of South Australia

Mary O'Connor
University of Adelaide

Sharon Scott
The University of South Australia

Paul Ward
Flinders University

Paul Wilkins
University of Adelaide

Melbourne

Rebekah Bailey
Federation University Australia

Athena Bangara
Swinburne University
of Technology

Madhu Bhaskaran
RMIT University

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The University of Melbourne

Helen Borland
Victoria University

Alex Boussioutas
The University of Melbourne

Terry Bowditch
Australian Government,
Department of Education
and Training

Adrian Carter
Monash University

Denise Cuthbert
RMIT University

Amanda Davis
The University of Melbourne

Emily De Rango
The University of Melbourne
Graduate Student Association

Alan Dench
The University of Western
Australia

Karen Farquharson
Swinburne University

David Goodman
The University of Melbourne

Jasonne Grabher

Sabine Hammond
The Australian Psychological
Society

Carolyn Johnstone
Federation University Australia

Conor King
IRU

Jen Kwok
NTEU

Alison Lewis
The University of Melbourne

Michelle Lopez
Monash University

Tim Lynch
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Geoff Prince
AMSI

Margaret Robertson
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The University of Melbourne

Dick Strugnell
The University of Melbourne

Monica Wehner
Monash University Institute
of Graduate Research

David Williams
Williams Deane

Wendy Wright
Federation University Australia

Brisbane

Wendy Abbott
Bond University

Sarah Baker
Griffith University

Sue Berners-Price
Griffith University

Andrea Bishop
Griffith University

Christine Bruce
Queensland University
of Technology

Linda Clay
Queensland University
of Technology

Stephen Cox
Queensland University
of Technology

Gerry Docherty
Griffith University

Karen Dooley
Queensland University
of Technology

Marcus Foth
Queensland University
of Technology

Laurent Frossard
Queensland University
of Technology & University
of the Sunshine Coast

Alison Gable
University of Queensland

Guy Gable
Queensland University
of Technology

Louise Hafner
Queensland University
of Technology

Debra Howarth
Griffith University

Neil King
Queensland University
of Technology

Paige Maguire
e-Grad School Australia

Angela Mordocco
Office of the Queensland
Chief Scientist

Anthony O'Mullane
Queensland University
of Technology

Kylie Poulton
Griffith University

Sarah Romig
Queensland University
of Technology

Sarah Savage
Bond University

Margo Sendall
Queensland University
of Technology

Colin Solomon
University of the Sunshine Coast

Lynda Togl
e-Grad School Australia

Shari Walsh
Growth Psychology

Eliette Webb
Queensland University
of Technology

Elizabeth Williams
Queensland University
of Technology

Jenny Wilson
Deans and Directors of Creative
Arts

David Wiseman
Queensland University
of Technology

Courtney Wright
Griffith University

Andrew Zele
Queensland University
of Technology

Perth

David Badcock
The Psychology Foundation
of Australia

Judith Berman
University of Western Australia

Alan Dench
University of Western Australia

Peter Derbyshire
Council of Australian
Postgraduate Associations

John Finlay-Jones
Edith Cowan University

Colleen Fisher
University of Western Australia

Michael Garrett
Cinglevue International

Susan Gourvenec
University of Western Australia

Krystyna Haq
University of Western Australia

Martine Hawkins
Edith Cowan University

Kate Howell
The University of Notre Dame

Madeleine Laming
Murdoch University

Joe Luca
Edith Cowan University

Ian McArthur
University of Western Australia

Jenny McIlwain
Curtin University

Helen Monks
Edith Cowan University

Alex Reid
University of Western Australia
& AARNet

Karina Schaap
Office of Science, Department
of the Premier and Cabinet

Vikraman Selvaraja
Postgraduate Students
Association of the University
of Western Australia

Benjamin Smith
University of Western Australia

Elizabeth Watkin
Curtin University

Fiona Wood
WA Health Department &
University of Western Australia

Kate Wright
Curtin University

Susan Young
University of Western Australia

Canberra

Kylie Brass
Australian Academy
of the Humanities

Sarah Brown
Universities Australia

Duncan Byrne
CSIRO

Anna Cowan
The Australian National
University

Hazel Ferguson
Department of Education
and Training

Steve Georgiadis
Popular Culture

Sophie Hardman
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Rami Ibo
The Australian National
University

Heather Jenks
The Australian National
University

Margaret Kiley
The Australian National
University

Geraldine Mackenzie
Southern Cross University

Inger Mewburn
The Australian National
University

Faye Miller
Queensland University
of Technology

Elizabeth Minchin
The Australian National
University

Robert O'Connor
Department of Industry,
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Caroline Perkins
Regional Universities Network

Matthew Spriggs
The Australian National
University

Carolyn Strange
The Australian National
University

Jenefer Tan
Universities Australia

Marina Trigueros
Cariboo Design

Karen Visser
Australian National Data Service

Paul Wong
Australian National Data Service

Sydney

Herma Buttner
ANSTO

Ross Coleman
The University of Sydney

Lisa Hanlon
Western Sydney University

Tori Hocking
Macquarie University

Allyson Holbrook
SORTI, The University
of Newcastle

Rachel Jones
University of Wollongong

Deb Kane
Macquarie University

Val Klenowski

Catriona Mackenzie
Macquarie University

Nick Mansfield
Macquarie University

Jeanine Parsons
Australian Catholic University

Leah Schwartz
The University of Sydney

Kylie Shaw

Nicky Solomon
University of Technology Sydney

Gethin Thomas
Charles Sturt University

Katrina Trewin
Western Sydney University

Adrian Vickers
The University of Sydney

Julia Warning
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Kylee Warren
Council of Australian
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Jason Weise

Ren Yi
Macquarie University

Stakeholder interviews

In-person and telephone interviews were conducted with a range of stakeholders from the university, government, industry and research sectors. Interviews conducted include:

Adelaide
ATN; SANTOS; Uni SA; Uni of Adelaide; SAHMRI; SA Chief Scientist; MDPP Flinders University; National Centre for Groundwater Research and Training.

Melbourne
NTEU; AAMRI; Research Australia; Max King; CAPA; University of Melbourne Graduate Student Association; CRC for Mental Health; AMSI; EMCR Forum; AAHMS; CSL; The Lowitja Institute; Minerals Council of Australia; Victorian Government Department of Health and Human Services; ARC Centre of Excellence for Mathematical and Statistical Frontiers; Boeing.

Brisbane
CRC for Cell Therapy Manufacturing; Triple P International; Advance Queensland; JCU; NATSIHEC and Centre for the Advancement of Indigenous Knowledge, UTS; CSIRO Agriculture; QIMR Berghofer; NIRAKN.

Perth
UWA Postgraduate Students Association; UWA; Western Australian Museum; Western Australian Council of Social Services Inc. and St Vincent de Paul Society in Western Australia; Curtin University; BHP Billiton; CSIRO Minerals; Edith Cowan University; University of Notre Dame; WA Chief Scientist; Australian Council of Engineering Deans; WA Department of Agriculture and Food.

Canberra
New Zealand Deans of Graduate Studies—Auckland University of Technology, Waikato University, University of Auckland; NHMRC; Australian National Data Service; CRC Association; Defence Science and Technology Group; ANU Director of Research Training; ANU; ANU Postgraduate & Research Students' Association; Bureau of Meteorology; Australian Chief Scientist; CSIRO National Innovation Systems; The Lowitja Institute.

Sydney
Australasian Research Management Society; DASSH; Macquarie University; University of Sydney; Australian Business Deans Council; ABS; Queensland Chief Scientist; Centre for the Study of Research Training and Impact; Translational Research Institute; Cochlear; Australian Association of Educational Research; Australian Astronomical Observatory and Australian Institute of Physics; Medical Technologies and Pharmaceuticals Industry Growth Centre; University of Sydney, Indigenous Strategy and Services.

Other interviews
University of Tasmania; Flinders University; Australian Water Association; Australian Logistics Council; Australian Computer Society; Clean Energy Council; Ai Group; Australian Conservation Foundation; Australian Medical Association; Pharmaceutical Society of Australia; Australian Chamber of Commerce and Industry; Business Council of Australia.

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