Review of Research Policy and Funding Arrangements

Report

November 2015

Letter of Transmittal

Senator The Hon Simon Birmingham
Minister for Education and Training
Parliament House
CANBERRA ACT 2600

Dear Minister

I am pleased to present the report of the Review of Research Policy and Funding Arrangements.

On 7 July 2015, the then Minister for Education and Training, the Hon Christopher Pyne MP, appointed me to undertake the review. I have been ably supported by an expert working group comprised of Professor Peter Coaldrake AO, Professor Edwina Cornish AO, Professor Sandra Harding, Mr Conor King and Professor Steven Schwartz AM.

The overarching objective of the review was to identify opportunities for the reform of research policy and funding arrangements within the Education and Training portfolio, and to deliver on the Australian Government's Agenda for Action under the Boosting the Commercial Returns from Research Strategy.

An extensive consultation process took place following the release of an issues paper in August 2015. Seventy-six written submissions were received and I met with representatives from universities, research bodies, business and industry leaders and government representatives.

The consultations demonstrated the high level of interest in the future of research policy and funding. They also showed that there is widespread agreement that the review was timely in identifying opportunities for Australia to increase the benefit it receives for its investment in research in universities.

In proposing these important reforms, the review recognised the importance of research income to universities and recommended a time-limited transition to stage the introduction of the new Research Block Grant arrangements to allow universities time to adjust.

The review considered the current funding arrangements for university research including Research Block Grants, competitive grants programmes and business focused research collaboration programmes. It identified considerable current good practice, but importantly highlighted opportunities to streamline programme arrangements and increase the incentives for universities to engage with business and other end users of research.

The review acknowledged the important work universities and other publicly funded research organisations are already undertaking, for example in approaches to intellectual property and the placement of research students with business, and makes recommendations for further actions.

The review also looked at how we could ensure better stewardship and develop a better understanding of the health and effectiveness of our publicly funded research system, including how we could assess impact and engagement as well as quality.

I would like to thank the members of the expert working group for their contributions as well as Professor Peter Lee for his contributions and advice. I would also like to thank Ms Virginia Hart and the other members of the secretariat for supporting me and the working group in this important task.

Yours sincerely

I J Watt

30 November 2015

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Executive Summary

The overall quality of the Australian research sector is high by OECD standards but Australia's performance is poor when it comes to translating publicly funded research into collaboration with business. We rank last out of 26 OECD countries on the proportion of businesses collaborating with higher education and public research institutions on innovation.

On 7 July 2015, the then Minister for Education and Training, the Hon Christopher Pyne MP appointed Dr Ian Watt AO to conduct a review of research policy and funding arrangements. The review was given the task of developing options to strengthen Australia's research system and encourage greater collaboration between universities and business and other research end users to enable Australia's high quality research to be translated into economic and social benefits for the nation.

Extensive consultation with the university and business sector was a central feature of the review. Seventy-six submissions were received in response to the issues paper, *Review of Research Policy and Funding Arrangements for Higher Education.* Dr Watt conducted roundtables and held meetings with universities, research bodies and institutes, business and industry leaders and government representatives over a period of four months to inform the recommendations of the review.

Higher education research expenditure is 30 per cent of Australia's gross expenditure on research and development (R&D) and is therefore an important, but by no means dominant component of Australia's R&D spending. Change to policy settings for higher education research funding can be expected to yield improvements in Australia's innovation performance but, alone, cannot transform that performance. In that context, the review developed recommendations which in broad terms aim to:

- ensure the quality and excellence of Australian university research and research training
- allocate funding through Research Block Grants (RBG) in a simpler and more transparent manner
- provide incentives to universities to increase and improve engagement and collaboration with business and other end users
- encourage universities to engage in research commercialisation and knowledge transfer with business and the broader community, including through funding incentives and a focus on more effective management of intellectual property (IP)
- ensure that competitive grant criteria recognise the quality of the proposal and support the opportunities for commercialisation and collaboration with business.

RBG occupied a central place in this review. Funding through RBG makes an important contribution to supporting the indirect costs of research, end user engagement and research training. Changes to the architecture over time have resulted in limited policy coherence, introduced unnecessary complexity for little benefit and failed to clearly incentivise the goal of increasing university engagement with business and other end users.

The report sets out a new model, to commence in 2017, which substantially simplifies RBG by combining six schemes into two — a Research Support (RS) programme combining Research Infrastructure Block Grants, Sustainable Research Excellence and Joint Research Engagement, and a Research Training (RT) programme which combines the current Research Training Scheme, Australian Postgraduate Awards and the International Postgraduate Research Scheme.

The RS programme recognises that high quality research and end user engagement are equally important goals for publicly funded research and proposes equal weighting be given to two funding drivers to reflect this — competitive grants (Category 1) and business and end user research income (Categories 2, 3 and 4). In relation to the RT programme, the model proposes equal weight be given to student completions, a key measure of the efficiency of the research training system, and research income across Categories 1-4.

Universities are agile institutions well able to respond to the new incentives, and are expected to start to do so from the start and well before the funding changes fully cut in. That said, it was recognised that there is a need for transition arrangements over the first four years, so that institutions can meet existing commitments and adjust to new incentives.

In recognition of the Government's commitment to increasing collaboration between universities and business, the report recommends that modest additional funding of $50 million per annum from 2018 (or sooner if fiscal circumstances permit) be provided to increase the level of engagement incentives under the new RBG model.

The review also considered how competitive grants provided through the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) could better support research end user engagement. Linkage Projects is the ARC's flagship scheme designed for collaboration between universities and business and other end users. The restriction of annual grant rounds presents a barrier to businesses which need to respond to time critical market or innovation opportunities. The review recommends moving to a continuous round from 1 July 2016 to increase responsiveness to both researcher and business needs. The review also proposes that for businesses with fewer than 20 employees, the requirement for cash contributions to Linkage Projects be dropped.

To further strengthen the assessment of ARC grant proposals that have commercialisation and business collaboration potential, the review recommends the establishment of panels made up of business and industry experts as part of the process of peer review of grants.

The review was concerned about the low and declining success rates across ARC and NHMRC grant programmes and the burden on universities, researchers and partner organisations resulting from these inevitably very high failure rates under currently available funding. The total number of grants submitted for assessment is something that the

research councils do not control — it should be the responsibility of universities and research institutes to scrutinise and filter grant applications so that the levels of wasted effort in the system are significantly reduced. Consequently, the review has recommended that institutions apply more stringent control on grant application numbers.

Collaboration is a contact sport and requires that both university and business sectors improve their capacity to build and maintain productive relationships over time. The review, consistent with its terms of reference, has mainly focused on policy and programmes within the Education and Training portfolio but recognises the importance of programmes which support business to 'reach in' to universities to access business relevant research. Data shows that collaboration with researchers, including universities, more than triples the likelihood of business productivity growth. Research Connections, administered by the Department of Industry, Innovation and Science, helps small and medium enterprises (SME) to identify their research needs and purchase relevant research. There is evidence that this programme supports a valuable first step in collaboration which provides the foundation for continuing engagement. The report therefore recommends that the current programme be expanded to provide new funding of around $25 million over the next four years from 2016-17. Businesses need to be able to access information about relevant research and connect with researchers. To assist this, the review supports speedy implementation of the Industry Department's online access point, under development, which will provide this information.

Including business placements as part of PhD research training is an effective way of driving change. The business benefits from access to high level research skills applied to their specific needs and the student develops an understanding of the value of business relevant research and builds skills for future employment. The review commends university programmes already in operation which provide for business placements but concluded the scale of these is small. It therefore recommends funding for a new PhD business placement initiative to support an additional 700 placements per year, at a cost of $12.5 million.

The report considered opportunities to improve the management of intellectual property created by university research. There are a range of initiatives underway which focus on making IP more openly available including Source IP, Easy Access IP and simplified contracting arrangements such as the IP Toolkit. The report proposes that the ARC and NHMRC require use of these arrangements as a condition of funding. Importantly, the Productivity Commission is conducting a broad ranging inquiry into Australia's IP arrangements. The review assessed a 'use it or lose it' approach to IP which would require universities to either make IP from publicly funded research openly accessible or take steps to commercialise it within a specified timeframe. While it has attractions, given the complexities involved in this approach, the report recommends that the existing PC inquiry be asked to look into the feasibility of implementing this approach.

While Australia is globally recognised as producing high quality research we do not have a comprehensive approach to assessing the economic, social and other benefits of that research — commonly referred to as the 'impact' of research. The report recommends that Australia implement an impact and engagement framework, drawing on the lessons from the United Kingdom's approach to impact assessment. The new initiative would sit alongside Excellence in Research for Australia (ERA), which measures quality. It would combine

metrics, including the Research Engagement for Australia developed by the Australian Academy of Technology and Engineering, with case studies and expert review. Details of the assessment would be settled in 2016 and the approach piloted in 2017. ERA and the new impact and engagement assessment should be conducted every three years to provide a comprehensive assessment of the university research system.

The review noted work already underway to develop a whole of system assessment of the publicly funded research system and urges acceleration of this activity. Based on this work, the Minister for Education and Training, in consultation with the Minister for Industry, Innovation and Science and the Minister for Health, in addition to other relevant Ministers, should take the lead on assessing the performance of the system annually and advise Government on current and emerging issues to inform future policy decisions.

Summary of recommendations

Research Block Grants

Research Support

1. The review recommends that, commencing in the 2017 calendar year, the Australian Government should introduce the following arrangements to simplify the Research Block Grants and to provide greater encouragement of engagement and innovation in research and research training:

    a. Simplify arrangements for research support and increase incentives for business and other research end user engagement by combining the three schemes which provide research support, using drivers which equally reward excellence and end user engagement:

        i. 50 per cent based on Category 1 research income to support the indirect costs of Australian competitive grants

        ii. 50 per cent based on Category 2-4 research income to support business and other research end user engagement.

Research Training

2. Simplify arrangements for research training funding by combining the three schemes which support this function, using the following drivers:

    a. 50 per cent student completions

    b. 50 per cent Category 1-4 research income, with equal weighting to be given to Category 1 income and Category 2-4 income.

Transition to new arrangements

3. To allow an orderly transition to the new arrangements:

    a. introduce a safety net for Research Support funding, for the first four years of operation, so that no university receives less than 95 per cent of its funding for the prior year, which is indexed

    b. progressively increasing the influence of the new Research Training funding formula by applying it to 25 per cent of the pool in each of years 2017 to 2020, with the balance being based on the previous year's allocations.

Additional funding to further incentivise engagement

4. Additional funding of $50 million per annum, ongoing, should be provided, commencing in 2018, to further increase incentives to universities for business and end user engagement.

Should fiscal circumstances permit, a modest down payment should be made in 2017.

Review of RBG engagement data

5. In consultation with Universities Australia, the Department of Education and Training and the ARC should examine research income counted in Categories 2, 3 and 4 and, by mid-2016, determine which data provide the most appropriate measures of end user contributions.

Competitive grant programmes

6. The review recommends that:

    a. the ARC Linkage Projects scheme moves from one round per year to a continuous application and peer assessment process from 1 July 2016, with strong applications to be progressed immediately for ministerial approval, and the remaining applications to be considered in one of three selection meetings per year

    b. grant outcomes should be announced within a maximum of six months from the submission of applications

    c. the ARC revises its guidance for selection advisory committees for the Linkage Projects scheme to ensure that high quality proposals that involve business partner organisations are given greater priority

    d. the Education and Training portfolio, in consultation with the Department of Finance, assess whether additional resources are required by the ARC to undertake continuous Linkage Projects rounds, and provide advice to government accordingly.

7. The review recommends that businesses with up to 20 employees be exempt from the requirement for partner organisations to provide cash contributions under the ARC Linkage Projects scheme.

8. The review recommends the establishment of expert panels to assess the elements of ARC grant proposals that relate specifically to commercialisation potential and collaboration with businesses and other end users.

9. The review recommends that:

    a. universities take a more active role in scrutinising applications for competitive research grant funding to filter out those potential applications which are less competitive

    b. greater prominence should be given to the ARC's and NHMRC's measures of success by institutions when considering the submission of grant applications

    c. universities should also revise any policies that may encourage the submission of applications without due regard to quality.

Business focused research collaboration programmes

10. Australian Government funding of around $25 million over four years from 2016-17 be provided to expand Research Connections.

11. Australian Government funding of $12.5 million per annum be provided to create a small programme to support universities to increase numbers of industry placements for PhD students. The programme should commence in 2017 and the Department of Education and Training should develop the details of the new programme arrangements in consultation with the university and business sectors.

12. The Department of Industry, Innovation and Science should implement, as a priority action in 2016, an online access point which will assist businesses to connect with business relevant research and researchers.

13. Universities revise their appointment and promotion policies where necessary to ensure that the value of business experience is recognised and that individuals who have spent time in business are not disadvantaged in the selection process.

Improved management of intellectual property

14. The PC inquiry into Australia's IP arrangements should be asked to consider the feasibility of a 'use it or lose it' arrangement, including whatever wider policy changes would be necessary to support this approach.

15. The ARC should require all future Linkage Project applications, and progress reports, to identify actual and potential IP to be generated through the project and the intended IP management arrangements.

16. The ARC and NHMRC amend funding agreements and funding policies as relevant to:

    a. require institutions to list the IP generated by public funding on Source IP from 2017

    b. require institutions to offer, and utilise if requested, the IP Toolkit model contract and term sheet where collaborative research arrangements with business are involved.

17. The Department of Education and Training, in consultation with other relevant policy departments, publicly funded research organisations and universities, should provide advice to Government by June 2016 on the merits of the broader application of Easy Access IP or similar arrangements across the publicly funded research sector and, if relevant, proposed implementation arrangements.

18. The 2018 ERA should take into account the relative share of research output made available through publication, open source repositories and exploited through IP arrangements in the assessment process.

Assessment of impact and engagement

19. The Australian Government commit to the assessment of the economic, social and other benefits of university research through an impact and engagement assessment framework, which will have an impact on future research funding.

20. The framework include both quantitative and qualitative measures, moderated by expert review, with:

    a. the metrics proposed by ATSE as the starting point for the development of quantitative measures, and other potential measures also considered

    b. the lessons of the 2014 UK REF, the 2012 EIA and the 2010 UK REF pilot drawn on to measure the extent and cost of the approach to qualitative measurement and minimise the burden imposed on universities and others by the assessment methodology

    c. an expert working group, convened by the Department of Education and Training and comprising representatives from the research sector, government and end users (including business) be established to provide advice by the end of June 2016 on the specific approach to be used, the measures to be adopted and the implementation path to be followed.

21. The impact and engagement assessment model should be piloted in 2017, with the lessons from the pilot to be finalised by the end of 2017.

22. The new framework should:

    a. be implemented as a companion to ERA in 2018, so that quality and impact and engagement can be assessed at the same time on a three year cycle

    b. be implemented so that any additional burden on universities is minimised by using existing sources of data and evidence and reducing data and information required for ERA and/or other reporting.

23. Following the 2017 pilot, the Australian Government should consider whether a specific level of funding should be influenced by the impact and engagement assessment, with 10 to 20 per cent of RBG research support from 2019 being a possible starting point.

24. The ARC be provided with sufficient ongoing funding (around $10 million over the three year assessment cycle) to manage the development and implementation of the assessment.

Assessing Australia's research system

25. The Minister for Education and Training, in consultation with the Minister for Industry, Innovation and Science, the Minister for Health and other relevant ministers, should take the lead on assessing and reporting on the performance of the publicly funded research system through:

a. an annual public assessment of the performance of the Australian research system

b. advice to the Cabinet annually on current and emerging policy implications to inform policy consideration at both the whole of government and portfolio by portfolio levels

c. public release of the results of the assessment after the Cabinet's consideration.

26. Early work currently underway by the Departments of Education and Training and Innovation, Industry and Science to develop system-level performance measures should be accelerated and developed in consultation with the business and the university sectors.

27. The first assessment of the performance of the publicly funded research system should be produced by the end of 2016 using existing data collections.

Global university ranking systems: an Australian developed system?

28. Australia should seek to influence the initiatives of existing and possibly new global ranking systems moving to incorporate innovation and industry engagement measures into their rankings.

Introduction

The challenge

The overall quality of the Australian research sector is high by OECD standards.

Australia's research output ranks in the top ten OECD countries, as assessed by most quality measures.[1] Australia also received the tenth highest ranking for research and development (R&D), among 141 countries, in the Global Innovation Index 2015 Country Rankings,[2] and Excellence in Research for Australia (ERA) assessments have confirmed that significant numbers of universities are producing research rated at world standard or higher across many, if not most, fields of research.[3]

Australia's expenditure on R&D is not particularly high by comparable country standards, and was equal to 2.12 per cent of GDP in 2013-14, up from 1.73 per cent in 2004-05.[4] This is slightly below the OECD average of 2.36 per cent in 2013.[5] Australia's nominal gross expenditure on R&D more than doubled from $16.0 billion in 2004-05 to $33.5 billion in 2013-14 and increased by more than 60 per cent in real terms over the same period.[6] However, our position in global rankings based on expenditure as a percentage of GDP remained unchanged, at around 15th among OECD countries. In a competitive world, most OECD countries are increasing research expenditure as they see it as a key factor in future productivity and economic growth. Non-OECD countries are also rapidly increasing expenditure as a share of GDP — the two highest spending countries are China and Singapore (gross expenditure on R&D of 2.08 per cent and 2.02 per cent respectively).[7] Accordingly, we will need to run faster just to stand still. And we also need to get the most out of our R&D spending, regardless of the level of that expenditure.

Australia needs to improve the translation of publicly funded research into commercial outcomes because it is there that our performance is poorest. Australia ranks last out of 26 OECD countries on the proportion of both large businesses and small to medium enterprises (SME) collaborating with higher education and public research institutions on innovation.[8] Further, although our performance has never been strong in business collaboration, it has deteriorated over time. For example, in 2004-06, Australia ranked 20th and 13th out of 23 countries respectively for large business and SME collaboration with higher education. Similarly, Australia also does poorly in new-to-the-world innovation,

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[1] Office of the Chief Economist, 2015, *Australian Innovation System Report 2015 Tables.*
[2] Dutta S, Lanvin B and Wunsch-Vincent S, 2015.
[3] Australian Research Council, 2015, *State of Australian University Research 2015-16: Volume 1 ERA National Report.*
[4] Australian Bureau of Statistics, 2015, '8104.0 - Gross Expenditure on R&D (GERD), Research and Experimental Development, Businesses, Australian 2013-14'.
[5] OECD, 2015, 'Main Science and Technology Indicators; GERD as a percentage of GDP'.
[6] Australian Bureau of Statistics, 2015, '8104.0 - Gross Expenditure on R&D (GERD), Research and Experimental Development, Businesses, Australian 2013-14'.
[7] Dutta S, Lanvin B and Wunsch-Vincent S, 2015.
[8] Office of the Chief Economist, 2015, *Australian Innovation System Report 2015 Tables*.

ranking second last of the 17 OECD countries assessed. We need to improve significantly on that performance, and get more out of our modest R&D expenditure, if we are to create more future growth opportunities.

This review has been given the task of recommending higher education research funding arrangements within the Education and Training portfolio that will encourage increased engagement with business and other research end users, in order to better translate the high quality research undertaken by the higher education system in Australia into economic and social benefits for the nation.

Our poor performance over a long time in this regard suggests that there is no simple solution to the problem. However, our need to boost our relative rates of future productivity and economic growth suggests that better performance is essential. This is Australia's challenge.

The review: origins, terms of reference and conduct

Origins

The *Industry Innovation and Competitiveness Agenda*,[9] announced by the then Prime Minister and the Minister for Industry on 14 October 2014, identified four objectives:

- a lower cost, business friendly environment with less regulation, lower taxes and more competitive markets
- a more skilled labour force
- better economic infrastructure
- industry policy that fosters innovation and entrepreneurship.

Better translation of research into commercial outcomes is a key part of this agenda.

The then Minister for Education and Minister for Industry initiated consultation on options to support the translation of research into commercial outcomes on 29 October 2014. Those consultations helped shape the Boosting Commercial Returns from Research strategy, which was announced by the then Minister for Education and Training, the Minister for Industry and Science, and the Minister for Health on 26 May 2015.[10] The strategy included a range of measures to enhance the contribution of research in universities and business to help increase Australia's capacity for innovation, productivity and growth, including:

- the development of simpler, more transparent research block grant arrangements which continue to focus on quality and excellence, support greater industry and end user engagement, and encourage better knowledge transfer with industry

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[9] Australian Government, 2014, *Industry Innovation and Competitiveness Agenda: An action plan for a stronger Australia*.
[10] Department of Education and Training, 2015, *Launch of the strategy Boosting the Commercial Returns from Research*.

- working with the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) to ensure rules for the councils' competitive grants appropriately recognise industry relevant expertise or research
- developing an intellectual property toolkit to facilitate collaboration between research and industry
- improving the assessment of the research system, including through developing improved metrics on engagement and knowledge transfer with industry, research outcomes, and impact.

To help implement the strategy, the former Minister for Education and Training, The Hon Christopher Pyne MP, announced on 7 July 2015 that Dr Ian Watt AO would conduct a review of research policy and funding arrangements to identify a range of reform options that will strengthen Australia's research system and encourage greater collaboration and engagement between universities and business and other end users.

Terms of reference of the review

The terms of reference, also announced by the Minister on 7 July 2015, are shown in full below.

> The review will identify opportunities for the reform of research policy and funding arrangements within the Education and Training portfolio to deliver on the Government's Agenda for Action under the Boosting the Commercial Returns from Research (BCR) strategy.
>
> In particular, the review will provide advice to government on arrangements that would ensure the world class research undertaken by the higher education system in Australia is translated into economic advantage for the nation with options to:
>
> - ensure the quality and excellence of Australian university research and research training
> - allocate existing research block grant funding in a simpler and more transparent manner
> - provide incentives to universities to increase and improve engagement and collaboration with industry and other end users
> - encourage universities to engage in research commercialisation and knowledge transfer with industry and the broader community, including through funding incentives and a focus on more effective management of intellectual property
> - ensure that competitive grant criteria recognise the quality of the proposal and where appropriate the opportunity for commercialisation and collaboration with industry.
>
> The review will also consider the development of measures of research-industry engagement and collaboration, including the availability of international rankings to compare performance and drive improvement over time.
>
> The recommendations of the review should reflect the Government's commitment to a world class research and research training system, including: quality, impact, research-industry linkage, commercialisation, and international collaboration.
>
> The review should as far as practicable take account of the implementation of the National Science and Research Priorities, the Review of Australia's Research Training System by the Australian Council of Learned Academies, the Research Infrastructure Review, the Higher

Education Infrastructure Working Group, the Miles Review of the Cooperative Research Centres Programme and other actions being taken to implement the BCR strategy.

The review's proposals will be limited to the arrangements within the Education and Training portfolio and arrangements in other portfolios that directly impact on the research policy and funding arrangements in that portfolio.

Working group

Dr Watt has been assisted in the review by a small working group of experts with knowledge of the higher education and research sectors, comprising:

- Professor Peter Coaldrake AO, Vice-Chancellor of the Queensland University of Technology
- Professor Edwina Cornish AO, Provost and Senior Vice-President of Monash University
- Professor Sandra Harding, Vice-Chancellor of James Cook University
- Mr Conor King, Executive Director of the Innovative Research Universities group
- Professor Steven Schwartz AM, Executive Director of the Council for the Humanities, Arts and Social Sciences, and former Vice Chancellor of Macquarie, Brunel, and Murdoch universities.

The review's consultations

An issues paper entitled *Review of Research Policy and Funding Arrangements for Higher Education* was released on 11 August 2015 to support consultations for the review. The paper posed a series of questions designed to draw out views and suggestions about how to strengthen Australia's research system and encourage greater collaboration and engagement between universities, business and other end users. It called for submissions by 18 September 2015. Seventy-six submissions were received, with the majority from universities and other academic bodies and individuals, and a small number from individual businesses or bodies representing business interests. The review also sourced a range of additional material from universities, including 48 case studies on collaboration from 32 universities. The review was also informed by the Australian Council of Learned Academies (ACOLA) report *Translating research for economic and social benefit: country comparisons* and a commissioned report by the Melbourne Centre for the Study of Higher Education entitled *International Innovation Benchmarks — scan of overseas models of university/industry research collaboration and analysis for implications for Australia*.

Dr Watt consulted with participants in the higher education and business sectors in August and early September 2015 and conducted comeback meetings in October and November. The consultations involved 55 meetings with universities, research bodies and institutes, business and industry leaders and government representatives, including Australian Government Ministers and Departmental Secretaries. A full of list of the meetings undertaken is shown in the report appendices. Dr Watt additionally undertook a series of 15 focused roundtables with university Vice-chancellors and representatives in late October and early November. These roundtables took place in Sydney, Adelaide, Melbourne,

Brisbane, Perth, Townsville and Canberra to discuss directions and options arising from the submissions and consultations to that date.

Related reviews and activities

As requested in the terms of reference, the review takes into account a number of other reviews and activities, particularly those which are part of the implementation of the Boosting the Commercial Returns from Research strategy including:

- the Review of Australia's Research Training System — being conducted by ACOLA and due to report to the Minister for Education and Training in March 2016 — which is considering a range of ways to improve Australia's research training system, including provision of greater opportunity for industry relevant research training
- the Research Infrastructure Review, which reported to the Minister for Education and Training in September 2015 and considers future critical research infrastructure needs and funding
- the Higher Education Infrastructure Working Group, which has been tasked by the Minister for Education and Training to advise on universities' infrastructure investment needs and how these can be financed and funded
- the 2015 Miles Review of the Cooperative Research Centres programme, the recommendations of which have been accepted by the Government
- the strategic whole of government approach for boosting Australia's capability in science, technology, engineering and mathematics which is currently being developed by the Commonwealth Science Council.

Higher education research funding framework

In considering options for reform to improve Australia's performance in translating higher education research into economic and social benefits, the review has been mindful that the policy framework underlying research funding needs to achieve multiple objectives. For example, universities are expected to maintain research capability and excellence in a range of disciplines, some of which have limited capacity to attract external funding. Further, they must offer research training across a range of disciplines and provide opportunities for young academic staff to develop a research profile. Finally, at the same time, universities need to win competitive grant funding and to better collaborate and engage with research end users. Underlying these considerations is the need for academic organisational units and those academics holding research and teaching appointments to balance their research, teaching and public service roles.

The review has applied the following framework in considering Australia's higher education research funding system:

- research excellence is at the core of the higher education research endeavour and public funding should strike a balance between supporting basic research capacity and maintaining the research training system on the one hand, and encouraging a responsiveness to government priorities on the other

- universities should be autonomous, self-directing and focused on the quality of their research and teaching with policies influencing priorities and outcomes in universities by rewarding performance, while maintaining the underlying autonomy of the institutions
- public funding arrangements should provide clear incentives and rewards for national priorities, such as those relevant to this review, which include increased effective collaboration with business and other end users, and better commercial returns on research
- while the amount of research funding that is determined by the performance of individual institutions will vary over time, governments should avoid high levels of variability in annual funding outcomes
- a strong system of training for Higher Degree Research (HDR) students, who are the next generation of Australian researchers, is an essential element of the research system.

Consistent with this framework, the review has developed recommendations which:

- maintain support for high quality research in Australia's universities across the spectrum from basic to applied research
- simplify the Research Block Grant arrangements (RBG) as far as possible and ensure they have clearly defined policy goals and outcomes
- sharpen the funding incentives provided by RBG, in particular to improve incentives for collaboration between universities and business to increase the commercial returns from Australia's research effort
- better gauge the effectiveness of research investment and influence researchers' behaviour by assessing the real world impact of research outcomes.

In developing its recommendations, the review has also been mindful of the views expressed by research and business stakeholders in their submissions and during the consultations — that government needs to provide clear policy direction, and support closer engagement by making a longer term policy and funding commitment to improving Australia's performance in collaboration between universities, business and other end users of research.

The review's recommendations seek to maintain the strengths of the current research system, while proposing and supporting changes which will help drive significant improvement in what has been its greatest weakness over time — the low level of engagement by universities with businesses and other end users of research and the consequent low level of translation of research into economic benefits for Australia as a whole.

This report

This report addresses the terms of reference and makes recommendations under the following structure:

Chapter 1 provides an overview of research expenditure in Australia focusing on Australian Government funding and university research funding.

Chapter 2 discusses RBG, explaining the current funding arrangements and key issues with those arrangements. It proposes a new model for RBG that will be simpler and provide clearer incentives for universities to engage with business and other research end users.

Chapter 3 discusses competitive grant programmes, how they operate currently and makes recommendations to streamline and improve these programmes.

Chapter 4 covers business-focused research collaboration programmes and the role of business placements in HDR training.

Chapter 5 considers the current framework for the management of intellectual property and current approaches taken by universities. It proposes actions to help universities and business to fully harness outputs from publicly funded research.

Chapter 6 addresses the performance of our research system and the assessment of impact and engagement as well as quality. It recommends that a new impact and engagement assessment framework be developed by an expert working group and suggests possible measures for inclusion.

Chapter 7 recommends an approach to ensure effective stewardship of Australia's publicly funded research system including the development of an annual health assessment of the system.

Chapter 8 considers how Australia can ensure it can influence effective international research ranking systems.

Case studies of university-business collaboration are published as a separate volume to this report.

1. Australian Government funding for university research

The review has been asked to:

> identify opportunities for the reform of research policy and funding arrangements within the Education and Training portfolio to deliver on the Government's Agenda for Action under the Boosting the Commercial Returns from Research strategy.

Individual chapters of this report consider aspects of the Australian Government's research policy and funding arrangements. This chapter sets out the broad context by providing an overview of the funding arrangements for university research, with specific reference to the Education and Training portfolio funding programmes.

Australia's gross expenditure on research and development (R&D)

Australia's gross expenditure on R&D by component over the period 2004-05 to the latest year for which data is available, 2013-14, is shown in Chart 1.

Chart 1. Expenditure on R&D by sector (constant prices $ million)*
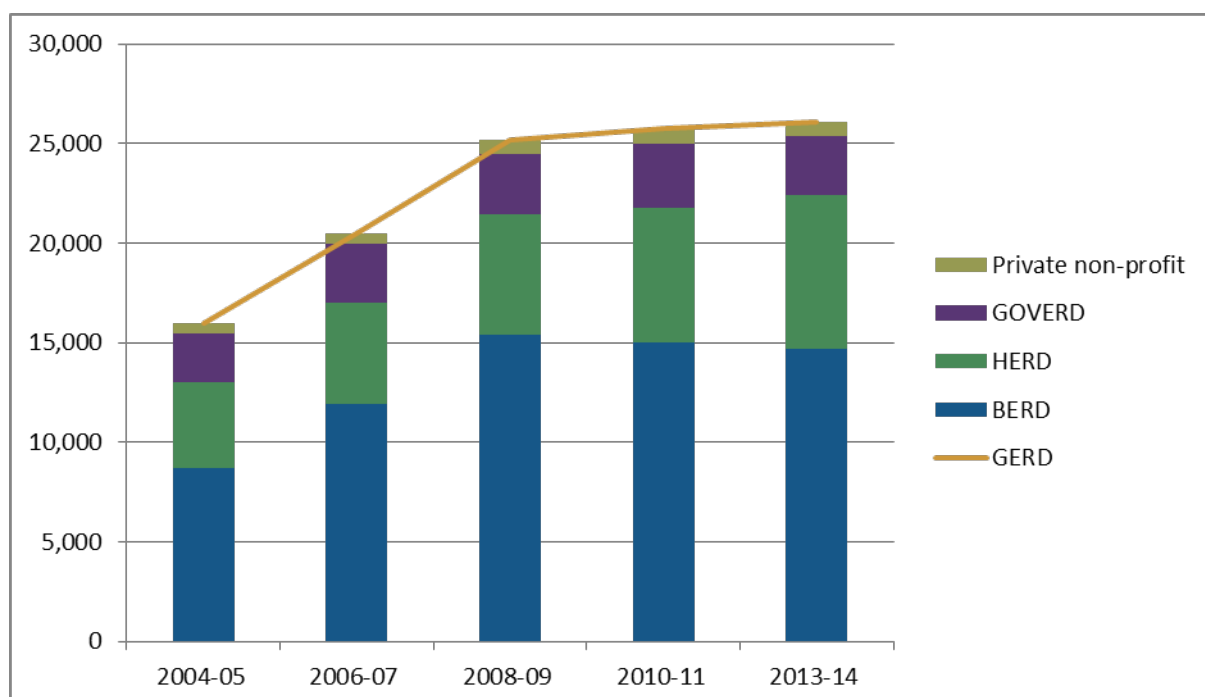
Source: ABS, 8104.0 - Research and Experimental Development, Businesses, Australia, 2013-14, 6401.0 - Consumer Price Index, Australia, Sep 2015
* Constant prices are derived from research expenditure data deflated in 2004-05 dollars using year ended CPI for June.
Notes on Chart

- GERD (Gross Expenditure on R&D) is the total expenditure on R&D by the business, government, higher education and private not-for-profit sectors.
- BERD (Business Expenditure on R&D) is expenditure on R&D carried out by businesses in Australia.
- GOVERD (Government Expenditure on R&D) is expenditure on R&D carried out by Commonwealth, state and territory governments.

- HERD (Higher Education Expenditure on R&D) is expenditure on R&D undertaken by Australian higher education institutions.

Total Gross Expenditure on R&D (GERD) has more than doubled in nominal terms over the past decade, rising 110 per cent from $16.0 billion in 2004-05 to $33.5 billion in 2013-14 representing constant price growth of 5.6 per cent per annum. Business (BERD) has consistently accounted for more than one half of all spending on R&D over the decade, increasing by 117 per cent, from $8.7 billion in 2004-05 to $18.8 billion in 2013-14. Higher education expenditure on R&D (HERD) accounted for $9.9 billion, or 30 per cent, of GERD in 2013-14. This was an increase of 129 per cent from the $4.3 billion spent on HERD in 2004-05, and an increase of 2.5 percentage points in the proportion of GERD.

Higher education research expenditure is also an important, but again by no means dominant, component of Australia's R&D spend. Change to policy settings for higher education research funding can be expected to yield improvements in Australia's innovation performance but, alone, it cannot transform that performance. Increasing the benefits of the total national R&D spend has to involve considerably more than increasing the benefits of HERD.

Australian Government funding of R&D

As shown in Chart 2 below, the direct funding the Australian Government provides to universities for research through the dual funding system is an important, but not dominant, component of the Australian Government's overall support for science, research and innovation, which totals $9.7 billion in 2015-16.

Chart 2. Australian Government support for science, research and innovation by sector, 2015-16
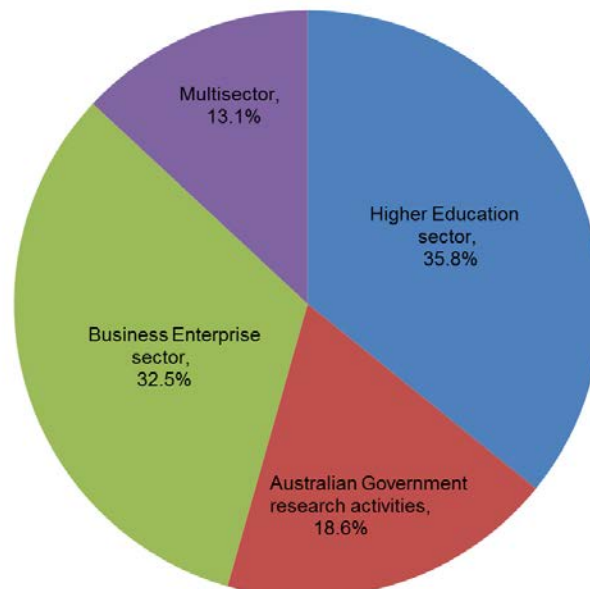
Source: Science, Research and Innovation Budget Tables 2015-16
Note: Higher education sector funding includes ARC grants, proportion of NHMRC grants going to universities (76.9 per cent) and Research Block Grants.

Higher education is the largest sectoral funding recipient, receiving $3.5 billion, or 36 per cent of the total. Business receives $3.2 billion, including $2.9 billion in R&D tax measures and $257 million in business innovation measures.

Research Block Grants (RBG) will provide $1.8 billion, or 20 per cent, of government support for research and innovation in 2015-16. Australian Research Council (ARC) competitive grants will provide a further $0.8 billion, or 8 per cent.

The data for Australian Government funding suggests that the government funds a significant proportion of research across all sectors and has potential to help achieve desired outcomes through use of funding levers. However, funding provided through any single programme is not large relative to total expenditure, and alignment between different policies is therefore important.

One of the main recommendations of the review is to change the architecture of RRBG. RBG funding makes a significant contribution to total research expenditure by universities but still only represents around 15 per cent of the total. The changes will have limited effect unless combined with other initiatives which work in a co-ordinated manner to reinforce policy goals.

The introduction of a new impact and assessment system is also a key element in these other changes. The system will assess the economic, social and environmental benefits arising from all research conducted by universities, including the substantial amount of research funded by universities themselves.

Research funding for universities

Overall, university research is supported from two major funding sources:

- Australian Government research funding delivered through the dual funding system of competitive grants and RBG
- university funding, involving funding from a variety of income sources such as student fees, contracts and consultancies, investment income and philanthropy.

The dual funding system

The competitive grant programmes and RBG are the central focus of this review.

The competitive grant component is made up of the merit-based, peer-reviewed funding programmes administered by the ARC, the National Health and Medical Research Council (NHMRC) and Rural Research and Development Corporations (RDC). These competitive programmes fund only the direct costs of individual research projects.

RBG support the indirect costs of Australian competitive grants, end user research and research training.[11] RBG funding is not tied to specific funded projects, allowing universities to make strategic decisions on their research investments.

Allocations through the dual funding programmes over the four year period from 2015-16 are shown in Table 1.

Table 1. Australian Competitive Grant (ACG), RBG and RDC funding 2015-16 to 2018-19 ($m)

	2015-16	2016-17	2017-18	2018-19
RBG	1,803	1,707	1,863	1,855
ARC	790	751	784	792
NHMRC	889	879	886	896
RDC	12	12	13	13
TOTAL	3,494	3,349	3,546	3,556

Source: Portfolio Budget Statements 2015-16 for Education and Training Portfolio, Departments of Agriculture and Water Resources, and Health

Note: While NHMRC grant funding is open to medical research institutes as well as universities, 79.3 per cent went to universities over the period 2004 to 2013.[12] It is estimated that universities are likely to win $653 million, or 77 per cent, of NHMRC competitive grant funding in 2015-16.[13]

University funding of research activities

Funding provided by ACG and RBG makes only a relatively modest contribution to total university research expenditure, as shown in Table 2.

In 2012, the most recent year for which data is available, universities spent $9.6 billion on research. ACG funded 17 per cent of that expenditure and research block funding around 15 per cent.

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[11] The programmes constituting RBG have been introduced over time but were established with integrated policy underpinnings from 2002 as a result of the 1999 policy statement by the then Minister for Education, Training and Youth Affairs, Dr David Kemp, *Knowledge and Innovation: A policy statement on research and research training*.

[12] National Health and Medical Research Council 2014, *Research Funding Facts Book 2013*.

[12] Department of Industry and Science 2015. *The Australian Government's 2015-16 Science, Research and Innovation Budget Tables*.

Table 2. Higher Education R&D expenditure, 2012

Source of funds	$ million	%
Australian competitive grants	1,625	16.9
General university funds	5,340	55.6
Other Commonwealth government (includes RBG)*	1,448	15.1
State and local government	420	4.4
Business	398	4.1
Donations, bequests and foundations	124	1.3
Other Australian	24	0.2
Overseas	231	2.4
TOTAL	9,610	100

Source: Australian Bureau of Statistics 2014. 8111.0 – Research and Experimental Development, Higher Education Organisations, Australia, 2012
* 'Other Commonwealth government' is RBG plus other targeted research funding from Australian Government agencies (other than Australian competitive grants), including Cooperative Research Centre (CRC) grants and payments for R&D contracts. The amount of funding other than RBG is small.

More than one half of the expenditure on research undertaken by universities came from 'general university funds'. These include:

- international undergraduate and postgraduate student fees
- domestic undergraduate student income, particularly that from the Commonwealth Grants Scheme (CGS)
- other, smaller, contributions such as non-research specific donations and bequests and investment income.

The role of Commonwealth Grant Scheme (CGS) funding

Through the CGS, the Australian Government provides a contribution to the cost of education of Australian students enrolled in an undergraduate degree course, as well as some sub-degree and postgraduate coursework degree students. Students subsidised through the CGS also make a contribution to the cost of their education, which they can pay through the HECS-HELP scheme or by up-front payment to the university in which they are enrolled. Course fees and the proportion met by the CGS do vary by discipline but, for all CGS supported students, the cost of courses is shared approximately 60:40 between the Australian Government and students.

A number of submissions to the review argued that reliance on student-derived income to support research was unfair to coursework students and undesirable because it required universities to grow student numbers in order to support their research strategies.

Some also argued that the sustainability and quality of Australian research may be undermined without increased funding to support a higher level of indirect costs for competitive grants.

CGS funding is provided to support both teaching and research activities in universities. While the allocation is paid on the basis of student load, the Australian Government places no particular conditions on its use. Universities have discretion about the amount directed to support students and the amount directed to support research.

Consistent with the framework set out in the introduction to this report, universities should be autonomous, self-directing and focused on the quality of their research and teaching. It follows from this that universities continue to have discretion to direct funding to these activities to best address their missions and strategic goals.

Investment from broader university funds in research is a long standing feature of Australia's research funding system. The dual funding arrangements, in themselves, cannot meet all university research funding needs and neither the current nor predecessor arrangements have ever done so. Universities are required by the Higher Education Provider Standards[14] to carry out research in at least three fields of education and must therefore maintain some level of research, independent of their success at winning competitive external funding.

Therefore, regardless of the argument about the adequacy of RBG in covering the indirect costs of competitive grant research, which is discussed in the following section, universities need further, very substantial discretionary sources of research funding. The CGS plays an important role in this regard. This is not a new conclusion. The 2011 Higher Education Base Funding Review highlighted that the use of base funding (the CGS plus the student contribution of Australian Government-subsidised coursework students) for research activities is an accepted part of the research funding system.[15]

Indirect research costs

The ability of RBG to meet the indirect costs of Australian competitive grant research was raised in submissions.

The level of support for the indirect costs is typically shown as the ratio between the Research Infrastructure Block Grants (RIBG) and Sustainable Research Excellence (SRE), and the competitive grant pools. As Chart 3 shows, this ratio is currently slightly below 25 cents in the competitive dollar in 2015. While there have been variations, Chart 3 shows that indirect funding support has been less than 25 cents in the dollar for at least the past 20 years.

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[14] Commonwealth of Australia 2011. *Higher Education Standards Framework (Threshold Standards) 2011*.
[15] Lomax-Smith J, Watson L, Webster B, 2011, *Higher Education Base Funding Review: Final Report*.

Chart 3. Cents in dollar ratio 1996-2019 (RIBG+SRE)/ACG
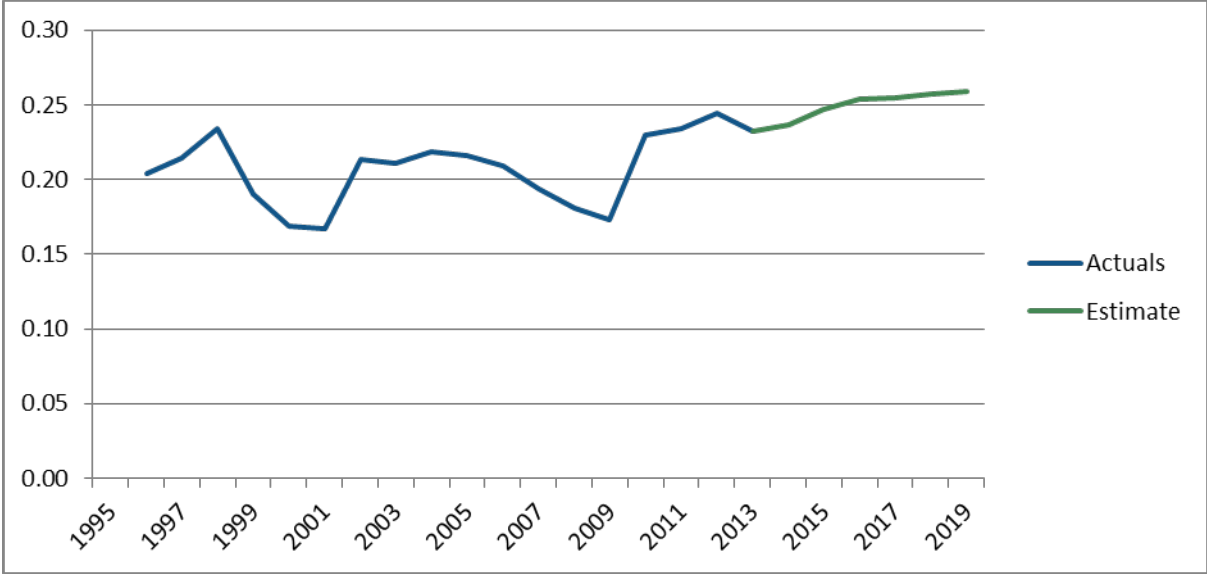
Source: Higher Education Research Data Collection, Departmental RBG funding records and budget forward estimates

It has been argued in some consultations that a reasonable benchmark for indirect costs would be 50 cents in the competitive dollar. Some submissions also referred to the then Government's intention, in introducing SRE funding in 2009-10, to increase indirect support for competitive grants to this level over time, although this was not achieved. Universities would need to receive around $430 million additional RBG funding in 2015 to reach the 50 cents benchmark.

Despite concerns about the insufficiency of support for indirect costs, universities have built and maintained high quality research with the present rate of funding of the indirect costs of competitive grant research, which has remained below 25 cents for many years. It is, however, important that the current arrangements are monitored to ensure that there is no significant deterioration in research quality, an issue discussed in the chapters on assessing Australia's research system and assessment of impact and engagement.

Indirect costs of research conducted by Medical Research Institutes (MRI)

Inconsistencies do appear to exist in regard to the funding of indirect costs of research conducted by independent MRI. Policy responsibility for the funding of MRI rests with the Department of Health and the NHMRC. The NHMRC provides support for the indirect costs of health and medical research conducted by MRI through the Independent Research Institute Infrastructure Support Scheme (IRIIS). MRI are, however, also able to gain access to university RBG through affiliate arrangements allowed for under the Higher Education Research Data Collection (HERDC).

Decisions about whether MRI seek funding under the IRIIS schemes or RBG have important financial implications as RBG currently pay more than IRIIS (around 24 to 25 cents per dollar in indirect cost support compared to 20 cents from IRIIS). However, there are a number of policy issues associated with allowing MRI to access RBG funding. For example, in a fixed

funding pool, RBG funding provided to MRI via affiliated universities would otherwise be allocated to other universities, the intended recipients of RBG funding.

Given the inconsistencies, the Department of Education and Training and the Department of Health should work to resolve the current complex and seemingly inequitable indirect cost support arrangements to determine how to achieve a level playing field for researchers that is independent of their host institution.

2. Research Block Grants: A new approach

The Research Block Grants (RBG) occupy a central place in this review. The review has been asked to advise on options to:

- ensure the quality and excellence of Australian university research and research training
- allocate existing block grant funding in a simpler and more transparent manner
- provide incentives to universities to increase and improve engagement and collaboration with industry and other end users
- encourage universities to engage in research commercialisation and knowledge transfer with industry and the broader community, including through funding incentives.

While only the second of these points mentions RBG explicitly, RBG are an essential element in the dual funding system for university research (refer to Chapter 1 on university funding) and comprise schemes which support research and research training as well as engagement with business and other end users.

However, while they are an essential element, RBG make only a modest contribution to total university research expenditure.

In 2012, the most recent year for which higher education research expenditure data is available, 'other Commonwealth government' — which is made up of RBG plus some other minor Commonwealth research funding — accounted for only 15 per cent of the $9.6 billion spend on research by universities.

The share of total university research income provided by RBG varies across the sector and has declined over time for all universities.

Chart 4. RBG funding as a share of total research income
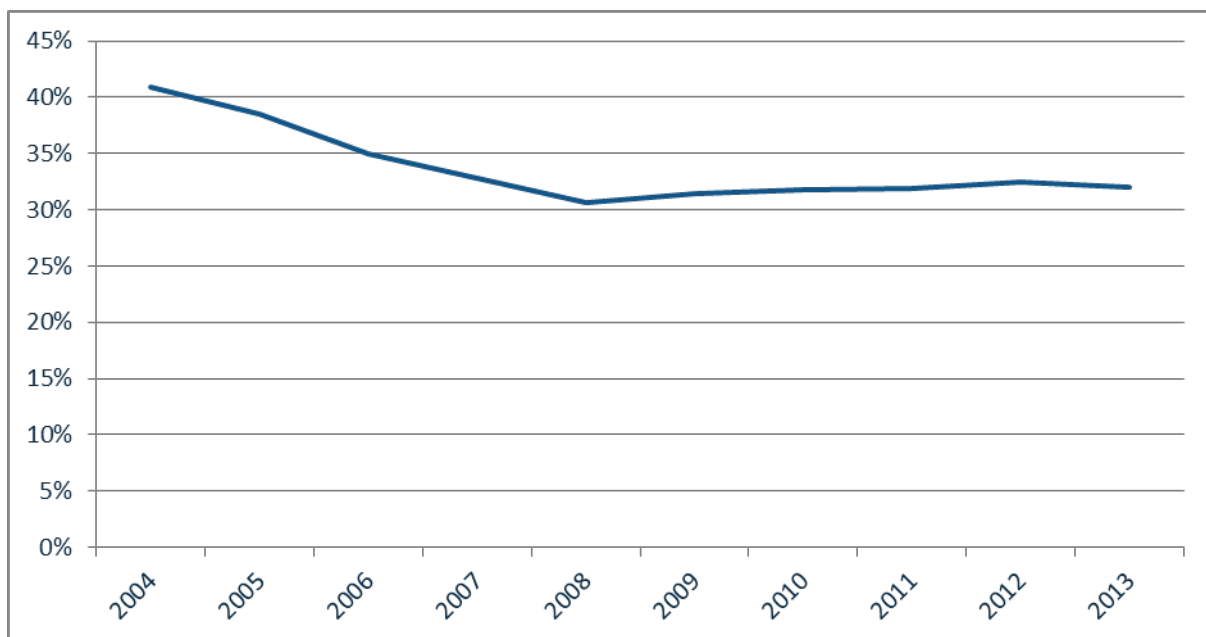
Source: Higher Education Research Data Collection and RBG funding records, Department of Education and Training, 2015

The distribution of funding is clearly weighted toward a small number of universities, as shown in Chart 5. The funding received by the first quartile, or top ten RBG funded universities by value, accounts for around 70 per cent of the total RBG funding (see Chart 6). By contrast, the universities in the lowest quartile receive around 3 per cent of total RBG funding. This distribution has remained largely unchanged over the past ten years.

Chart 5. Shares of RBG funding by institution, 2015 distribution ($ million)
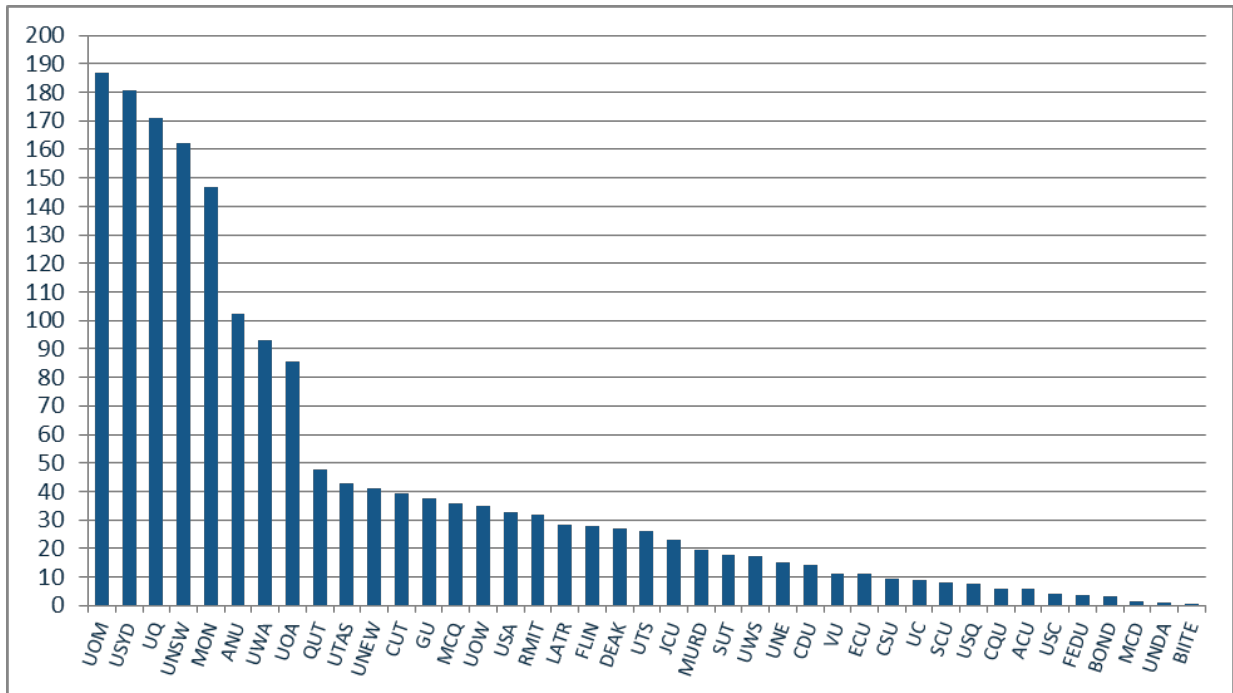
Source: RBG funding records, Department of Education and Training

Chart 6. Shares of RBG funding per quartile
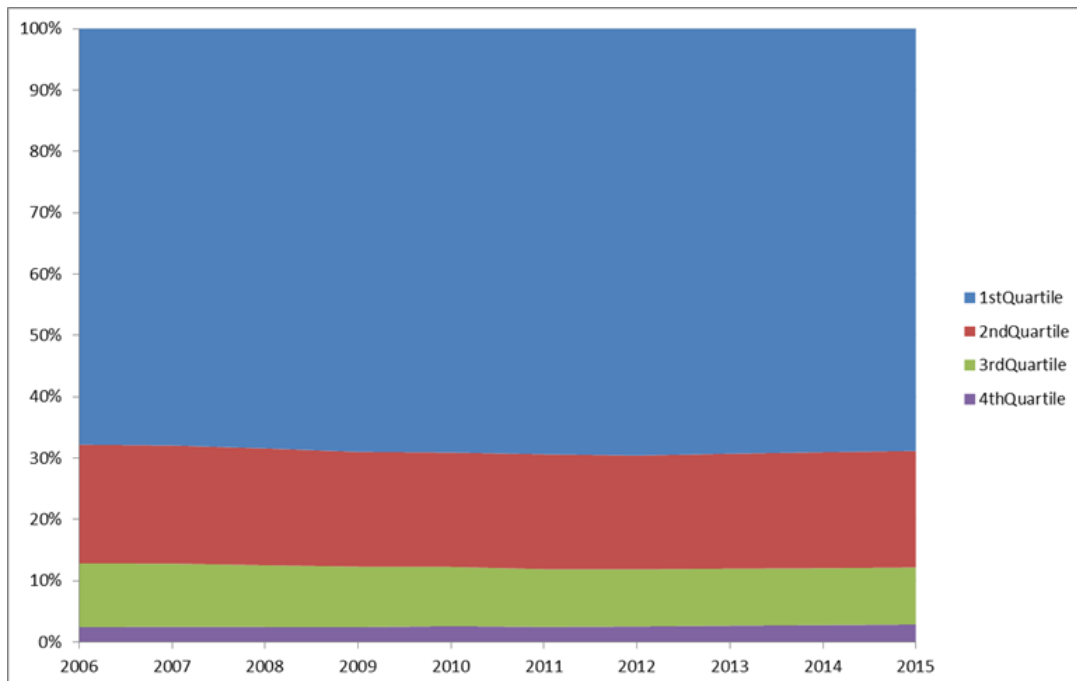
Source: RBG funding records, Department of Education and Training

In this chapter, the review considers the effectiveness of RBG since their establishment in 2001 in achieving government policy objectives and, consistent with its terms of reference, makes recommendations to simplify the allocation method and sharpen incentives for business and other end user engagement.

Research Block Grants – current arrangements

The current RBG arrangements include six schemes (and one sub-scheme), with funding allocations under each driven by performance based formulae. In broad terms, the schemes are designed to contribute to the indirect costs of conducting research and support Higher Degree by Research (HDR) training in universities. The objectives and funding drivers for each scheme are set out below. The objectives are drawn from the *Higher Education Support Act*: Other Grants Guidelines (Research) 2012. The date refers to implementation using current funding drivers.

Research Infrastructure Block Grant (RIBG), 1995

Objectives

- remedy deficiencies in current research infrastructure
- enhance support for areas of research strength
- ensure that areas of recognised research potential, in which institutions have taken steps to initiate high quality research activity, have access to the support necessary for development.

Funding driver: 100 per cent Australian Competitive Grant (ACG) income (Category 1 income).

Sustainable Research Excellence (SRE), 2010

Objectives

- address an identified shortfall in the funding available to meet the indirect costs associated with ACG research
- support universities to build and maintain research excellence through the implementation of best practice financial management, performance and reporting frameworks.

Funding driver: 100 per cent ACG income (Category 1 income). Note: Excellence in Research for Australia (ERA) results and data from the transparent costing exercise are used as moderators and make modest adjustments to initial funding allocations.

Joint Research Engagement (JRE), 2010

Objectives

- continue to support soft infrastructure
- continue to support the maintenance of capital items (not capital purchases)
- change the way that the level of funding for each university is calculated.

Funding drivers

- 60 per cent research income from Categories 2, 3 and 4 which represent income from the public sector other than ACG income, industry and Cooperative Research Centres
- 10 per cent publications
- 30 per cent student load.

Sub-scheme: JRE Grant – Engineering Cadetships

Objective: Encourage research students in engineering or science to undertake employment with a business concurrently with PhD or research Masters.

Research Training Scheme (RTS), 2002

Objectives

- enhance the quality of research training provision in Australia
- improve the responsiveness of higher education institutions to the needs of their research students
- encourage institutions to develop their own research training profiles
- ensure the relevance of research degree programmes to labour market requirements
- improve the efficiency and effectiveness of research training.

Funding drivers

- 40 per cent total research income (Categories 1-4 income)
- 50 per cent student completions
- 10 per cent publications.

Australian Postgraduate Awards (APA), 2003

Objectives

- support postgraduate research training in the higher education sector
- provide financial support to postgraduate students of exceptional research promise.

Funding drivers

- 40 per cent total research income (Categories 1-4 income)
- 50 per cent student completions
- 10 per cent publications.

International Postgraduate Research Scheme (IPRS), 2003

Objectives

- attract top quality international postgraduate students to areas of research strength in the Australian higher education sector
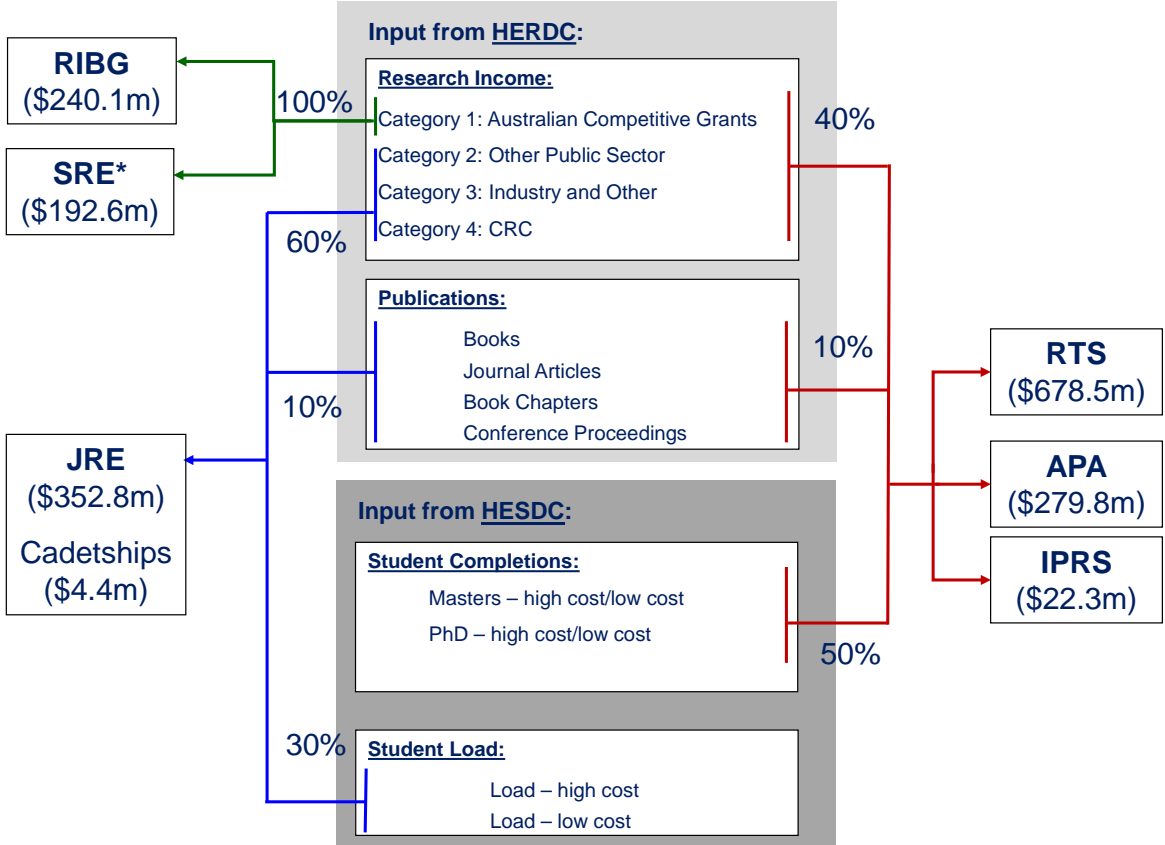- support Australia's research effort.

Funding drivers

- 40 per cent total research income (Categories 1-4 income)
- 50 per cent student completions
- 10 per cent publications.

Review consultations highlighted the key role played by RBG in supporting university research and research training. There was widespread support among universities for the continuation of RBG funding arrangements driven by quantitative performance metrics, rather than qualitative measures involving human judgement. Universities indicated that RBG provide a flexible income stream which supports the broad infrastructure required to undertake research, contributes to capacity to meet national and institutional priorities and allows the long term planning required to deliver on this.

Funding allocations for 2015 by scheme and funding driver are set out in Chart 7.

Chart 7. Research Block Grants, 2015

RIBG ($240.1m)	100% **Input from HERDC:**
SRE* ($192.6m)	**Research Income:** Category 1: Australian Competitive Grants / Category 2: Other Public Sector / Category 3: Industry and Other / Category 4: CRC — 40%
	60% **Publications:** Books / Journal Articles / Book Chapters / Conference Proceedings — 10%
JRE ($352.8m) Cadetships ($4.4m)	10%
	Input from HESDC: **Student Completions:** Masters – high cost/low cost / PhD – high cost/low cost — 50%
	30% **Student Load:** Load – high cost / Load – low cost
	RTS ($678.5m) / **APA** ($279.8m) / **IPRS** ($22.3m)

HERDC – Higher Education Research Data Collection
HESDC – Higher Education Student Data Collection

* SRE also uses ERA results and the indirect costs of research as moderators to make adjustments to SRE Threshold 2 funding amounts (67 per cent of the total SRE allocation), calculated on the basis of a higher education provider's (HEP) performance index. HEP ERA ratings for each four digit field of research are weighted such that the ratings 5, 4, 3, 2, 1, have a weighting of 7, 3, 1, 0, 0 respectively. For more information, see http://education.gov.au/research-block-grants-calculation-methodology#calculation-logic-for-sustainable

Moderation of changes in funding shares

The use of performance based formulae in RBG mean that universities' funding shares will change over time depending on their relative performance against the funding drivers. The rate of change is deliberately influenced by incorporating stabilising elements such as data averaging, pipelines and safety nets.[16] This system results in a significant level of stability across institutions and a high degree of funding certainty from year to year. While some movement does occur, it is always within the bounds set above.

Since the establishment of RBG, the Minister has determined the use of stabilising elements. Their purpose has been to minimise large fluctuations which, in theory, could lead to loss of essential funding support and mid-course abandonment of research projects and HDR students' study. At the time of establishment of RBG, stabilising elements were intended to be a transitional arrangement only. A 2003-04 evaluation of RBG recommended removal of an interim cap limiting gains to 5 per cent. [17] This was considered to disadvantage those institutions which were most successful in attracting non-competitive grant research income and, in that way, working against the intent of the reforms. This recommendation was not accepted and stabilising elements — albeit in somewhat different form — have remained part of RBG ever since.

Lags in performance reward

Lags in data collection mean that funding in a particular year rewards performance at least two years prior. For example, 2015 allocations announced in late 2014 were based on the two most recent years' data available at the time of determination of allocations. These were data for 2013 (collected in the 2014 Higher Education Research and Student Data collections) and data for 2012. As a result, there is a lag of three years before improved performance will fully influence funding allocations, with implications for both change and responsiveness. In particular, performance improvements from this point forward (i.e. starting 2016) will not fully influence allocations before 2019. That said, universities do anticipate expected funding changes and take steps to address them well before they occur. The impact of these lags is discussed further in the 'Transition' section later in this chapter.

Research support schemes (RIBG, SRE and JRE)

The RIBG and SRE schemes are the main source of support to universities for the indirect costs of ACG research (indirect costs are discussed in Chapter 1).

The RIBG was introduced in 1995 to support research infrastructure, particularly to meet project-related infrastructure costs associated with ACG. It has always been allocated using ACG income. A 1999 discussion paper proposed that RIBG funding should be attached to competitive grants — but this was not adopted on the basis that universities should have

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[16] Data averaging: data other than student load is averaged over the current reporting year and the previous year; pipelines provide guaranteed funding for ongoing students in APA and IPRS; safety nets for RTS and JRE are set at 95% so that the institutions funding cannot decline by more than 5% from year to year.
[17] External Reference Group, 2004, *Evaluation of Knowledge and Innovation Reforms Consultation Report*.

the flexibility and capacity to manage their infrastructure requirements at institutional level across all disciplines.[18] RIBG funding was increased substantially in 2002 under the then government's *Backing Australia's Ability – An Innovation Action Plan for the Future*, with the aim of maintaining research infrastructure funding of at least 20 cents in the competitive dollar.

The SRE was introduced in 2010 with the objective of increasing funding to support the indirect costs of research over time. The scheme also sought to build and maintain research excellence in universities through providing incentives to implement best practice financial management, performance and reporting frameworks. Funding under SRE is driven by Category 1 research income and uses two moderators to determine final grant amounts — an excellence index based on ERA results and data from transparent costing — the latter based on a staff hours survey in 2011[19] and an annual financial report by each institution on their indirect costs.

In 2015, the application of the excellence index created an average loss against pre-moderated allocations of $0.35 million and an average gain of $1.51 million. These average movements represent 0.4 per cent and 2.0 per cent of the SRE excellence pool and 0.2 per cent and 0.8 per cent of total SRE funding.

Transparent costing has a smaller impact on allocations. In 2015 the application of the transparent costing moderators created an average loss against pre-moderated allocations of $0.11 million and an average gain of $0.04 million. These average movements represent 0.14 per cent and 0.05 per cent of the transparent costing pool and 0.06 per cent and 0.02 per cent of total SRE funding.

The third scheme, the JRE, replaced the Institutional Grants Scheme in 2010. The JRE aimed to introduce greater incentives for end user research by removing Category 1 (ACG income) from the funding formula for the preceding scheme. However, both the funding allocation and its purpose, to support general institutional research infrastructure, remained unchanged.

The JRE Engineering Cadetships is a small sub-scheme with funding of $4.4 million in 2015. It provides participating institutions with supplementation to support the research training costs for each HDR student undertaking a cadetship in relevant areas of engineering and science. Cadetships involve a combination of formal research training with the institution and concurrent employment with a business to carry out R&D activities. This scheme has been unsuccessful since its start. The number of universities participating has declined each year and in 2015, fourteen universities indicated they would not participate.[20] 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

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[18] Kemp D A, 1999, *Knowledge and Innovation: a policy statement on research and research training*.

[19] The transparent costing exercise collected data on how university researchers balanced their time between research and other activities over a two week period. It aimed to determine the relative costs associated with supporting ACG research.

[20] Department of Education and Training data.

placements. It is clear that the scheme is too complex and imposes excessive requirements on participating students, employers and universities.

Research training schemes (RTS, APA and IPRS)

The RTS, the APA and the IPRS have been largely stable in their objectives and structure since the introduction of the RTS in 2002. The current funding allocation drivers for the APA and IPRS programmes were implemented fully in 2003. IPRS scholarship holders became eligible to compete, along with domestic students, for an APA stipend in 2011.

In the 2014-15 Budget, the Australian Government announced that institutions would be able to charge RTS students undertaking HDR courses a contribution towards the costs of that degree. In recognition of the ability to raise student contributions, funding provided to universities through the RTS was to be reduced by 10 per cent from 1 January 2016. The Government has indicated subsequently that it will consult with the sector on future directions for higher education reforms. In that context and to ensure certainty for universities, funding arrangements will remain unchanged for 2016.

The architecture of new RBG arrangements recommended by the review is not materially impacted by this change to RTS funding arrangements. The financial modelling done for the review assumes that, consistent with government policy, it will take effect in 2017.

Key issues

Research support schemes

Under current arrangements, three schemes support the systemic and indirect costs of research. The review concluded that there was no purpose served by retaining separate schemes for RIBG and SRE, which have the same objective — to support the indirect costs associated with competitive grants.

Further, the review did not see value in the continued inclusion of moderators in SRE. The level of any benefit they may bring to the arrangements is not commensurate with the complexity they add. In relation to use of the excellence index, based on ERA ratings, there is a high level of correlation between ERA outcomes and Category 1 funding (which is the sole driver for the scheme). Moreover, ERA takes place every three years and covers activity in the five to six years prior to the assessment year, while Category 1 data is collected annually and on a shorter lag cycle (discussed above). The review concluded, on balance, that this moderator should be removed. It also concluded that transparent costing data, also used as a moderator, should be removed. It imposes a substantial reporting burden on universities and moderates a small amount of funding only.

In relation to the JRE scheme, the review considered that publications and student load should be removed as funding drivers. Publications are a very important measure of academic productivity. However, the incentives to publish embedded in almost all other areas of the academic research system, such academic promotions and global university rankings, are far stronger than the impact of less than 10 per cent weighting in the current

RBG. Student load is an input measure which does not appear to have a relationship with either research excellence or end user engagement.

Finally, the JRE Engineering Cadetship has been unsuccessful with increasing numbers of universities withdrawing from participation. The review concluded that the scheme should be retired and funding subsumed in the new model.

It also appears that the JRE scheme, despite its objectives, has not driven higher rates of business and end user engagement than other types of income. Data from the HERDC[21] show that the proportion of higher education research income from private sector sources has remained static, at around 27 per cent, over the period 2008-13.

In the light of these outcomes and Australia's poor standing in OECD data on collaboration between universities and business, the review concluded that RBG, as a possible policy lever, should have a greater focus on providing incentives for end user engagement.

Research training schemes

The three schemes which support research training — RTS, APA and IPRS — serve a common purpose. They contribute to the costs borne by the university in training HDR students while providing stipends to support living and other costs for the student while studying.

The review acknowledged that current differences between programme arrangements in these schemes such as programme lengths — with RTS support provided for 4 years and APA support for 3 years with possibility of a six month extension — and fixed stipend levels, limit institutional ability to align research training support with their priorities and student profiles. In particular, current arrangements create impediments to greater use of industry placements during PhD courses — a key strategy for generating greater commercial interests among PhD students.

The review concluded that the three schemes should be combined and the rules governing their use simplified.

By combining these schemes, universities will have greater flexibility to:

- offer both stipends and tuition fee scholarships to the best applicants in priority areas of research, regardless of nationality
- offer stipends and tuition fee scholarships for longer periods of time, where justified by innovation in course structures or personal circumstances
- introduce innovative structures and arrangements which increase the skills and employability of research graduates, such as business placements and relevant coursework in appropriate research fields.

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[21] Higher Education Research Data Collection data is available from the Department of Education and Training http://www.education.gov.au/higher-education-research-data-collection.

The review further concluded that only two funding drivers, research income and student completions, should be employed. Publications are not an effective measure of the research training environment within a university and inclusion of the publications measure represents the continuing adherence to historical research priorities. It should be removed.

A new model for RBG

Consistent with these objectives, it was concluded that RBG should be allocated through two schemes only, one supporting research and one supporting research training:

- a Research Support Programme combining RIBG, SRE and JRE funding allocations, which removes publications and student load as funding drivers and applies two equally weighted funding drivers — competitive grants (Category 1) income and business and other end user income (Category 2-4) income
- a Research Training Programme combining RTS, APA and IPRS funding allocations, which removes publications as a funding driver, and gives equal weight to student completions and research income (in which equal weighting is given to Category 1 and Category 2-4 income).

The equal weighting given to competitive grant (Category 1) research income and other (Category 2-4) research income reflects the Government's position that research aimed at meeting the needs of business and other end users and high quality fundamental research are of equal importance.

The recommended 50:50 split should not be seen as downplaying the continuing importance of research quality. As discussed in Chapter 6, the high quality of Australian university research in many fields is internationally recognised. Quality is fundamental to the international standing of Australian universities. It is central to almost all university assessment systems, including ERA and the major global ranking systems, and to individual academic careers. The need to balance the continuing importance of quality, as reflected in success in ACG, with the importance of driving increased levels of engagement, has resulted in the review proposing only a modest rebalancing of the weighting between Category 1 research income and Category 2-4 income, from 55:45 to 50:50, in driving research support funding. Further, the combined effect of the changes across the proposed schemes means that the influence of Category 1 income on total RBG actually increases slightly overall, as discussed below.

While the 50:50 split may appear to represent a modest shift only towards reward for engagement, the combined effect of the changes leads to significant increased financial reward for engagement, as set out in Chart 8(ii). The 50:50 split also sends a clear signal that the Government attaches great importance to both the universities being producers of new fundamental knowledge and working with businesses to use that knowledge to develop innovative products, services and processes.

The review anticipates that universities wishing to best position themselves for the future will seek to increase their engagement with industry and other end users of research from the start, not just to maximise their future RBG income but to strategically position

themselves to better align with government priorities that will be given effect in policies and funding going well beyond RBG.

In recent years, the sector has demonstrated its capacity to respond to incentives which have been soundly designed to encourage the behaviour sought by government. This is exemplified by growth in domestic undergraduate student load in response to demand driven funding and the removal of caps on undergraduate student places in 2012. Participation in higher education by disadvantaged students also increased over the period from 2007 in response to new programmes aimed at increasing equity,[22] despite concern about the red tape load associated with the programmes in their initial form.

The balance between the research income drivers is also reflected in research training arrangements. Weighting for student completions remains unchanged, at 50 per cent. With the removal of student load from RBG formulae, student completions become the only measure of student training an institution is undertaking. The use of completions rather than load more appropriately provides rewards for effectiveness of institutional research training performance.

RBG as a whole

The review concluded that incremental reforms over the life of RBG have reduced the focus and coherence of the programmes and have resulted in funding arrangements which:

- lack policy coherence, with multiple programmes supporting similar policy objectives
- employ funding allocation methods which are unnecessarily complex for no clear benefit
- lack clear incentives to drive the goal of increasing university engagement with business and other research end users.

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[22] Koshi P, and Seymour R, 2015.

Chart 8 (i). Research Block Grant Allocations 2017 under the existing model (2017 dollars)

| RIBG ($249.6m) | |
| SRE* ($214.1m) | |

Input from HERDC:

Research Income:
Category 1: Australian Competitive Grants
Category 2: Other Public Sector
Category 3: Industry and Other
Category 4: CRC

100%

40%

Publications:
Books
Journal Articles
Book Chapters
Conference Proceedings

60%

10%

JRE ($371.3m)

10%

Engagement ($222.8m)

Input from HESDC:

Student Completions:
Masters – high cost/low cost
PhD – high cost/low cost

50%

Student Load:
Load – high cost
Load – low cost

30%

RTS ($634.7m)

APA ($290.6m)

IPRS ($23.1m)

Engagement ($200.5m)

Note: SRE also uses ERA results and the indirect costs of research as moderators to make modest adjustments to initial funding amounts allocated by its performance index

Chart 8(ii). Research Block Grant Allocations 2017 under the new model (2017 dollars)

50% Competitive ($417.5m)

25% Competitive ($237.1m)

RSP ($835.0m)

Input from HERDC:

Research Income:
Category 1: Australian Competitive Grants
Category 2: Other Public Sector
Category 3: Industry and Other
Category 4: CRC

50% Income

50% Engagement ($417.5m)

25% Engagement ($237.1m)

~~10%~~ 0%

Publications:
Books
Journal Articles
Book Chapters
Conference Proceedings

~~10%~~ 0%

RTP ($948.4m)

Input from HESDC:

Student Completions:
Masters – high cost/low cost
PhD – high cost/low cost

0%

50% Completions ($474.2m)

Student Load:
Load – high cost
Load – low cost

~~30%~~ 0%

0%

The following tables set out a comparison of existing and new RBG funding models in 2017 dollars.

Modelling of the expected impact the new model will have at sector level is set out in Chart 8 (ii) and Table 3 (i).

The modelling shows how it is possible to significantly increase reward for engagement, as measured by Category 2-4 research income, without significantly impacting on reward for research excellence, as measured by Category 1 income.

The removal of publications and student load as funding drivers 'releases' $243.4 million RBG funding in 2017, as detailed in Table 3(iii). Across all programmes, $231.3 million of that funding is redirected to Category 2-4 income and $12.1 million to Category 1 income. The third driver to be used in the new model, student completions, is not changed.

The level of funding driven by the engagement indicator, Category 2-4 research income, increases by 87 per cent for Research Support in the new model relative to the old model, from $223 million to $417 million. For Research Training, it increases by 18 per cent, from $200 million to $237 million. Over the total RBG, the allocation driven by Category 2-4 income increases by $231 million, or 55 per cent, from $423 million to $654 million. Put another way, the amount of Category 2–4 income currently needed to return one dollar of RBG will return $1.55 under the new arrangements.

Overall, the percentage of total RBG driven by Category 2-4 income increases from 23.7 per cent to 36.7 per cent. Under the 50:50 balance which underpins the new model, Category 1 research income also drives 36.7 per cent of the total, a small increase over the 36.0 per cent it drives in the current model.

Table 3(i). Programme funding, dollar contribution by funding driver ($million)

Programme New/Old	Programme Total	Funding driver				
		Cat 1	Cat 2,3,4	Completions	Publications	Load
RSP Old	835.0	463.7	222.8	0.0	37.1	111.4
RSP New	835.0	417.5	417.5	0.0	0.0	0.0
RTP Old	948.4	178.8	200.5	474.2	94.8	0.0
RTP New	948.4	237.1	237.1	474.2	0.0	0.0
Total RBG Old	1,783.3	642.5	423.3	474.2	132.0	111.4
Total RBG New	1,783.3	654.6	654.6	474.2	0.0	0.0

Note: 'RSP Old' is the total of RIBG, SRE and JRE. 'RTP Old' is the total of the RTS, APA and IPRS.

Table 3(ii). Programme funding, percentage contribution by funding driver

Programme New/Old	Programme Total	Funding driver				
		Cat1	Cat2,3,4	Completions	Publications	Load
RSP Old	46.8%	55.5%	26.7%	0.0%	4.4%	13.3%
RSP New	46.8%	50.0%	50.0%	0.0%	0.0%	0.0%
RTP Old	53.2%	18.9%	21.1%	50.0%	10.0%	0.0%
RTP New	53.2%	25.0%	25.0%	50.0%	0.0%	0.0%
Total RBG Old	**100.0%**	**36.0%**	**23.7%**	**26.6%**	**7.4%**	**6.2%**
Total RBG New	**100.0%**	**36.7%**	**36.7%**	**26.6%**	**0.0%**	**0.0%**

Note: 'RSP Old' is the total of RIBG, SRE and JRE. 'RTP Old' is the total of the RTS, APA and IPRS.

Table 3(iii). Change within programme ($ million)

Programme	Programme Total	Funding driver				
		Cat1	Cat2,3,4	Completions	Publications	Load
RSP	0.0	-46.2	194.7	0.0	-37.1	-111.4
RTP	0.0	58.3	36.6	0.0	-94.8	0.0
RBG	0.0	12.1	231.3	0.0	-132.0	-111.4

Table 3(iv). Change within programme (percentage)

Programme	Programme Total	Funding driver				
		Cat1	Cat2,3,4	Completions	Publications	Load
RSP	0.0%	-5.5%	23.3%	0.0%	-4.4%	-13.3%
RTP	0.0%	6.1%	3.9%	0.0%	-10.0%	0.0%
RBG	0.0%	0.7%	13.0%	0.0%	-7.4%	-6.2%

Source: Department of Education and Training

Support for the indirect costs of ACG through the Research Support Programme, as reflected by the level of funding driven by Category 1 income, decreases by 5.5 per cent, from $463.7 million to $417.5 million in the new model, or from 55.5 per cent of research support grants to 50.0 per cent (see Table 3(ii)). This represents a decrease from the current level of slightly less than 25 cents in the dollar provided by RIBG and SRE to 22.5 cents in the dollar. However, at 22.5 cents, indirect cost support has remained well within the 20-25 cent range prevailing since the introduction of RBG. The review has concluded that, on balance, the disadvantages of this small decrease are outweighed by the benefits of the new model.

The importance of Category 1 income in allocating funding dollars is not diminished by this change. The proportion of research training driven by Category 1 income increases from 18.9 per cent to 25.0 per cent. Across both new RBG programmes, the proportion of grants driven by Category 1 income is maintained, increasing slightly from 36.0 per cent to 36.7 per cent (see Table 3(ii)).

There was broad support expressed during review consultations for the approach embodied in the new model on the basis it would simplify formulae used in RBG calculation and because it provided clearer signals about government priorities for university research.

Benefits of the new model

The recommended single **Research Support** Programme achieves the policy goals of:

- simplifying the current arrangements — by combining three schemes into one, removing student load and publications and removing complexities in the SRE funding arrangements
- establishing clearer incentives for business and other end user engagement — including by increasing the weighting for Category 2, 3 and 4 income from its present 45 per cent to 50 per cent to reward this activity
- emphasising clearly that excellence and engagement are equally important elements of university research.

The recommended single **Research Training** Programme achieves the policy goals of:

- simplifying the current arrangements — by combining three schemes into one and using two drivers to allocate funds, removing publications from the formula
- providing more flexibility to universities to meet national and institutional priorities, such as increased numbers of students accessing business placements, and removing regulatory requirements
- retaining a strong focus on completions, which is a measure of the effectiveness of the research training system
- recognising that research training quality and excellence and engagement in research, as measured by research income, are equally important elements of the environment in which research training is delivered.

The Australian Council of Learned Academies (ACOLA) is conducting a review Australia's research training system and identifying areas for improvement. The ACOLA review will report in March 2016. This review has been conducted in consultation with ACOLA to help ensure congruence between the findings and directions of the two reviews, where relevant. ACOLA has identified some emerging findings which will be tested and refined during the remaining period of their review. These findings relate to a very broad range of research training issues and include consideration of areas such as entry pathways, thesis examination and academic teaching training, which are beyond the terms of reference for this review. Themes in ACOLA's emerging findings which are relevant to this review and RBG arrangements in particular include support for doctoral training centres to promote industry involvement in research training; improving access to professional skills development; arrangements to combine academic and industry partners in the development and supervision of HDR research projects; and increasing support for industry internships and partnerships.

This review considers that proposed changes to RBG and other review recommendations will support the directions being considered by ACOLA, particularly in respect of the shared objective of increasing university collaboration with business in the context of the research training system as well as more broadly in the university research system.

Refining the engagement indicator

The existing indicator — Category 2, 3 and 4 research income — is at present the most robust, routinely collected measure of university engagement with business and other end users of research. For this reason, the review has concluded that information collected under these categories through the HERDC should continue to be used as a driver in RBG funding allocation, at least until superior indicators are agreed and relevant data collected.

There are two levels of potential improvement of the engagement indicator:

- development of new, more sophisticated metrics for impact and engagement — this is addressed in Chapter 6
- refinement of the existing research income indicator, which is discussed below.

The HERDC requires universities to report research income according to the disaggregation shown in Table 4.

Table 4. Categories and sub-categories of research income collected by HERDC

Category	Sub-category
Category 2: Other public sector research income	Australian Government (non-Category 1) State or territory government Government business enterprises Cooperative Research Centres (CRC)
Category 3: Industry and other research income	Australian contracts Australian grants Donations, bequests and foundations HDR fees for domestic students International: competitive, peer-reviewed research grant income International: other income International: HDR fees for international students
Category 4: CRC research income	Research income derived from Australian Government grants to CRC Research income derived from non-university members of CRC Research income derived from external parties contributing to CRC

The collection includes income from sources which are not, prima facie, measures of engagement arising directly from research activity, for example, fees for research students or donations and bequests.

The review considers that there should be scrutiny of these categories with a view to defining and collecting data under revised categories, which more accurately differentiate research income associated with business and other end user engagement. This work should be conducted by the Department of Education and Training and the Australian Research Council in consultation with the university sector and be completed by late 2016, taking into account existing plans for a single data collection to satisfy both ERA and RBG needs.

Transition and transition support

The architecture of the new RBG model will be implemented from the start of calendar year 2017.

Universities are agile institutions that are well equipped to respond to the government's clear signals about priorities and invariably do. Many universities are already implementing strategies aimed at increasing business and other end user engagement. It is expected that they will start to bolster these strategies as soon as new research funding arrangements are decided. The results of these strategies will in turn influence the funding allocations flowing from RBG.

However, the lags in the funding system will mean that actions taken by universities from 2016 on will not be fully reflected in funding allocations made under the new funding arrangements until 2019, as explained in Table 5.

Table 5. Chronology of transition from existing to new RBG funding arrangements

Funding Year	2016	2017	2018	2019	2020
Latest Data Year	2014 [a]	2015 [a]	2016 [b]	2017 [b]	2018 [b]
Second latest data year	2013 [a]	2014 [a]	2015 [a]	2016 [b]	2017 [b]

[a] Old incentives

[b] New Incentives

The review recognises that universities have existing commitments and will need some time to adjust to the new RBG arrangements. However, Australia cannot afford to continually defer decisive action to improve engagement, particularly given our performance to date. While the pace of change should not be too fast, concerns about transition cannot serve to delay implementation or blunt the incentives for increased university-business engagement.

Modelling undertaken for the review suggests that some universities are likely to lose funding in 2017 and 2018 at a level which is potentially higher than normal year to year institution-level fluctuation. The possibility of too rapid a change in funding levels may undermine universities' capacity to effectively complete existing research projects and students undergoing research training and prevent them focusing on the new engagement agenda.

Modelling also suggests that some universities of lower research intensity, particularly the smaller ones, may be negatively impacted. Although many of these institutions are strongly engaged with their communities, their geography and limited research profiles suggest they may take longer than the research intensive metropolitan universities to establish business collaborations yielding research income. A smooth transition is of particular importance for these institutions.

The review concluded that there is a need for some time-limited transition support. There are different considerations applying to research support and research training and the two components should have a somewhat different transitional arrangement:

Research Support transitional arrangements

The Research Support Programme is the strongest lever to influence academics and institutions to change their behaviour. They need to be exposed to the impact of the formula from day one in order to drive them seek new opportunities for engagement. A modest level of support while they respond to the new arrangements will strengthen their capacity to respond. This support should be provided through the use of a safety net so that funding is not reduced below 95 per cent of the prior year's funding (indexed). The safety net support should be provided for the first four years only, with institutions subject to full movement based on performance after that.

While there are changes to distributions, modelling suggests the Research Support safety net will work to limit the scale of this variability by providing support in the order of $15 million in 2017, $11 million in 2018, $8 million in 2019 and $6 million in 2020 to institutions that would lose funding under the proposed arrangements if current relative performance is maintained across universities. These amounts represent 1.8 per cent of $835 million down to 0.6 per cent of $975 million of Research Support funding in those years.

Research training transitional arrangements

The Research Training Programme supports students who have already committed to their studies and will take some time to complete their degrees. Their institutions need to support their existing entitlements for that period. The transition should apply the new formula to only 25 per cent of the funding pool in the first four years with the remainder allocated on the basis of the prior year's funding. This will allow the amount of funding influenced by the new formula to rise steadily over the transition period, with 100 per cent of the distribution allocated under the new formula from 2021, supporting an orderly transition. During the transition, the department should publish the 100 per cent formula amounts at the same time as actual funding to fully inform institutions on their likely future outcomes.

The operation of the Research Training transitional arrangements is shown schematically in Chart 9.

Chart 9. Transitional arrangements for new Research Training block grant funding
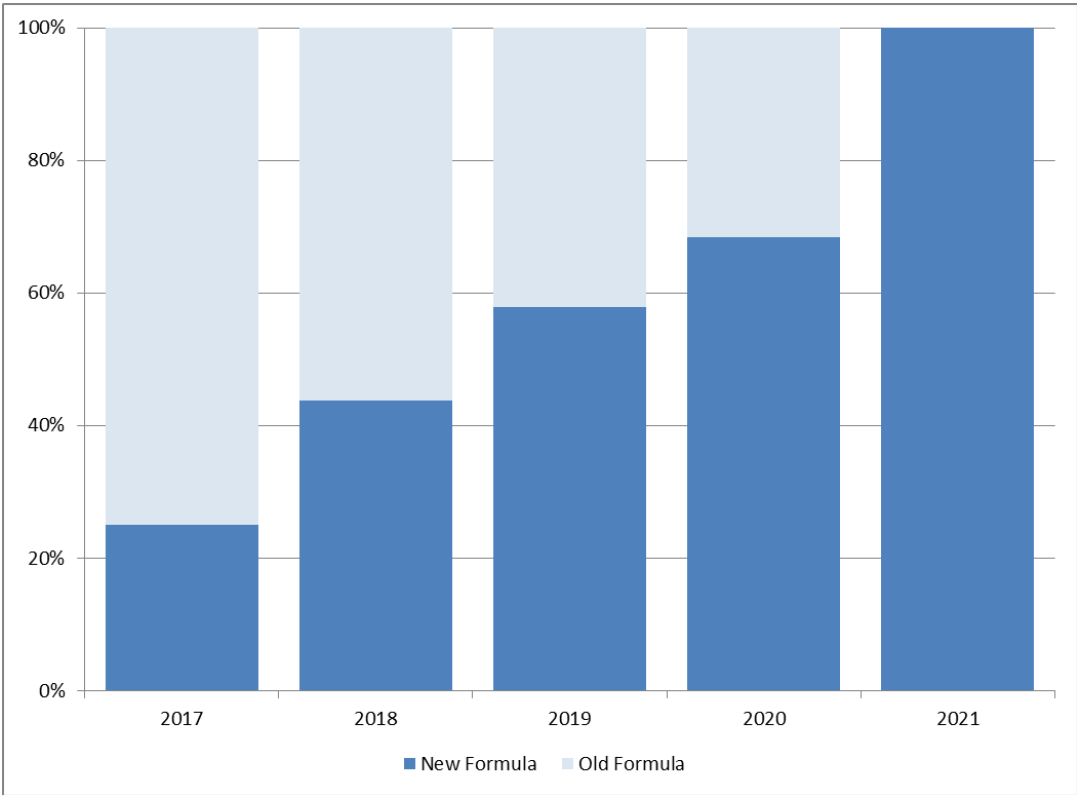
Further incentives for increased engagement

The proposed new RBG model seeks to achieve a better balance between rewarding increased engagement and sustaining the quality of the broad spectrum of university research. A modest injection of new funding tied to performance in collaboration measures would further emphasise and support the signal of the Government's expectation — of both universities and business — that there should be a step change in university-business engagement and, more particularly, knowledge transfer and innovation.

Additional funding for Research Support should be introduced once universities have had time to start to reflect the new incentives in institutional strategies.

The review therefore considers that additional funding of around $50 million a year, or roughly 12 per cent of the engagement funding, should be provided from 2018 and this should be reflected in the 2017-18 Budget to further incentivise business and end user engagement. If fiscal circumstances permit, a modest down payment in 2017 would be a useful starting point.

Recommendations

The review recommends that, commencing in the 2017 calendar year, the Australian Government should introduce the following arrangements to simplify RBG and to provide greater encouragement of engagement and innovation in research and research training:

Research Support

1. Simplify arrangements for research support and increase incentives for business and other research end user engagement by combining the three schemes which provide research support, using drivers which equally reward excellence and end user engagement:
    a. 50 per cent based on Category 1 research income to support the indirect costs of Australian competitive grants
    b. 50 per cent based on Category 2-4 research income to support business and other research end user engagement.

Research Training

2. Simplify arrangements for research training funding by combining the three schemes which support this function, using the following drivers:
    a. 50 per cent student completions
    b. 50 per cent Categories 1-4 research income, with equal weighting to be given to Category 1 income and Category 2-4 income.

Transition to new arrangements

3. To allow an orderly transition to the new arrangements:
    a. introduce a safety net for Research Support funding, for the first four years of operation, so that no university receives less than 95 per cent of its funding for the prior year, indexed
    b. progressively increasing the influence of the new Research Training funding formula by applying it to 25 per cent of the pool in each of years 2017 to 2020, with the balance being based on the previous year's allocations.

Additional funding to further incentivise engagement

4. Additional funding of $50 million per annum, ongoing, should be provided, commencing 2018, to further increase incentives to universities for business and end user engagement.

Should fiscal circumstances permit, a modest down payment should be made in 2017.

Review of RBG engagement data

5. In consultation with Universities Australia, the Department of Education and Training and the ARC should examine research income counted in Categories 2, 3 and 4 and, by mid-2016, determine which data provide the most appropriate measures of end user contributions.

3. Competitive Grant Programmes

The terms of reference for the review note the Government's commitment to 'working with the Australian Research Council and the National Health and Medical Research Council to ensure rules for competitive grants appropriately recognise industry relevant expertise or research'. Further, the terms of reference require that the review provide advice to Government on options to:

- ensure the quality and excellence of Australian university research
- provide incentives to universities to increase and improve engagement and collaboration with industry and other end users
- ensure that competitive grant criteria recognise the quality of the proposal and where appropriate the opportunity for commercialisation and collaboration with industry.

This chapter provides an overview of current Australian Research Council (ARC) and National Health and Medical Research Council (NHMRC) competitive grant programmes that support collaboration between university researchers and business and other end users. It discusses recent changes to the funding rules of both agencies and makes recommendations to further improve their responsiveness to the needs of partners and their effectiveness in facilitating collaboration.

The current competitive grant programmes

Current ARC and NHMRC competitive grant programmes support both fundamental (blue sky) research, which aims to develop and advance knowledge, and applied research, which is usually conducted in collaboration with business and other end users and focused on the translation of knowledge to achieve economic, social, environmental and other benefits.

A focus on research quality underpins the competitive research grant programmes, including those which facilitate collaboration. High quality basic research is widely accepted as fundamental to support the generation of new ideas and future innovative capacity. The OECD has identified the importance of fostering strong and effective research to support innovation, arguing that institutions should seek both 'to enhance excellence and to create better links to other innovation actors and stakeholders.'[23] Further, drawing on international findings, the OECD notes the particular importance of basic research, which 'gives rise to significantly larger knowledge spillovers than applied research while making applied research much more productive'.[24]

Several ARC and NHMRC schemes are designed to support research conducted in collaboration with a range of partners (including business and other end users such as non-profit organisations, and local, state, territory and Commonwealth government organisations).

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[23] OECD, 2010, *Ministerial report on the OECD Innovation Strategy: Innovation to strengthen growth and address global and social challenges – Key Findings*.

[24] OECD, 2015, *The Innovation Imperative: Contributing to Productivity, Growth and Well-Being*.

The value of partners' contributions to research projects under these schemes illustrates the scale of current collaboration. For example, in 2015, the ARC allocated nearly $117 million in funding for new and ongoing projects within key collaboration-focused schemes – Linkage Projects, Industrial Transformation Research Hubs (ITRH) and Industrial Transformation Training Centres (ITTC). These projects involved collaboration with 1,118 for-profit businesses, contributing over $45 million in cash and $89 million in-kind, and 1,305 non-profit organisations contributing $25 million in cash and nearly $62 million in-kind.[25] Based on these figures, every dollar of ARC funding through these schemes leverages around $1.88 of cash and in-kind contributions from partner organisations. More information on partner organisation contributions in the Linkage Projects scheme is in Chart 10.

Australian Research Council

The ARC administers the National Competitive Grants Programme (NCGP). The NCGP comprises two programmes: Discovery ($514 million in 2015-16) and Linkage ($275 million in 2015-16). The Discovery Programme focusses on supporting excellent fundamental (blue sky) research to expand Australia's knowledge base and research capability, recognising the importance of fundamental research to the national innovation system. The Linkage Programme funds collaborative research between universities, researchers, businesses, publicly funded research agencies and community organisations. Its aim is to improve the use of research outcomes and strengthen links within Australia's innovation system. It consists of the following schemes:[26]

- The Linkage Projects scheme ($89.4 million for projects in 2015) is designed to initiate and develop strategic alliances between universities and businesses and other end users of research. Linkage Projects is the ARC's flagship scheme for collaboration between universities and end users, providing flexible opportunities for a broad range of partnerships in diverse disciplines. It offers the largest number of ARC collaboration-focused grants and received the greatest focus from stakeholders during consultations.
- the Industrial Transformation Research Programme (ITRP), which includes Research Hubs ($14.1 million for projects in 2015) and Training Centres ($13.1 million for projects in 2015), is designed to offer a transitional step between the support for individual research projects and support for larger programmes of research.

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[25] Data provided by ARC. Figures include combined totals for the Linkage Projects scheme, ITRH and ITTC. Although some projects under these schemes involve collaboration between research institutions, there are no projects that involve only research institutions as partners. Figures for the ARC Centres of Excellence scheme have not been included, as collaboration between research institutions is a key focus of the scheme, and it includes some projects that involve collaboration between research institutions only.

[26] Data provided by ARC. The Linkage Programme also includes the Linkage Infrastructure, Equipment and Facilities scheme. This scheme provides funding for research infrastructure, equipment and facilities to eligible organisations.

- the ARC Centres of Excellence scheme ($77.5 million for projects in 2015) provides support for large scale research programmes that feature both pure and applied research. [27]

The review focused on the Linkage Projects scheme, the ARC's major vehicle for supporting end user collaboration. In this scheme, business represented 38 per cent of all partner organisations across the years 2005 to 2014 (ranging from 33 per cent in 2011 to 43 per cent in 2013). As shown in Chart 10, below, business partner organisations have also made the largest contribution to research projects, pledging half of all cash and in-kind contributions ($1,069 million of a total $2,127 million) over that period. [28]

Chart 10. Linkage Projects, partner organisation pledged contributions (cash and in-kind) by type of organisation, by year [*]
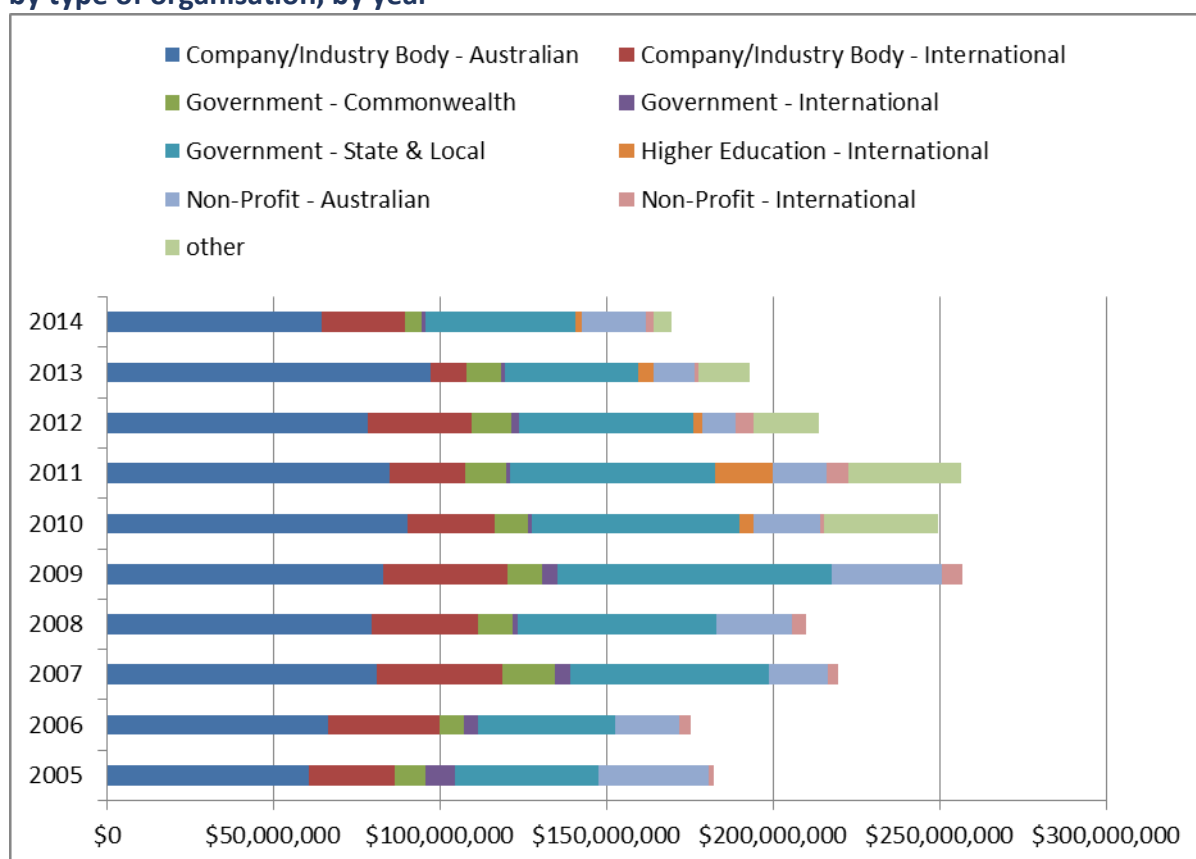
[*] Chart provided by ARC. Note: The decline in partner organisation contributions in 2012 and 2013 reflect changes in the ARC Linkage Programme to facilitate the introduction of the ITRP. Funding was realigned to facilitate the introduction of the ITRH scheme in 2012, and the ITTC scheme in 2013. In 2013, selection rounds conducted under the Linkage Projects scheme were reduced from two rounds per year to one round per year.

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[27] Collaboration between research institutions is a key focus of the ARC Centres of Excellence scheme. ARC funding in 2015 for projects under the scheme involving only Australian and international research institutions was $17.0 million (data provided by ARC).
[28] Data provided by ARC.

Success rates for Linkage Projects proposals (successful applications as a percentage of applications received) have declined slightly from 36.4 per cent in 2012 to 35.5 per cent in 2015 (after reaching 39 per cent in 2013), and return rates for successful proposals (funding granted as a percentage of funding requested) have increased from 63.2 per cent in 2012 to 78.8 per cent in 2015. However, this has been accompanied by a decline in the number of applications from 922 in 2012 to 710 in 2015. This decline may have resulted from the ARC changing from two rounds of Linkage Projects per year to one round per year in 2013.[29]

National Health and Medical Research Council (NHMRC)

NHMRC's functions are to foster 'improved health and medical knowledge, including through funding research, translating research findings into evidence-based clinical practice, administering legislation governing research, issuing guidelines and advice for ethics in health and the promotion of public health'. These functions reflect the role for NHMRC set out in its enabling legislation.[30] The major component of NHMRC's work is to administer the Medical Research Endowment Account (MREA) to fund priority driven, strategic research and researcher initiated research.

NHMRC supports research across the four pillars of health research — biomedical, clinical, public health and health services research — and funds both individuals and teams and the highest quality research and researchers. NHMRC supports diversity of research and researchers across disciplines and sectors and fosters the career development of health and medical researchers. Applicants are encouraged to explain how their research will translate into improved outcomes in health. Each application is then assessed against the published selection criteria for the particular funding scheme.

The main types of business collaboration supported are:

- between research and commercial industries (e.g., pharmaceutical or medical devices companies)
- between research and health service industries (e.g., Commonwealth/state governments, primary, tertiary, quaternary and allied health care providers).

NHMRC is working to improve recognition of industry relevant experience and promote collaboration with business and other end users in its competitive grant processes. Further details are provided in the next section.

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[29] Data provided by ARC.

[30] Under the NHMRC Act, NHMRC is responsible for promoting the development of individual and public health standards, fostering national consistency in health standards, supporting research and training, and fostering consideration of relevant ethical issues.

Issues in competitive grants processes

Grant timeframes – continuous Linkage Projects rounds

During review consultations, industry bodies and some universities stressed that the restriction of annual timeframes for grant decisions undermines the opportunity for timely collaboration. Businesses and other end users need to respond to time critical market or innovation opportunities. The lengthy timeframe entailed in an annual grant round is likely to cause partner organisations to seek speedier solutions to their research needs or to lose interest in committing to a collaborative relationship with a university.

Under current arrangements, Linkage Projects applications open in September and close in November, with grant announcements made in June the following year. Applicants may therefore need to wait between seven and nine months (depending on when they lodge their application) to learn whether they have received a grant. If unsuccessful and they wish to continue to pursue a grant, applicants may need to wait for another three months for a new round to open and up to another nine months for a result. Further, if applicants miss the application closing date by a month due to the time specific nature of a proposal, they will need to wait up to ten months to apply for the next round and a further nine months for the announcement of results.

The introduction of continuous Linkage Projects grant rounds would improve responsiveness to end users' operational needs and increase incentives to partner with universities. Under this process, the ARC would accept applications at any time. Once received and checked, applications would undergo peer assessment immediately. Applications that receive strong peer assessments would be processed immediately and submitted for ministerial approval. Applicants would be notified once ministerial approval is received.

Less strongly supported grants would be considered against other applicants in the next of three selection meetings to be held per year, with decisions submitted for ministerial approval and announcement after each meeting. To ensure certainty and assist universities and their partner organisations to get on with their research, the ARC should ensure that the announcement of outcomes for all applications occurs within a maximum of six months from the time they are received by the ARC.

These changes would offer more flexibility for researchers and end users, better meet the operational and budget needs of partners, and enhance the potential for translation and commercialisation of innovative research within market driven timeframes.

NHMRC's Partnership Projects Scheme has a continuous application process, which allows applicants to apply at any time during the year rather than through just one annual round. Following positive feedback from the research community regarding the continuous rounds, NHMRC is considering how multiple or continuous rounds could be implemented in other small schemes, for example in the Development Grants Scheme.

Prioritising business partner organisations in Linkage Projects

As noted earlier, business represented around 38 per cent of the partner organisations in the Linkage Projects scheme over the period from 2005 to 2014. While recognising the benefits which flow from collaborative research with all end users, the Government has specifically committed to increasing university-business engagement as a means of contributing to stronger innovation and commercial outcomes from research. The review therefore considers that proposals under the Linkage Projects scheme which involve business partners should be given priority. This can be achieved by revising the guidance for ARC selection advisory committees for the scheme to ensure that high quality proposals that involve business partner organisations are given greater priority. Such an approach has been effective in previous ARC schemes, for example, to ensure appropriate consideration of whether proposals address specific priority research areas identified for funding under the ITRP.

Small business participation

The OECD Innovation Strategy highlights the importance of small and medium-sized enterprises (SME) in translating knowledge and ideas into jobs and wealth.[31] Although Australia's industry structure is characterised by a large number of small businesses (over 97 per cent of active businesses in Australia have fewer than 20 employees[32]), they represent only 17 per cent of business expenditure on research and development (R&D).[33] However, there is little data available on the participation of small and medium businesses in competitive research grants. Further, most collaboration-focused programmes do not collect information that distinguishes between large and small or medium business participation.[34] The ARC and NHMRC should consider collecting better information about business partner organisations in grant applications. This will support a better understanding of and improved ability to address and promote the participation of small and medium businesses.

The review consultations also highlighted challenges for small business participation, such as a lack of resources or expertise to clarify their research needs, identify partners and effectively manage collaboration. Some stakeholders argued that the requirement for cash contributions was also a barrier to participation in collaborative research by small businesses with limited cash resources.

The funding rules for the ARC Linkage Projects scheme currently allow exemptions from the requirement to provide cash contributions for certain types of organisations, including charities, non-profits and start-ups. Exempt organisations may participate by providing

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[31] OECD, 2010, *The OECD Innovation Strategy: Getting a Head Start on Tomorrow*.

[32] Australian Bureau of Statistics, 2015, *8165.0 - Counts of Australian Businesses, including Entries and Exits, Jun 2010 to Jun 2014.*

[33] Australian Bureau of Statistics, 2015, *Business Expenditure on R&D (BERD).*

[34] The Cooperative Research Centres programme, administered by the Department of Industry, Innovation and Science captures data on SME involvement. The ARC has indicated that it is considering whether to collect this information in the future.

in-kind contributions alone. The addition of a new exemption applying to businesses with up to 20 employees would remove a potential barrier to their collaboration in research and would better support the scheme's objective of initiating and developing strategic alliances between universities and businesses. As the ARC does not currently collect data that distinguishes contributions by business size, the impact of such an exemption on the current level of overall cash contributions from partner organisations is unclear, though it is likely to be relatively minor. Importantly, the exemption would not prevent small businesses from contributing cash to collaborative research projects where they negotiate to do so with the relevant university.

Selection criteria

In response to the Boosting Commercial Returns from Research agenda, the ARC made significant changes to Linkage Programme funding rules in September 2015. Among these changes, selection criteria for the Linkage Projects scheme were revised to include consideration of whether the proposed research addresses a specific market opportunity and important problems for partners, whether it will benefit partners and other relevant end users, and whether there is a business model for implementation of research outcomes.

The ITRP schemes, which are specifically designed to find solutions to issues facing Australian industries, were also revised in September 2015 to include criteria on whether projects address a clearly identified market opportunity and provide an industry benefit, and retained criteria regarding strategies to encourage dissemination, promotion, and commercialisation of research outcomes. They now also require demonstration of meaningful engagement with relevant Industry Growth Centres.

Relevant to the Government's commitment to ensure rules for competitive grants appropriately recognise industry relevant expertise, ARC grant selection criteria include consideration of researchers' business and industry relevant experience through Research Opportunity and Performance Evidence (ROPE), which applies across all ARC funding schemes. ROPE takes into account the time researchers have spent working outside academia, research outputs other than academic publications, and research impact.

NHMRC's funding schemes include consideration of commercial and health service industry expertise. Several of NHMRC's research support schemes (such as Development Grants, Partnership Projects and Centres of Research Excellence) and people support schemes (such as Career Development Fellowships (Industry), Translating Research into Practice Fellowships and Practitioner Fellowships) include 'record of commercial [translation] achievement' and 'commercial [translation] potential of research' in their assessment criteria.

Peer reviewers make their assessments against these criteria taking into account factors of references such as clinical, administrative or teaching workload and restrictions on publication associated with time spent working in other sectors of references (e.g., industry, policy and government).

For upcoming rounds, NHMRC is strengthening its funding rules to better emphasise the value of commercial or health system experience in the assessment of the researcher record

of achievement. NHMRC is also reinforcing scheme assessment criteria relating to research translation into health policy and practice. It will also consider improving guidance to applicants and reviewers on how to evaluate provisional patent applications, Patent Cooperation Treaty applications and granted patents.

Finally, NHMRC is also developing its guidelines for Development Grants to drive grantees towards demonstrable commercial outcomes and is engaging a new cohort of industry experts to assist with assessing applications.

Selection committees

The relevant ARC Selection Advisory Committees always include members with experience outside academia to support consideration of the broader benefits of proposed research. The membership and proportion depends on the particular scheme and the nature of research proposals being considered.

Given the specific objective of the ITRP to find solutions to issues facing Australian industries, ITRP funding applications are assessed by the ARC's Industry Advisory Panel (IAP). The IAP comprises experts drawn from both academia and industry who are appointed to assist the ARC to identify and to evaluate excellence in industry relevant research.

While noting these processes, the review concluded that there should be greater involvement of business experts in grant assessments to ensure that the potential commercial and other translational benefits are fully assessed. The establishment of new panels, dedicated specifically to assessing the elements of proposals in all schemes that relate to collaboration, translation and commercialisation should emphasise and enhance the responsiveness of grant programmes to these issues. Such panels, comprised of business experts with entrepreneurial experience and/or academics with established records of engagement (including in realising the benefits of research for end users) would be well placed to apply their expertise in research translation and provide greater perspective on the challenges and implications for end users. Given appropriate weighting, the judgement of such panels would provide additional input to the existing evaluation of the academic quality of proposed research by peer review panels. This will put a greater focus on the achievement of economic, social and other benefits in publicly funded research.

During consultations, a number of universities raised the potential for conflicts of interest to arise for business members of expert panels assessing proposals. Such potential should be no greater, and should be able to be managed in the same way, as it is for academic experts involved in ARC processes. Accordingly, the criteria for selecting and managing panel members will need to include mechanisms to address potential conflicts of interest.

NHMRC's Development Grants scheme supports early stage commercial research that specifically drives towards a commercial outcome within a five year timeframe. Commercial experts are members of the peer review panels for the scheme and are currently responsible for 60 per cent of an application's overall score. Building upon the success of this model, NHMRC is exploring options for greater participation of experts from industry and the health system in peer review.

Burdens on competitive grant processes

Competition for ARC and NHMRC grants is high and success rates are low and declining. The success rates over the last four Discovery Projects scheme rounds have declined from 21.4 per cent for funding commencing in 2013 to 17.7 per cent for funding commencing in 2016.[35] This involves a failure rate of 82.3 per cent, or more than four out of every five applications. The success rates for Linkage Projects are higher, with 39.0 per cent of applications successful for funding commencing in 2013, declining to 35.5 per cent for funding commencing in 2015.[36] This is a failure rate of 64.5 per cent, or nearly two out of every three applications.

NHMRC funding rates have also decreased in recent years due to increases in application numbers, the increased size of grant budgets and a plateauing of the funds available in the MREA. The NHMRC's largest funding scheme, the Project Grants scheme, aims to support the creation of new knowledge by funding the best investigator-initiated research, in any area relevant to human health. The funded rates for Project Grants have decreased from 23.4 per cent for funding commencing in 2011 to 13.7 per cent for funding commencing in 2016,[37] the latter involving a failure rate of 86.3 per cent.

Failure rates have potential reputational consequences for institutions concerned. Further, low success rates mean that a large amount of time is taken by universities, researchers and partner organisations in developing and peer reviewing applications for funding which have little, if any, chance of success. With 3,584 Discovery Projects applications and 710 Linkage Projects applications submitted in the most recent round of each scheme,[38] the ARC faces a substantial burden and workload for its administrative, peer review and panel assessment processes. Most of that effort is spent on unsuccessful applications. The NHMRC faces a similar problem.

To address the large numbers of applications, some stakeholders proposed that the ARC and NHMRC could adopt a two stage process involving an expression of interest stage followed by a full application stage. Only those proposals that were considered competitive would proceed to the full application stage. While this proposal may have some merit, considerable time and resources would be still required to produce, collect and assess expressions of interest. It is also likely that a simple format application will attract more applicants. Arguably, therefore, there would be no reduction in overall effort.

In 2006, the NHMRC trialled a Notice of Intent process to enable earlier collection of applicant data and better support the peer review process. An unanticipated outcome was an increase in application numbers by over 30 per cent relative to the previous year, compared to an average 5 per cent increase each year in the preceding four years.[39] This increased the burden on applicants, peer reviewers and scheme administration and did not

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[35] Data provided by ARC.
[36] Data provided by ARC.
[37] Data provided by NHMRC.
[38] Data provided by ARC.
[39] Data provided by NHMRC.

lead to an overall improvement or reduction in the number of grant applications. This process has not been repeated.

During review consultations, some universities discussed internal measures they were implementing to prevent less competitive applications from being submitted to the ARC and NHMRC. These include a two stage review process where a short outline of the grant proposal is considered by a review committee within the university and a decision made about whether the proposal is likely to be competitive. If deemed so, the applicant develops a full proposal, which is then subject to further review by the committee before a final decision is made about suitability for submission. However, despite these strategies being applied in some institutions, the number of proposals submitted to the ARC and NHMRC continues to rise while funding is largely unchanged.

The number of proposals submitted is not a matter for government to influence as the ARC and NHMRC do not have control over the total number, or the quality, of applications received for any scheme. Universities and medical research institutes are autonomous and must address the poor use of time and resources arising from the growing numbers of applications by implementing a much more rigorous selection process to ensure only the most competitive grants are submitted.

The ARC and NHMRC publish data on institutional success and failure rates for each scheme on their websites. This information should be given prominence by institutions and used to inform the approach taken to their application review and submission decisions.

During consultations, some stakeholders raised the issue that university policies linked to appointments and promotions processes may encourage the submission of applications without due regard to their quality. While universities claimed that this is generally not the case in current policies, the review emphasises the need for all research institutions to revise any policies that reward such an approach to the submission of grant applications.

Recommendations

6. The review recommends that:
    a. the ARC Linkage Projects scheme moves from one round per year to a continuous application and peer assessment process from 1 July 2016, with strong applications to be progressed immediately for ministerial approval, and the remaining applications to be considered in one of three selection meetings per year
    b. grant outcomes should be announced within a maximum of six months from the submission of applications
    c. the ARC revises its guidance for selection advisory committees for the Linkage Projects scheme to ensure that high quality proposals that involve business partner organisations are given greater priority
    d. the Education and Training portfolio, in consultation with the Department of Finance, assess whether additional resources are required by the ARC to undertake continuous Linkage Projects rounds, and provide advice to government accordingly.

7. The review recommends that businesses with up to 20 employees be exempt from the requirement for partner organisations to provide cash contributions under the ARC Linkage Projects scheme.

8. The review recommends the establishment of expert panels to assess the elements of ARC grant proposals that relate specifically to commercialisation potential and collaboration with businesses and other end users.

9. The review recommends that:
    a. universities take a more active role in scrutinising applications for competitive research grant funding to filter out those potential applications which are less competitive
    b. greater prominence should be given to the ARC's and NHMRC's measures of success by institutions when considering the submission of grant applications
    c. universities should also revise any policies that may encourage the submission of applications without due regard to quality.

4. Business focused research collaboration programmes

The terms of reference call for advice on:

> arrangements that provide incentives to universities to increase and improve engagement and collaboration with industry and other end users, and encourage universities to engage in research commercialisation and knowledge transfer with industry and the broader community, including through funding incentives.

Collaboration with research institutions has a highly positive impact on business. Data from the Australian Bureau of Statistics (ABS) shows that collaborative innovation more than triples the likelihood of business productivity growth.[40] Businesses which are innovation-active are twice as likely to export, and twice as likely to increase productivity, employment and training.[41]

Data also shows that collaboration between innovation-active businesses and universities in Australia is limited. Of the innovation-active businesses in 2012-13, only a fraction of them reported collaborating on innovation with either universities (10 per cent) or research organisations (5 per cent).[42] A substantially higher proportion (30 per cent) of innovation active businesses identified websites, journals, research papers, and publications as sources of ideas — sources which predominantly report the results of publicly funded research.

In 2013-14, there were 13,500 companies that were registered under the R&D Tax Incentive programme and therefore can be assumed to be engaged in research and development (R&D), but there were only 1,800 businesses involved in Commonwealth funded collaboration programmes.[43] This suggests that collaboration programmes achieve relatively limited penetration with only a small proportion of R&D active businesses taking part in engagement.

Australia's business expenditure on R&D (BERD) as a proportion of GDP at 1.19 per cent is below the OECD average of 1.35 per cent [44] and collaboration between the research and business sectors is poor.[45] This means that even when universities or publicly funded research organisations (PFRO) undertake innovation relevant research, in the absence of strong linkages with business, the research is unlikely to be translated into benefits for business.

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[40] Department of Industry, 2013, *Australian Innovation System Report 2013*.

[41] Office of the Chief Economist, 2015, *Australian Innovation System Report 2015 Tables: Table 4 – Australia's business collaboration by innovation active business*

[42] Australian Bureau of Statistics, 2014, 8158.0 - *Innovation in Australian Business, 2012-13*.

[43] In 2013-14, 1,800 businesses were involved as partners on programmes and initiatives for business collaboration (excluding Department of Agriculture as it does not collect data on this metric). Initiatives were administered by the NHMRC, ARC, and the Department of Industry and Science (DIS).

[44] Office of the Chief Economist, 2015, *Australian Innovation System Report 2015*.

[45] Department of Education and Training, 2014, *Discussion paper 'Boosting the Commercial Returns from Research'*.

Australian Government spending on collaboration programmes was $575 million in 2014-15, which included spending on business focused collaboration programmes of $515 million. The latter is a small proportion, at 5.1 per cent, of the overall science research and innovation (SRI) budget for this period.[46] Funding of $259 million was allocated to Rural Research and Development Corporations (RDC) for collaboration between researchers and business. The remaining $256 million was allocated for all other collaboration programmes, such as the National Health and Medical Research (NHMRC) Development and Partnership schemes, Australian Research Council (ARC) Linkage programmes, Research Connections and Cooperative Research Centres (CRC).

The review considers that there is scope to improve research collaboration in industry including through increased funding for specific initiatives, which are discussed later in this chapter.

Australian industry and collaboration capacity

The OECD Innovation Strategy highlights the importance of small and medium-sized enterprises (SME) in translating knowledge and ideas into jobs and wealth.[47] Australia's industry structure is characterised by a large number of small businesses (over 97 per cent of active businesses in Australia have fewer than 20 employees[48]). Small business expenditure on R&D represents only 17 per cent of total business expenditure on R&D.[49]

SME face a number of challenges in linking with research institutions, as they often lack the resources or expertise to clarify their research needs, identify partners and manage the collaboration. Further, SME are not always able to access even small amounts of money to match grants.

Programmes to enhance business collaboration

The review considered that two programmes in particular have benefits for SME-university collaboration — the ARC Linkage Projects scheme and Research Connections.

The Linkage Projects scheme is the only large programme to offer grants with a value of less than half a million dollars. The review identified that the requirement for matching funding is likely to be an impediment for SME and concluded that the current cash matching requirement should be removed for businesses with twenty employees or fewer. The review also identified that the annual grant approval process acted as a barrier to businesses in applying for grants, and recommends more frequent grant approval rounds (refer to Chapter 3 on competitive grant programmes).

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[46] Department of Industry, Innovation and Science, 2015, Data Collection Selected Government Agencies programmes and initiatives on industry collaboration, Unpublished data.
[47] OECD, 2010, *The OECD Innovation Strategy: Getting a Head Start on Tomorrow.*
[48] Australian Bureau of Statistics, 8165.0 - *Counts of Australian Businesses, including Entries and Exits, Jun 2010 to Jun 2014*.
[49] Australian Bureau of Statistics, 2015, *Business Expenditure on R&D (BERD)*.

Research Connections, administered by the Department of Industry, Innovation and Science, helps SME in a variety of ways including to purchase research and fund researchers placed in business. The programme offers the facilitation/intermediary services necessary to allow SME to identify their research needs and potential partners, as well as to manage collaborations. The programme also provides small grants worth up to $50,000 to support research. Funding in 2015-16 is $2.8 million.[50]

Research Facilitators are a key element in this programme. They have specialised skills in connecting business with the appropriate sources of research expertise and addressing knowledge gaps preventing business growth by providing services such as:

- tailored information and options for each SME
- referrals to other business support programmes and services
- links to existing knowledge and solution providers
- identification of existing research activities and support to connect businesses to researcher organisations to create innovative products, processes and services.

There are 13 Research Facilitators located across the country. Each Research Facilitator has regular contact with research organisations in their area.

Experience with a previous programme on which Research Connections was based, *Researchers in Business,* indicates the value of this approach. The programme provided 22 per cent of participants with their first introduction to R&D collaborations with universities and other publicly funded research organisations (PFRO). Further, the evaluation found that 78 per cent of SME maintained relationships with the researchers after the project was completed.[51] This is particularly important as the programme supports a valuable first step in matching SME and researchers and this initial engagement can provide the foundation for continuing collaboration into the future.

The review concluded that Research Connections, although small in scale, provides benefits to business through funding facilitators and vouchers to match businesses' needs to research providers. It also encourages improved links between SME and researchers that are likely to continue after the grant project is finished, facilitating longer term and more valued collaboration.

The review proposes that funding be increased to expand the programme. Additional funding in the order of $25 million over the next four years, starting in 2016-17, would meaningfully increase the number of Research Facilitators and increase the number of matched grants available to fund researchers to be placed in business. The funding profile should allow time for the programme to ramp up to avoid underspends in the early years.

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[50] Department of Industry and Science, 2015, *The Australian Government's 2015-16 Science, Research and Innovation Budget Tables*.
[51] As part of taking part in the Researchers in Business (RiB) programme, businesses provided information on the experience and the data summarises the feedback obtained from SME participants who had completed an RiB project.

Consultations with both businesses and universities supported collaboration models, such as Research Connections, that provided small business with the ability to purchase research. Some universities noted that broadly similar schemes are in operation within a number of states in addition to the national programme, for example the Techvouchers in NSW,[52] the Innovation Vouchers Program in WA[53] and the Innovation Vouchers Program in SA[54] and that these were useful in improving university-business research collaboration. The voucher systems have similarities in that they offer the business an amount of money, ranging from $15,000 in NSW to $50,000 in SA, require co-contribution in varying ratios and encourage partnerships between businesses and R&D organisations.

There can be problems of overlap and divided responsibility when the Australian Government and state governments fund similar programmes in the same policy space. Close co-operation and co-ordination between the different levels of government will be essential to minimise any potential problems. Despite this concern, the review considered, on balance, that maintenance and expansion of Research Connections was merited given the relatively small size of the programme and the importance of immediately improving our low levels of collaboration.

A national research compendium

During consultations, business raised a number of other issues that hinder collaboration with universities. These range from difficulties in accessing information on available expertise (particularly within the research sector), to poor engagement and negotiation skills on both sides, and differences in cultural perspectives and alignment of priorities between researchers and businesses. Some business representatives argued that if they are to collaborate with universities, they need better information on the expertise and services the research sector could provide.

Several interlocutors suggested that a compendium or database, which captures all publicly funded research and provides information about research outcomes, be established as a tool to connect businesses with relevant research and research partners. The Department of Industry, Innovation and Science is already leading development of a web based access point to connect businesses to commercially relevant research and potential research partners. When implemented, this should provide a central point which directs businesses to existing initiatives including Research Map, a visualisation search tool which can be used to identify current Australian researchers with capabilities relevant to business research needs, and Source IP (refer to Chapter 5 on improved management of IP, Recommendation 15). Such an online access point will help match the needs of businesses with opportunities for industry-research collaborations more efficiently and effectively. The review recommends that the initiative be implemented as a matter of priority in 2016.

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[52] New South Wales Department of Industry, *Techvouchers*.
[53] Innovation Centre WA, *Innovation Vouchers Program 2015*.
[54] South Australia Department of State Development, *Innovation Voucher Program*.

R&D Tax Incentive

The R&D Tax Incentive is designed to offset some of the costs of doing R&D.[55] The programme is currently open to firms of all sizes in all sectors which are conducting eligible R&D. The R&D Tax Incentive helped 10,663 companies with $2.3 billion in tax offsets for eligible R&D investment in 2014-15.[56]

While beyond the scope of this review, many stakeholders raised the need to change the R&D Tax Incentive to create incentives to motivate businesses to seek university assistance in research. Universities have also made submissions[57] to this effect to the review of taxation currently being conducted by the Australian Government.[58] The R&D Tax Incentive is the largest single component of the Australian Government's total R&D expenditure. Given the importance of policy alignment (as discussed in Chapter 1 on overview of Australian Government funding arrangements), the Government should consider ways to improve the function of the programme. Depending on the approach chosen, this can have a potentially greater impact on improving collaboration between university and business than changes to Research Block Grants (RBG).

CSIRO

The CSIRO plays an active role in the research community, through in house research and collaboration with other researchers, universities and business, both domestically and internationally. It also has targeted programmes that seek to engage with business and provide innovation solutions.

The SME Engagement Centre administered by CSIRO aims to help bridge the gap between businesses and the research sectors through finding the right expertise and government programmes for businesses and connecting businesses to relevant people.[59] Since 2008, CSIRO has helped more than 100 SME to grow and gain a competitive advantage through accessing cutting edge research and technology. The review considers this is an effective model to overcome the difficulties in translating research into commercial returns and should be encouraged.

Industry relevant research training

The review noted that there are various approaches in Australian universities which support industry engaged research training. These range from specialised, industrial doctoral training programmes to more general PhD programmes which incorporate business placements and industry relevant coursework.

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[55] Australian Government, *R&D Tax Incentive*.
[56] Australian Taxation Office, *Annual report 2014-15*.
[57] For example, the Australian Technology Network or the Group of Eight.
[58] In late March 2015, the Australian Government announced a review of Taxation, which will examine a range of tax measures including the R&D tax rebate.
[59] CSIRO, *Solutions for SMEs*.

The Industry Doctoral Training Centre (IDTC), run by the ATN, provides doctoral training which combines a PhD thesis with training in business relevant professional and technical skills. The IDTC requires PhD students to collaborate with industry partners and work on an industry identified problem.

The Australian Research Council (ARC) Industrial Transformation Training Centres (ITTC) scheme provides opportunities for PhD candidates to pursue industrial research training. Priority areas are identified for the programme each year. The ITTC priorities for 2016 are: Advanced Manufacturing; Food and Agribusiness; Oil, Gas and Energy Resources; Mining Equipment, Technology and Services; and Medical Technologies and Pharmaceuticals. These priorities are consistent with the five high growth sectors established under the Industry Growth Centres initiative.

The Australian Council of Learned Academies (ACOLA) is currently reviewing Australia's research training system and will report to the Minister for Education and Training in March 2016. In consultations to date, a key issue raised is that current funding arrangements for research training do not promote, and in some cases inhibit, active industry involvement in research training, professional skills development, and multidisciplinary research. The review pointed to the example of the UK Doctoral Training Centres (DTC), as one model which works to encourage better university-business collaboration in research training. The UK research councils allocate funding to DTC to manage the structure of doctoral training. The DTC embed collaboration by ensuring that research students have both an academic and an industry supervisor and that the PhD's research project is focused on an industry relevant issue. In its emerging findings, ACOLA has suggested that Australia should consider implementation of DTC as a means of achieving collaboration between universities and business in PhD training. This review is supportive of the proposal set out in ACOLA's emerging findings in regard to DTC.

Business skills and placements for students

Consultations for the review stressed the importance of cultural change in both the industry and the university sectors as essential to improving collaboration. One strategy identified to drive this change was the inclusion of business experience in the early stage of a research career. Incorporation of business placements in PhD training can help students understand the value of business relevant research as well as building skills for future employment in business settings. Work integrated learning already has a growing focus in undergraduate training.[60]

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[60] Work integrated learning programmes can range from a student being employed for a period in a business and the employment counts toward course or qualification credit, internships, or as a non-credit activity to gain workplace skills, exposure to workplace culture or to develop professional networks and relationships. On 11 March 2015, Universities Australia, Australian Chamber of Commerce and Industry, Australian Industry Group, the Business Council of Australia and the Australian Collaborative Education Network launched the National Work Integrated Learning Strategy. See https://www.universitiesaustralia.edu.au/news/media-releases/Landmark-strategy-to-make-graduates-more--job-ready-#.Vk1munLouUl

Universities also indicated that business relevant courses in areas such as commercialisation skills and project management are being offered during PhD training. However, these are separate to the opportunities provided by universities that support research students to access business placements. Placing research students in business will yield benefits for the firm. Over time, and at sufficient scale, this has the potential to increase business 'pull' on universities for research engagement. Such arrangements can also lead to PhD students taking up employment in industry after graduation. An increase in the number of businesses with employees who have themselves been researchers will also assist in driving demand in the private sector for research inputs into operations including through research collaborations with universities.

In the course of consultations, universities provided information on their existing PhD programmes which incorporate business placements. The review commends universities for offering these programmes but concluded that the scale of these programmes is still relatively modest, as assessed by universities themselves, since there are no data collections to measure the extent of these activities. To achieve a bigger impact, the review recommends that additional funding be provided to support universities to deliver a new PhD business placements programme.

The review commends the Group of Eight on its *Innovation 2016* plan, which commits to expanding its participation in internship programmes at both the undergraduate and postgraduate level. The Group of Eight indicate that this has already begun. An agreement with the Australian Chamber of Commerce and Industry will commence with student placements in the first semester of 2016.[61]

A new PhD business placement programme

The proposed new PhD business placement programme will put PhD students with business for a period of six months. The aim of the programme is to increase access by business to the benefits of high level research skills and for students to gain experience in applying their research skills to real world problems and build experience for future employment.

There is no data collected on the number of PhD students engaging in placements with business or other end user organisations so the current level of placement activity in universities is unknown. Consultations indicated that while many universities have implemented placement arrangements as part of PhD training, the numbers are relatively small and tend to be focused in areas in Science, Technology, Engineering and Maths (STEM) disciplines.

Under the new model of RBG funding proposed in this report, universities will have greater flexibility to determine the length of support provided to a research student. In some circumstances, universities may decide to extend the period of support for the PhD student to incorporate a business placement. If this occurred at significant scale, it could reduce the

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[61] Group of Eight, 2015, *Go8 delivers industry and innovation work plan to Minister*.

number of PhD students able to be supported with a given funding allocation. Additional funding through this initiative will help to ensure no decrease in PhD student numbers.

Funding and student numbers

The programme would provide $12.5 million per year when fully funded for around 700 PhD placements providing funding of around $18,000 per placement. In 2014, there were 37,509 domestic students enrolled in a PhD in Australian universities and around 8,400 completing.[62] At this rate, the 700 placements would have accommodated around 8 per cent of annual completions in 2014. While this is a small percentage of PhD students compared to their total number, the additional funding will add to the existing initiatives already being undertaken within universities.

The cost of the programme reflects the cost of a six month extension of the Australian Postgraduate Awards (APA) programme, plus funding per place for businesses to cover any additional costs associated with equipment, supervision or training for the student. The placements are for existing students and will not diminish the number of existing PhD places.

While many universities have indicated there are placement programmes operating within their institutions, it will take some time for them to 'gear up' arrangements to increase student numbers. Implementation of the new programme requires selection of PhD students in relevant areas and matching the students to businesses with the capacity to benefit from the placement. The table below sets out a suggested funding profile.

Table 6. Proposed funding profile of the PhD business placements programme

Year	2017	2018	2019	2020
Number of places	350	700	700	700
Costs (million)	$6	$12.5	$12.5	$12.5

Universities would receive a share of total programme funding based on their performance on RBG engagement measures (research income in Categories 2, 3, 4) (50 per cent) and student completions (50 per cent).

Universities would report annually on the number of additional placements supported through the programme. This data would be published on the Department of Education and Training website.

The placement could be taken at any time during the PhD candidature. It would be of minimum six months duration but could entertain proposals for a shorter or extended time period if this was judged to be more appropriate. Universities indicated that a common approach is to arrange placements in the time lag between thesis submission and

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[62] Department of Education and Training higher education data.

ratification so that the candidature period is not lengthened. However, flexibility about timing of the placement would be a matter for the end user organisation to determine in consultation with the university. The proposed arrangements to allow universities greater flexibility in determining length of programmes under the research training schemes will work in conjunction with this new programme.

The costs to the universities administering the programme, finding relevant placement opportunities within business and other end user organisations and supporting any costs to the placement entity would be managed through the allocation per student. Any intellectual property created during the course of the student placement would be owned by the business or end user organisation.

The final details of the programme will be developed in consultation with universities and business and other end users. An implementation plan should be developed in 2016 so that the new programme can start at the beginning of 2017.

The role of university promotion policies

The mobility of PhD qualified personnel is regarded as low in Australia.[63] Some business groups and universities raised the concern that the university sector does not recognise, or places low value on, business expertise relative to traditional measures of academic success such as publications and research grants. Promotion prospects for researchers who spend time in occupations outside of academia may be lowered because their productivity is likely to be less than those with full time academic positions.

Spending time in business may act as an impediment to researcher mobility. During consultations, some universities indicated that appropriate promotion policies were changing to better recognise the value of business experience. Given the capacity of such policy changes to improve mobility across the business and university sector over time, the review encourages all universities to ensure that their appointment and promotion polices do not disadvantage applicants with business experience.

The review supports the Group of Eight commitment to work with its member universities to draft elements of a reward and recognition framework for academics that promotes a symbiosis between excellent functional research and research impact that delivers outcomes for the community.[64]

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[63] Department of Innovation, Industry, Science and Research, 2011, *Research Skills for an Innovative Future*.
[64] Group of Eight, 2015, *Go8 delivers industry and innovation work plan to Minister*.

Recommendations

10. Australian Government funding of around $25 million over four years from 2016-17 be provided to expand Research Connections.

11. Australian Government funding of $12.5 million per annum be provided to create a small programme to support universities to increase numbers of industry placements for PhD students. The programme should commence in 2017 and the Department of Education and Training should develop the details of the new programme arrangements in consultation with the university and business sectors.

12. The Department of Industry, Innovation and Science should implement, as a priority action in 2016, an online access point which will assist businesses to connect with business relevant research and researchers.

13. Universities revise their appointment and promotion policies where necessary to ensure that the value of business experience is recognised and that individuals who have spent time in business are not disadvantaged in the selection process.

5. Improved management of intellectual property

The terms of reference for the review call for advice on options to facilitate research-business collaboration and the commercialisation of ideas — in particular, how to:

> encourage universities to engage in research commercialisation and knowledge transfer with business and the broader community, including through funding incentives and a focus on more effective management of intellectual property.

Funding arrangements are covered in Chapter 2 and Chapter 3. This chapter deals with issues specific to the higher education sector on the more effective management of intellectual property (IP).

Consultations with business groups and businesses of various sizes identified IP issues as actual or potential barriers to greater collaboration with universities and publicly funded research organisations (PFRO). Issues raised included:

- sometimes long and difficult IP contract negotiations and the resources required to engage them
- an overvaluation in some universities of university-held IP, particularly early stage IP, in the belief it will generate significant revenue
- the view that there is considerable unlicensed IP still held by universities which could be released and developed for commercial use
- complexities arising from a lack of clarity on IP ownership and inventor rights for students in industry placements or researchers on secondment
- sometimes poor management of translation and commercialisation activity in universities
- the relatively few university staff having experience of working in commercially competitive environments.

While the concerns raised were often based on anecdotal evidence, some of which was dated, they were keenly felt, and too widespread to be fully discounted.

The universities acknowledged some of the concerns in consultations, which they felt were overstated, but also validly pointed to a variety of efforts made in recent years to address the problems. While these may have not yet borne full fruit, these efforts do have promise and they are having an impact.

The review considered further steps that can be taken to improve IP management, noting that many of these issues will need to be addressed at the institution level. It did not consider complexities of IP ownership during placements or secondments as this is a matter for the collaborating partners to resolve.

The framework for managing IP created from publicly funded research

Since 2001, the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) have implemented a national principles approach to IP management for the recipients of competitive research grant funds. Current funding agreements state that institutions that administer grant funding must have IP management and data sharing policies in place before a grant is given. This means a grant recipient must adhere to its institutional IP policy, including the aim of maximising the benefits arising from research — this may involve protection or rapid placement in the public domain. These funding agreements and policies state the funding councils make 'no claim on the ownership of intellectual property brought into being as a result' of the research activities for which funding is provided.[65]

This is complemented by good practice protocols for the management of IP created from publicly funded research[66] — the Australian Code for the Responsible Conduct of Research[67] (the Code) and the National Principles of Intellectual Property Management (the Principles) for publicly funded research.[68]

The Code establishes the overall framework for responsible research practices in Australia. The Principles provide national guidance for the ownership, promotion, dissemination, exploitation and protection of IP generated through publicly funded research. The Principles state that universities must make the IP openly accessible through licensing and accessibility arrangements, particularly IP that would benefit innovation and the Australian economy, or protect the IP through licensing and accessibility arrangements that provide exclusive opportunities to undertake commercial exploitation. Neither the Code nor the Principles include mechanisms for reporting or monitoring compliance with these provisions.

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[65] See for example, http://www.arc.gov.au/sites/default/files/filedepot/Public/NCGP/LP15/LP15_Funding_Agreement_16July15.pdf or http://www.nhmrc.gov.au/_files_nhmrc/file/grants/policy/nhmrc_funding_agreement_effective_october15_150807_0.pdf

[66] *The Patents Act 1990* and *the Copyright Act 1968* provide the legislative framework. The Attorney-General's Department and the Department of Finance share responsibilities for determining IP ownership, indemnities and warranties in government contracts and have issued protocol and guidance documents on these matters.

[67] The Code was developed by the ARC, the NHMRC and Universities Australia in 2007. For a copy of the code, refer to https://www.nhmrc.gov.au/guidelines-publications/r39

[68] The Principles were developed by the Coordination Committee on Innovation IP Working Group and were adopted by the ARC and the NHMRC in April 2013. The Coordination Committee on Innovation (CCI) is a discussion forum for Australian Government departments and agencies with responsibilities or interests that impact on the national innovation system. The CCI IP working group comprised the NHMRC (chair), the Department of Industry, Innovation and Science, the ARC, the Department of Agriculture, Fisheries and Forestry, Department of Climate Change, Department of Environment, DSTO, Geoscience Australia, Council of Rural Research and Development Corporations, the Australian Institute of Marine Science and IP Australia. For more information, see http://www.industry.gov.au/

In 2013, the ARC and the NHMRC introduced limited open access policies. Grant recipients are expected to deposit publications arising from competitive grant funded research projects into an open access institutional repository within twelve months from the date of publication. Responsibility for compliance and implementation rests with funding recipients who must justify in their final report why they have not complied with the open access policies.

University initiatives

Consistent with this framework, universities have introduced their own policies for IP management. Seven Australian universities[69] use the Easy Access IP model, with the University of New South Wales (UNSW) as the first Australian university to adopt the model in 2011. Easy Access IP is an international network of 26 universities and research institutes which aims to facilitate collaboration by offering a simplified one-page contract for IP.[70] Universities in Easy Access IP network make early stage IP or higher risk IP available free of charge through the Easy Access IP Portfolio, using short and simple one-page agreements, which allow companies to evaluate it and put it to use quickly. Businesses must acknowledge the university's contribution, provide reports on progress and agree to pay for all patent costs. Businesses have three years to exploit the IP or it reverts back to the university. Universities have no limitation on the use of their IP for teaching and research. Submissions from Australian universities which participate in Easy Access IP indicate that it is a useful tool to facilitate knowledge transfer with end users of research.

A recent UK study conducted by the National Centre for Universities and Business concluded that, while still in its early stages, Easy Access IP has resulted in efficiencies in staff time and legal costs at the transaction stage but not in the partner identification stage. [71] The study also concluded that while simplified contracts provide a base from which to negotiate collaborative arrangements, the contracts are not used extensively. In the reporting period from 2012 to early 2015, the study found that there were 68 Easy Access IP licence deals by 18 organisations, compared to 677 traditional licence deals reported by 14 organisations. Two universities — UNSW and the University of Glasgow — accounted for 66 per cent of the reported Easy Access IP arrangements.

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[69] The University of Glasgow introduced the Easy Access IP model in 2010. The seven Australian universities which use Easy Access IP are Edith Cowan University, Macquarie University, UNSW Australia, University of Technology Sydney, University of Western Sydney, University of Wollongong and La Trobe University.
[70] The international universities are: the University of Ottawa and l'Ecole de technologie supérieure, Canada; Shanghai Jiao Tong University, China; the University of Copenhagen, Denmark; dkfz (the German Cancer Research Centre in the Helmholtz Association) in Germany; the Linköping University and Mittuniversitetet, Sweden; CERN technology, Switzerland; King's College London, Lancaster University, Staffordshire University, Swansea University, University of Birmingham, University of Bristol, University of Exeter, University of Glasgow, University of Sussex, Durham University and the UK Defence Science and Technology Laboratory, United Kingdom.
[71] National Centre for Universities and Business, 2015, *Easy Access IP: A Preliminary Assessment of the Initiative*.

In a finding that is particularly relevant to Australia, the study found that the vast majority of reported deals under Easy Access IP were with SME. This evidence gives some expectation that Easy Access IP arrangements can provide an important avenue to expand access to IP in universities as partners gain experience with these tools.

There was no clear consensus in consultations regarding the best way to improve the sharing of IP generated by universities. Several university submissions to the review supported the adoption of a consistent IP model across universities, including open access IP policies where appropriate. However, other university submissions stressed that government should not mandate a uniform system of IP management across the research sector. Similarly, two industry submissions to the review supported a standardised approach to IP management in industry-university research collaborations, while one went further and proposed making grants conditional on the dissemination of IP.

Most recently, on 25 November 2015, the Group of Eight universities announced their intention to

> draft general principles of an approach to IP that treats university IP as a national asset over which the sector is the custodian and which promotes open innovation partnerships to get this IP used.[72]

Such an approach is a very useful step towards easier access to IP and a common model across the university sector.

The review acknowledges the significant efforts of universities to make IP more easily accessible but considers that more could be done to improve levels of collaboration between firms, particularly SME, and university researchers.

Use it or lose it IP?

The review has given consideration to the potential for a 'use it or lose it' regime for IP arising from public funding. 'Use it or lose it' would not require universities to relinquish control but would require universities to make the IP arising from publicly funded projects openly accessible to potential end users (e.g., through Easy Access IP arrangements) within a specific timeframe of the project's completion, unless the university has taken steps to commercialise the IP. It would provide a significant push in access to IP but would mean ownership of IP would still rest with universities although with the addition of time specific conditions on its management. However, while attractive as a global policy setting, the review concluded that universities are moving in that direction anyway and that such a policy would be difficult to implement.

To enforce a 'use it or lose it' policy would require a significant investment in a reporting and compliance regime by both universities and public research funders — the identification of the absence of action in a distributed network is likely to be expensive and ultimately less

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[72] Group of Eight, 2015, *Go8 delivers industry and innovation work plan to Minister*.

effective than the provision of incentives for local decision making to prioritise the exploitation of research outputs.

On the evidence available, the review could not determine whether a significant number of research outcomes were being held at the university level or whether opportunities for exploitation or translation of the research were being regularly ignored. There are incentives for academics and students to share research outcomes, including any potential for IP, through a variety of mechanisms including publications, conferences and commercial partnerships. Further, the cost associated with identifying and registering IP suggests that universities have an incentive to exploit an IP that has been formally recognised through the IP registration system. Yet other views persist that neither incentive is sufficient.

On 18 August 2015, the Australian Government commissioned the Productivity Commission (PC) to undertake an inquiry into Australia's IP arrangements, including their effect on investment, competition, trade, innovation and consumer welfare.[73] The report and recommendations will be tabled in mid-2016.

The review considers that the comprehensive nature of the inquiry provides the better context for further consideration of a 'use it or lose it' regime for publicly funded research activity. The PC should be asked to include in its inquiry consideration of the feasibility of a 'use it or lose it' arrangement, including whatever wider policy changes would be necessary to support this approach and, if recommended, set out appropriate implementation approaches to guard against unintended consequences.

Encouraging use

There are several possible options to increase the incentives for universities to ensure that they are fully harnessing outputs from publicly funded research and they are open to the potential for collaboration with business on the exploitation of IP, especially with SME.

Source IP

IP Australia launched Source IP on 23 November 2015 as a central website for Australian universities, PFRO and research institutes to list their patent holdings and signal their licensing intent for Australian businesses to exploit.[74] Australian universities, PFRO and research institutes will be able to use Source IP to promote their areas of innovation and technology specialisation to interested commercial partners. Source IP intends to make it easier for Australian businesses to find a public sector research partner.

IP Australia is collecting content for the website from universities, PFRO and research institutes across Australia. As at November 2015, all universities have signed up to use Source IP.

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[73] Productivity Commission, 2015, *Intellectual Property Arrangements: Terms of reference*.
[74] IP Australia, 2015, *Source IP*.

The review considers that the use of Source IP should be encouraged, and to do so, all recipients of public research funding should be required to regularly list the IP generated by public funding on Source IP from 2017.

Linkage Projects

The ARC Linkage Projects scheme is the key funding programme supporting collaboration between universities and end users. The review considers that given this focus, the ARC should require all future Linkage Project applications, and progress reports, to identify actual and potential IP to be generated through the project and the intended IP management arrangements. While it can be difficult to identify in advance the IP a research project will generate, increasing focus will increase the likelihood that IP issues will be considered, planned and managed.

Simplified contracts

The Australian Government launched the IP Toolkit in September 2015 to simplify and improve IP use and management with businesses — particularly SME — as well as PFRO and individual researchers intending to undertake collaborative research.[75]

The Toolkit contains two guides, a list of collaboration tools and a model contract. The two guides provide advice on identifying opportunities and market gaps in domestic and international markets; the identification of potential collaborators; the process of planning and negotiating collaborative arrangements; and contract negotiation. The collaboration tools provide a checklist, a relatively simple model confidentiality agreement and a term sheet with basic terms and conditions upon which the collaboration will be based. While these elements are designed to be used independently, together they provide a common framework which should result in a more streamlined process for businesses and universities entering into collaborative IP arrangements.

To encourage uptake of the IP Toolkit, the review concluded universities should be required, as a condition of ARC and NHMRC grants, to offer the IP Toolkit model contract and term sheet and that it be utilised, if requested, by business. This would not prevent the university or business partner identifying an alternative streamlined agreement (such as Easy Access IP) or more bespoke arrangement if the circumstances warranted. However, it will ensure that a simplified contract alternative is available to businesses when negotiating IP arrangements.

Easy Access IP

The review concluded that the Easy Access IP model is useful in supporting universities to release IP to businesses who want to commercialise it with reduced risk. The review proposes that government, through the Department of Education and Training and PFRO,

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[75] Australian Government, *Australian IP Toolkit for Collaboration*.

should continue to explore the broader application of Easy Access IP or similar arrangements across the publicly funded research sector.

Providing better information

IP Australia's Patent Analytics Hub is a trial service offered to universities, PFRO and businesses and is designed to help innovators assess market potential for their patents.[76] Upon request by organisations, the Patent Analytics Hub generates reports with data on the scale, intensity and areas of patent concentration, areas of specialisation and level of collaboration between companies, universities, research centres or institutes in a given sector. These reports include information on the patenting activities of PFRO and universities in a particular area which could lead to potential collaboration and partnerships opportunities. To date, four reports have been published on the IP Australia website — the Australian mining industry, medical devices, a pilot study on the assessment of patents as indicators of university research impact, and the Australian food industry.[77]

The review recommends that the relevant policy departments, IP Australia and Universities Australia promote the Patent Analytics Hub to industry and universities with a view to increasing its use.

Open access to research outputs

The review considers that many of the concerns identified by stakeholders under the banner of 'IP challenges' are in practice better addressed through the continued promotion of open access arrangements as a key plank of government policy. Open access ensures the sharing of the output of publicly funded research, increasing the exposure, sharing, comparison and critique of research, which will raise the quality of research outputs and provided.

Since 2013, the NHMRC[78] and the ARC[79] have required any publication arising from research to which they contribute funding to be freely accessible to the public within 12 months of publication. To reinforce this policy, and to speed the open publishing of research results, the review considers that the 2018 ERA (refer to Chapter 6) should take into account the relative share of research output made available through publication, open source

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[76] IP Australia, 2015, *Patent Analytics Hub*.

[77] As an example, the 2014 report on the Australian food industry (http://www.ipaustralia.gov.au/uploaded-files/reports/The_Australian_Food_Industry_Patent_Analytics_Report.pdf) identifies the scale and intensity of patent activity in food inventions, the number of food inventions originating in Australia, national and regional specialisations, key patents applications by the top filing 30 entities, small businesses which received Australian Government grants for product development or to protect IP rights, and the extent of collaboration which measured through co-applicants and patent citations. The report concluded that Australia ranks 14th in food inventions globally and that the majority of Australian patents are in the beverage, sugar and dairy sectors of references. Twenty-three per cent of patents in Australia are collaborative, which is above collaboration rates in comparable countries such as Canada (18 per cent), Norway (17 per cent) and Sweden (8 per cent).

[78] National Health and Medical Research Council, 2014, *NHMRC's Policy on the Dissemination of Research Findings*, accessed November 2015, https://www.nhmrc.gov.au/grants-funding/policy/nhmrc-open-access-policy.

[79] Australian Research Council, 2015, *ARC Open Access Policy*.

repositories or exploited through IP arrangements as a factor in assessing compliance with open access requirements by universities.

Recommendations

14. The PC inquiry into Australia's IP arrangements should be asked to consider the feasibility of a 'use it or lose it' arrangement, including whatever wider policy changes would be necessary to support this approach.

15. The ARC should require all future Linkage Project applications, and progress reports, to identify actual and potential IP to be generated through the project and the intended IP management arrangements.

16. The ARC and NHMRC amend funding agreements and funding policies as relevant to:
    a. require institutions to list the IP generated by public funding on Source IP from 2017
    b. require institutions to offer, and utilise if requested, the IP Toolkit model contract and term sheet where collaborative research arrangements with business are involved.

17. The Department of Education and Training, in consultation with other relevant policy departments, the PFRO and universities, should provide advice to Government by June 2016 on the merits of the broader application of Easy Access IP or similar arrangements across the publicly funded research sector and, if relevant, proposed implementation arrangements.

18. The 2018 ERA (refer to Chapter 6) should take into account the relative share of research output made available through publication, open source repositories and exploited through IP arrangements in the assessment process.

6. Assessment of impact and engagement

Although Australia's research sector is globally recognised as producing high quality research,[80] this alone is not sufficient for the public investment that is made in Australia's universities. Research must be high quality and must also have an impact. That is, as defined by the Higher Education Funding Council for England (HEFCE), it must have 'an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia'.[81]

It has long been recognised that, with the emergence of a knowledge-based global economy, the diffusion of knowledge is just as important for innovation as the creation of knowledge.[82] Access to and application of relevant knowledge increasingly drives innovation that leads to new products, services and business models

For example, in a discussion paper produced for the Australian Council of Learned Academies (ACOLA), *The role of science, research and technology in lifting Australia's productivity*, the authors refer to the 2011 General Electric Global Innovation Barometer, which indicated that forty per cent of all innovation in the next decade was expected to be driven by collaboration across institutional and national boundaries.[83] The discussion paper also noted that the nature of the relationships between business and research organisations is changing, saying that,

> Old linear models of 'science push', where business avails itself of findings from self-directed researchers and 'market pull', where researchers respond to the needs of business, are crude portrayals of a complicated reality. Notions of 'technology transfer', where one party supplies and another receives, have been replaced by the more relationship-based ideas of mutual engagement and 'co-production of knowledge'.[84]

The broader spill-over and adoption benefits of research are also important. Productivity benefits from research and successful innovations are not fully absorbed by the innovating organisations or firms, but rather diffused through the economy, leading to positive externalities in growth and the productivity performance of the other users.

Improved performance in research translation and business-researcher collaboration is essential. It benefits businesses and other end users through the access to ideas, knowledge, equipment and talent that they would not otherwise possess. This gives commercial advantage and boosts productivity.

The benefits to universities include new sources of income and new research opportunities. Better collaboration with end users can also produce a range of intangible benefits to researchers including enhanced reputation, insights to shape research agendas, opportunity

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[80] Office of the Chief Economist, 2014, *Australian Innovation System Report 2014*.

[81] Higher Education Funding Council for England, 2015, *REF Impact*.

[82] OECD, 1996, *The Knowledge-Based Economy*.

[83] Bell J, Frater B, Butterfield L, Cunningham S, Dodgson M, Fox K, Spurling T and Webster E, 2014, *The role of science, research and technology in lifting Australia's productivity*.

[84] Ibid.

to engage in real life problems, engagement with the broader community and improved employability for graduates.

A lack of strong person to person and institution to end user links prevents knowledge, skills, and resources from being shared and this reduces impact. In contrast, better linkages between the research sector and end users, including movement of academics and business people between universities and other sectors, helps build an innovation culture.

Impact and engagement sits alongside quality

Research quality is foundational to, and helps drive, research impact (as discussed in Chapter 3). The Australian university system has a strong focus on research quality, something that has been an important part of our recent relative success in international rankings. Excellence in Research for Australia (ERA) assesses the quality of research outputs of Australian universities against world standards. ERA uses expert review of a broad range of indicators of research (both quantitative and qualitative) to provide ratings of discipline areas in each university. The university response has been a strong one, perhaps reflective of the emphasis on research quality in the Australian system. Since its introduction in 2010, ERA has contributed to a 20 per cent increase in the share of university research in areas where Australia is assessed to be at or above world standard.[85]

A review conducted by ACIL Allen Consulting found that in response to ERA, universities have focused their research efforts by filling gaps and discontinuing less productive activities thereby improving overall quality. Further, ERA has enhanced collaboration within the university sector and between universities and external partners. The review also found evidence that ERA has led to cost savings by improving the efficiency and effectiveness of university operations through better management and strategic planning of research efforts within institutions.[86]

While universities have responded in these positive ways to ERA, there is no similar, systematic process for measuring the broader economic, social and environmental impact of university research. This is widely considered to be one reason why research impact is less of a focus than research quality. As in many areas of public policy, it is what is measured that is seen to matter.

The review concluded that measuring engagement and the impact of research is crucial to ensuring maximum benefits flow from Australia's investment in research in universities and an assessment system should be introduced urgently.

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[85] Australian Research Council, 2015, *State of Australian University Research 2015-16: Volume 1 ERA National Report.*
[86] ACIL Allen Consulting, 2013, *Benefits Realisation Review of Excellence in Research for Australia: Final Report.*

Approaches to assessing research impact

Measuring research impact is, however, difficult and international practice for doing so is still at an early stage. There are several methodologies that have been used or proposed to measure impact and engagement, including the use of quantitative data or metrics and qualitative case studies, often accompanied by peer review of the evidence. Several initiatives, both within Australia and overseas, have sought to assess research impact using these methodologies or combinations of them. The most notable international example is the United Kingdom's Research Excellence Framework (REF), the new system for assessing the quality of research and impact in UK higher education institutions, which was first run in 2014 and replaced the previous Research Assessment Exercise (RAE).[87]

a) Case studies

A case study based approach to assessing impact involves the evaluation of written university submissions that explain the specific social, economic and other outcomes, benefits or effects of selected research activity. One advantage of this approach is that it helps allow for the analysis of complex phenomena within their contexts. In the case of research impact, case studies can help to answer questions about how and why research has impact, complementing other data on aspects that can be measured quantitatively. The use of case studies is also of particular importance to assessing the impact of research in disciplines such as the humanities, social sciences and creative arts where appropriate quantitative measures, such as financial results for end users or commercialisation revenue may be low. Finally, some of the impacts in these disciplines may relate to social benefits over long time periods or may have an influence in informing policy settings in particular social, cultural, environmental or others areas, which can only be captured through qualitative analysis or assessment. Case studies of research impact are therefore best analysed and evaluated by peer reviewers with expertise in the relevant disciplines or fields in which the research has an impact.

The UK REF 2014 comprised assessment of research quality, the vitality of the research environment and impact case studies. For the impact case studies component, universities were asked to submit examples of impact that occurred between 2008 and 2013. They also completed an 'impact template' which provided a more general description of how they achieved impact and strategies to sustain the benefits from the research. The case studies were assessed and graded by panels of academics and research users in terms of the 'reach and significance' of the impacts.

The REF results are a key input to decisions on research funding allocations by UK higher education funding bodies. In 2015-16, these bodies will provide a total of £1,945 million in

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[87] Research Excellence Framework, 2014, *About the REF*.

research funding, of which the REF results (including the impact assessment) will be used to allocate an estimated £1,610 million.[88]

An evaluation of the UK REF by RAND Europe found a number of benefits in assessing impact, including the ability for institutions to identify and understand impact, stimulation of broader strategic thinking about impact, increased recognition within institutions of impact activities and the review and reaffirmation of relationships with external stakeholders.[89] Further, the evaluation showed that the impact component influenced a change in behaviour. This resulted in a cultural change with universities becoming more oriented towards measuring and recording benefits from the start of their research projects rather than a consideration once the research was completed.[90] It also concluded that the use of case studies is the most appropriate means of assessing the impact of research because of the breadth and diversity of impact.[91]

Both in the UK and during the review's consultation, the cost of impact assessment was identified as a concern. A review of the costs of REF 2014 by Technopolis found that the total estimated cost to the UK was £246 million (around $420 million).[92] That comprised costs of around £232 million for the higher education community and £14 million for the funding bodies. It cost UK universities around £55 million to prepare impact submissions as part of REF 2014. The estimated median cost of an impact case study were around £7,500 (around $16,000) and an impact template £4,500 (around $7,700). The Technopolis report noted, however, that these global figures tend to exaggerate the costs, which were not incurred in a single year.

Importantly, Technopolis provided an analysis of annualised costs over a six-year period (representing the time elapsed between the 2008 RAE and the 2014 REF),[93] finding that the total cost of the REF (£246 million) amounted to less than one per cent of higher education institutions' research income from public sources in the UK over that period.[94] On that basis, the annualised cost of the impact component (£55 million) represents around 0.2 per cent of research income from public sources over six years.

Commentators have pointed out that criticisms of the cost associated with impact assessment draw the wrong conclusion.[95] The cost of the UK's impact assessment should be compared to total UK university research expenditure and not just compared to the amount

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[88] Advice and data provided by HEFCE. Note: for England, HEFCE is allocating 82.8 per cent of its recurrent research funding for the academic year 2015-16 using the results of the 2014 REF. HEFCE is allocating 13.0 per cent of its recurrent research funding for the academic year 2015-16 using the impact quality profile from the 2014 REF. If applied consistently across the four UK funding bodies, this means that £253 million is directly allocated using the impact metric.

[89] Manville C, Morgan Jones M, Frearson M, Castle-Clarke S, Henham M, Gunashekar S, Grant J, 2014.

[90] Ibid.

[91] Ibid.

[92] Technopolis Group, 2015.

[93] Ibid.

[94] Ibid. Technopolis notes that 'Research income from public sources in publicly funded UK higher education institutions in 2013-14 was £4,513M. £27bn represents £4,513M multiplied by six years'.

[95] Sharma A, 2015.

of funding distributed by the funding councils. All countries make a substantial investment in university research, and the cost of impact assessment, which measures the economic, social and environment benefits of this funding, is comparatively small.

An additional benefit of the UK impact assessment exercise is the 6,679 published case studies which profile nationally important research. This sort of evidence is an important asset and useful in supporting informed advocacy for funding decisions regarding university research.[96]

There is Australian experience that is relevant. The 2012 Excellence in Innovation Australia (EIA) trial, conducted by the Australian Technology Network of Universities (ATN) and the Group of Eight (Go8), assessed a selection of case studies put forward by participating institutions. The report on the trial concluded that Australian universities can generate compelling case studies of impact across a wide range of disciplines and impact areas and that it was possible to develop a methodology for assessing research impact which could be used for allocation of research funding. However, the number of case studies involved in an impact component of any broader research assessment exercise would require consideration to ensure both effectiveness of the exercise and administrative feasibility.[97]

Volunteer expert panels assessed the EIA case studies. A majority of volunteers on all panels came from outside the university sector and included senior representatives of business, community organisations and government, while the remainder came from the university sector. The trial found that the use of expert panels, with significant input from external panel members, was appropriate for a national impact assessment process.[98]

The RAND evaluation of the UK REF used the Technopolis data and compared the costs of preparing the REF impact case studies with those of a UK REF Impact Pilot Evaluation in 2010 and with the EIA trial in 2012. It found that there was 'gold plating' of the REF 2014 case studies, driven by the funding implications of the REF process.[99] REF impact case studies took a median time of 30 staff days to prepare, including training time. In contrast, case studies in the 2010 UK pilot took 3.2 days to prepare plus 2.1 coordination days. In the EIA trial, the median time to produce a case study was 3 days and the estimated cost was between $5,000 and $10,000. RAND found many instances of REF case studies being rewritten more than ten times, and in one extreme example 30 times. Such 'gold plating' was not present in the UK REF pilot or the EIA, at least partly because future funding was not associated with these trials.[100]

The review concluded that the need to measure and ensure the benefits of university research, which represents considerable public investment, justifies the comparatively small cost that is likely to be associated with case studies that form part of an impact and

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[96] Ibid.
[97] Group of Eight, Australian Technology Network of Universities, 2012, *Excellence in Innovation: Research impacting our nation's future — assessing the benefits*.
[98] Ibid.
[99] Manville C, Morgan Jones M, Frearson M, Castle-Clarke S, Henham M, Gunashekar S, and Grant J, 2014.
[100] Ibid.

engagement assessment. However, the use of case studies should be informed by the lessons from the 2014 UK REF, 2012 EIA and 2010 UK REF pilot to ensure that the resource intensity of the process is minimised. This could be achieved by the use of standard templates, imposing strict limits on length and limiting coverage to the major impacts arising from the research rather than the case study attempting to detail all aspects of research impact.

b) Metrics

Metrics are quantitative standards used to measure and track performance. They are regularly used to drive university funding, including in Research Block Grants (RBG). Using metrics is generally a less costly method of measurement than case studies and assessment panels, particularly if it uses data that is already collected. Quantitative data is most useful where performance is easy to measure and outputs are easily quantified. There are a number of engagement metrics and a commonly used one is income from research end users.

The March 2015 report of the Australian Academy of Technology and Engineering (ATSE), *Research Engagement for Australia: Measuring research engagement between universities and end users,* proposed metrics to measure research engagement based on the amount of research income a university receives from industry and other end users.[101] The model applies the metrics at the two-digit research discipline level to ensure comparison across like disciplines. The ATSE engagement metric is intended to drive individual researchers and departments towards increased engagement with end users by publishing the rating and associated details at the field of research level.

Between April and October 2015, ATSE conducted a pilot study applying the metrics in Queensland and South Australian universities. ATSE found that the participating universities were able to supply data for the pilot with minimal effort and reported that the results generally aligned with their perception of their own engagement activity. Based on the results of the pilot, ATSE has proposed enhancements to its approach, including the addition of income from sources not correctly counted in the metrics, such as income from Research and Development Corporations (RDC), the inclusion of qualitative judgment to supplement numeric data, and assigning ratings to the level of engagement for specific disciplines within a given university.[102]

This approach has considerable merit, demonstrating that it is possible to create research engagement metrics from available data in existing collections.[103] However, many of the submissions to this review raised concerns that, although the proposed metrics would be

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[101] Australian Academy of Technology and Engineering (ATSE), 2015, *Research Engagement for Australia: Measuring research engagement between universities and end users*.
[102] Australian Academy of Technology and Engineering (ATSE) 2015, *Research Engagement for Australia: Pilot Study Findings*.
[103] ATSE, 2015, *Research Engagement for Australia: Measuring research engagement between universities and end users*.

normalised for discipline, research income from end users is not a good measure of knowledge transfer for the humanities, arts and social sciences.

Importantly, the proposed ATSE approach focuses on engagement, and does not address research impact more broadly. The review concludes that ATSE approach provides an important starting point to develop impact metrics that build on existing data collections. The review notes that measuring impact more broadly will require a series of metrics to be considered.

c) Peer review

Expert peer review is used to assess quality of research and can also be used to assess impact, bringing expertise and judgement that is not possible in quantitative analysis alone. The Innovative Research Universities (IRU) has proposed, as an alternative to a metrics only approach, using expert panel judgements on the value of university research for end users.[104] IRU argues that this will give greater credibility to the process, allow more informed judgements to ensure data is not misinterpreted and protect against data manipulation. The review noted that peer review processes could rely on either case study and/or metrics to inform judgements.

An evaluation of the UK's REF by RAND Europe found that the majority of those involved in expert panels assessing research impact felt that it was a fair, reliable and robust form of assessment.[105] The evaluation also found that the panel review process was effective in bringing together different expert perspectives necessary to reflect the breadth and multidisciplinary nature of research. However, the burden of involvement in terms of time spent was a significant challenge for impact assessors and was a significant contributor to the overall cost.

A balanced approach is proposed

The review concluded that it is essential that government assess the benefits flowing from university research in addition to the quality of the traditional research outputs, given the very substantial amounts of public funding involved and the desire to improve the translational and commercial benefits of the research supported. Measuring impact is expected to bring about cultural change within our higher education sector and drive increased impact from university research. This conclusion is partly based on the experience in the UK where the evaluation of the REF impact assessment process resulted in a number of benefits for universities including an enhanced ability to identify and understand impact and the stimulation of broader strategic thinking about impact.[106] It also reflects Australia's experience with ERA, which has clearly driven a focus on research quality across the higher education system.

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[104] Innovative Research Universities, 2015, *Measuring Research Value for End Users*.
[105] Manville C, Guthrie S, Henham M, Garrod S, Sousa S, Kirtley A, Castle-Clarke S, Ling T, 2014.
[106] Manville C, Morgan Jones M, Frearson M, Castle-Clarke S, Henham M, Gunashekar S, Grant, J, 2014.

Although it is early days, an evaluation of the REF impact assessment also points to cultural and behavioural change among researchers and institutions as a result of assessing impact. Some respondents to the impact template said the process helped them to reflect on their own research and their strategy for impact, while others said it helped them think about the wider faculty or institution's impact strategy. The evaluation also found that including impact assessment in the REF increased recognition within universities of those academics undertaking impact activities. It also provided an opportunity for universities to review and reaffirm relationships with external stakeholders.[107]

In order to capture the full range of benefits associated with university research the approach in Australia should initially combine quantitative metrics that provide measures of engagement, including the ATSE Research Engagement for Australia, and qualitative assessment based on case studies which will give a comprehensive picture of impact. Experts from the research sector, government and end users (including business), should also be involved in the assessment.

Implementation and timing

The impact assessment exercise should be developed by the Department of Education and Training and the Australian Research Council (ARC), with the ARC to take ongoing responsibility for implementation given it has established the necessary infrastructure, methodology and expert involvement through three rounds of ERA. Importantly, ERA already captures relevant data on university-based research, including on industry funding, interdisciplinary activity, commercialisation income and patents, which the new impact and engagement assessment could incorporate. This would help minimise the compliance burden and costs of assessment.

The review considered options for implementation that included:

1. separately conducting ERA and the new impact and engagement assessment, every six years, with one or other process occurring every three years
2. conducting the new impact and engagement assessment in parallel with ERA once every three years.

Option 1, involved a six year period between assessments, which was considered too long. In particular, the value to industry and other end users of measures of collaboration and commercialisation based on activity more than six years prior would be questionable.

Option 2 is preferable. However, there is a risk that conducting the assessment processes in parallel every three years would impose considerable administrative and resource burdens on universities and the assessing authority, unless the requirements and scope of ERA are reduced.

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[107] Ibid.

A pilot impact and engagement assessment should be developed and undertaken in 2017 to ensure the effectiveness of the methodology and the appropriateness of the approach used, prior to undertaking a full impact and engagement assessment, along with ERA in 2018.

An expert stakeholder group, convened by the Department of Education and Training and comprised of researchers, government and end user (particularly business) representatives, should be established to oversee the development of the approach to be taken to impact and engagement assessment and its implementation. This group should conclude its work in the first half of 2016 so the pilot assessment can be properly prepared and conducted in 2017.

It will be very important that the new impact and engagement assessment is implemented in a manner that minimises the burden on universities and others involved. There must be arrangements in place to ensure that it does not involve a significant additional reporting burden on universities that is not at least matched by the expected benefit from their participation in such an exercise. The approach would need to take account of lessons learned from the UK's experience with REF outlined earlier and consider how a simplified approach to the case study component of impact assessment could be implemented, given the cost to the government and universities involved in this component of the UK approach.

In developing the new framework, the Australian Government should take into account any scope to simplify reporting by universities, including through the use of existing bibliometric sources and by maximising the use of existing data collections. This should build on current work to consolidate the collection of Higher Education Research Data Collection (HERDC) and ERA data underway by the Department of Education and Training and the ARC. The ERA data collection burden should also be reduced to help offset the additional data collection required for the impact and engagement assessment.

The impact and engagement assessment will be a key exercise for government in driving a stronger focus on enhancing the returns from public investment in research and providing a reliable evidence base to inform future research and innovation policy. It is therefore essential that the assessment is robust, credible and accepted by the university research sector and end users alike. As the ARC is a small agency that will be unable to absorb the costs of implementing the assessment, the review recommends that the ARC should be provided with the necessary funding, expected to be in the order of $10 million over the three year assessment cycle, to manage the assessment, including to develop guidelines and technical documentation, manage expert qualitative review processes, report on the outcomes of the assessments, review and evaluate the assessments, and consult with the sector and stakeholders to further refine the methodology and systems for each assessment round.

The review recommends that following the pilot of the new impact and engagement assessment initiative, the Australian Government should consider whether or not to attach a level of funding to impact outcomes. The review considers that the results of the first full impact and engagement assessment in 2018 could be used to allocate RBG funding in the order of 10 to 20 per cent in 2019. The RBG model uses research income from Categories 2-4 to measure engagement. While income is a reliable and auditable measure, it is an input measure only and does not capture the full spectrum of benefits associated with end user

engaged research. This will be done through the new impact and engagement framework proposed here. As this framework will produce superior measures of end user engagement and its benefits, these measures could be used to balance or replace income Categories 2-4 in the RBG model starting in 2019.

On the other hand, the review acknowledges that due to lags in RBG between data collection and allocation timeframes, means that the new RBG model proposed will not fully influence allocations to universities until 2019 (reflecting university performance in 2016 and 2017). Changing the allocation measures to reflect the results of impact and engagement assessment, in 2019, could introduce further complexity into the RBG funding system. This could be detrimental in two ways — either by causing instability among universities when they are putting in place strategies to maximise performance in line with incentives under the new RBG model or by undermining the effect of the new RBG model before it starts to influence performance.

Given these concerns, the review considers that a decision about apportioning a level of RBG funding on the basis of the impact and engagement assessment results should be made in light of the outcomes of the pilot study in 2017.

Recommendations

19. The Australian Government commit to the assessment of the economic, social and other benefits of university research through an impact and engagement assessment framework, which will have an impact on future research funding.

20. The framework include both quantitative and qualitative measures, moderated by expert review, with:
    a. the metrics proposed by ATSE as the starting point for the development of quantitative measures, and other potential measures also considered
    b. the lessons of the 2014 UK REF, the 2012 EIA and the 2010 UK REF pilot drawn on to measure the extent and cost of the approach to qualitative measurement and minimise the burden imposed on universities and others by the assessment methodology
    c. an expert working group, convened by the Department of Education and Training and comprising representatives from the research sector, government and end users (including business) established to provide advice by the end of June 2016 on the specific approach to be used, the measures to be adopted and the implementation path to be followed.

21. The impact and engagement assessment model should be piloted in 2017, with the lessons from the pilot to be finalised by the end of 2017.

22. The new framework should:
    a. be implemented as a companion to ERA in 2018, so that quality and impact and engagement can be assessed at the same time on a three year cycle
    b. be implemented so that any additional burden on universities is minimised by using existing sources of data and evidence and reducing data and information required for ERA and/or other reporting.

23. Following the 2017 pilot, the Australian Government should consider whether a specific level of funding should be influenced by the impact and engagement assessment, with 10 to 20 per cent of RBG research support from 2019 being a possible starting point.

24. The ARC be provided with sufficient ongoing funding (around $10 million over the three year assessment cycle) to manage the development and implementation of the assessment.

7. Assessing Australia's research system

The terms of reference request advice on options to:

> ensure the quality and excellence of Australian university research and research training.

It would be incomplete to consider the effectiveness of the research activities at universities in isolation from the broader research endeavour supported by public funding. In particular, an effective research system should have space and opportunity for blue sky research but also value and prioritise applied research and translation activities. A diverse sector, in which research institutions are able to focus on their strengths and opportunities, but which is driven by an understanding of national priorities and imperatives, is most likely to serve Australia's interest.

There is currently no agreed set of performance measures for the publicly funded research system to help determine whether policy is encouraging the appropriate outcomes. This leaves something of a vacuum. It is therefore not surprising that each new data release from an Australian or an international source is routinely treated with the same scrutiny and focus in public discussion as the last, and with little sense of the quality of the data being scrutinised or its relevance to the Australian research system. Performance in these data releases is similarly often described as 'world class', 'middle of the road' and 'poor' with only scant understanding of what the data comprised and the way in which it was collected, ranked and presented.

For example, the regularly cited Global Innovation Index shows that in 2014 Australia was 81st of 143 countries on the 'innovation efficiency ratio' — which purports to show how effectively we get returns from research, ideas and institutions. But, on closer scrutiny, this index reveals that the top five countries on this composite measure of disparate inputs and outputs are Moldova, China, Malta, Indonesia and Vietnam.

It is important to develop a performance assessment and reporting system for Australia's publicly funded investment in research that allows regular review of the outcomes being achieved. The changes proposed in this review need to be accompanied by the introduction of such a system. A clearer set of benchmarks and performance indicators for the publicly funded research system will provide much needed context to the assessment of the performance of research in universities.

As Australia becomes an increasingly knowledge intensive economy, the importance of the research system will only increase, as will the importance of having access to regular and up to date information on the system's health and performance.

The Australian Government's Boosting the Commercial Returns from Research (BCR) strategy has already recognised the need for this work, recommending that:

> The Government work with the research sector and industry to improve assessment of the research system, including improved metrics on engagement and knowledge transfer with industry, as well as research outcomes and impact (BCR Action 14).

The research system as a whole: measuring what matters

Australia's research system is complex, with 37 public universities as well as three private universities, publicly funded research organisations (PFRO) such as the CSIRO, medical research institutes (MRI) and research institutes in other specific subject areas. State and territory governments also support research programmes, as do a number of Commonwealth departments. Finally, significant research activity occurs in the private sector and through public-private collaborations.

Institutions that are wholly or largely publicly funded are, inter alia, charged with a complex set of priorities and challenges:

- helping to develop solutions to address national and global challenges
- contributing to improved quality of life and social prosperity
- producing knowledge that helps drive the development of new products, technologies, processes and practices that contribute to productivity and economic growth
- developing highly skilled research graduates who are essential for industry innovation and competitiveness and the national research effort
- collaborating with other research organisations and industry to maximise the gain from our investment by knowledge transfer and partnerships.

At the federal level, Australian Government funding for research is provided through 13 portfolios in 2015-16.[108,109] Education and Training, Industry, Innovation and Science, and Health administer the most funding but other portfolios, such as Defence (Defence Science and Technology Organisation), Agriculture (Rural Research and Development for Profit), Environment (Antarctic Division, Bureau of Meteorology) and Foreign Affairs and Trade (Australian Centre for International Agricultural Research) also have significant roles. The other portfolios have smaller, sector specific research programmes. This has effectively meant that no single minister has overall responsibility for the research sector, and there is little focus on the performance of the publicly funded research system as a whole.

There are a variety of ways in which this lack of effective focus could be addressed. One might be for the research functions of the 13 portfolios to be combined into a new Research Department or included in one existing portfolio. That would, however, create more problems than it seeks to address — with the high attendant costs of disruption and change that new portfolio arrangements inevitably create, and the disjunction between research and other components of existing portfolios. Another option might be for the establishment of a Cabinet sub-committee to take on overall research responsibilities. However, given the rarity of Cabinet committees and the broad remit they usually have, such an option would

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[108] Department of Industry and Science, 2015, *The Australian Government's 2015-16 Science, Research and Innovation Budget Tables*, 30 July.
[109] The 13 portfolios are (in order of amount of funding administered): Industry and Science, Education and Training, Health, Defence, Agriculture, Environment, Foreign Affairs and Trade, Social Services, Communications, Veterans' Affairs, Infrastructure and Regional Development, Attorney-General's, and Prime Minister and Cabinet.

rightly be reserved for coordinating and delivering a larger slab of a government's policy agenda, such as the entire innovation agenda across industry, education and economic policy.

An alternative solution could be to have a single minister leading the assessment and reporting on the performance of the publicly funded research system — a 'steward' of sorts, who can provide a whole of sector view to support policy consideration at both the whole of government and portfolio by portfolio levels.

Under current arrangements this role is likely to be best placed with the Minister for Education and Training. That Minister already has responsibility for policy and funding to support the largest element of the publicly funded research system: university based research, which makes up over one third of the Australian Government funding support for public research.[110]

Such a role should not significantly impinge on the portfolio responsibilities of other ministers — it would be focused on reporting and assessing performance for the sector of reference as a whole. This assessment would be undertaken in close collaboration with the Minister for Industry, Innovation and Science and Minister for Health, given their portfolio responsibilities in respect of industry-research collaboration, innovation and health research. Other ministers with significant research responsibilities would also be consulted as part of the assessment approach. The Australian Innovation System Report prepared by the Industry portfolio for a number of years may be an appropriate analogue — it draws together business performance, skills formation, trade performance and research activity to give an overarching assessment of 'the performance of our innovation system over time, allowing emerging issues to be identified'.[111]

While formally outside of the scope of this review, the stewardship role played by the Minister for Industry, Innovation and Science in relation to Australia's innovation performance remains relevant and complementary to the proposal here and that role should continue and be enhanced as necessary to increase its effectiveness.

The first priority for such a steward's role would be to establish an agreed framework to assess the performance of the research system. This would help inform possible adjustments to policy and programme settings to improve performance of the research system. Work already underway within the Departments of Education and Training and Innovation, Industry and Science to implement the BCR strategy provides a starting point for the development of the assessment system and should be accelerated with the aim of developing the first whole of system assessment report in 2016.

Based on this assessment, the Minister for Education and Training in collaboration with the Ministers for Industry and Health could bring an annual report on the assessment of current

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[110]Department of Industry and Science, 2015, *The Australian Government's 2015-16 Science, Research and Innovation Budget Tables*.
[111] Office of the Chief Economist, 2014, *Australian Innovation System Report 2014*.

and emerging policy challenges in the publicly funded research system to the Cabinet for whole of government consideration. The assessment would then be released publicly.

A possible approach to system assessment

The system assessment work already underway has indicated a suite of measures that, when considered together, may allow an assessment of the health and performance of the Australian research system.

Characteristics of a well-performing publicly funded research system

Characteristics could include:

- **High quality** — the research undertaken is of high quality, possessing 'originality, significance and rigour'[112]
- **Responsiveness** — the system addresses key regional, national and global challenges and is adaptable to changing priorities. Research effort is directed to where it is needed in order to maximise economic, social and environmental benefits.
- **Return on investment** — research leads to benefits with minimal duplication and wastage, so that every public dollar spent results in greater benefit. This includes the translation of research into new or improved products, technologies, processes and systems, thus contributing to economic and productivity growth.
- **Engagement** — there is strong engagement between public sector research organisations and research users, facilitating the flow of knowledge into society more broadly. The system is also engaged internationally, with domestic researchers collaborating with overseas counterparts, contributing to domestic and global research endeavour.
- **Skilled workforce** — the research workforce is strong across disciplines and there is a supply of higher degree research graduates sufficient to meet Australia's research needs. The research training system produces graduates with industry relevant and entrepreneurial skills who will increase the innovativeness and absorptive capacity of their workplaces. Finally, researchers are mobile between sectors and internationally.
- **Balance** – there is an appropriate balance of government and private investment, including investment in research infrastructure. This includes a balance across the full spectrum from basic and applied research.

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[112] Research Excellence Framework, 2014, *Research Excellence Framework 2014: Assessment framework and guidance on submission*.

Data considerations

Performance against such possible benchmarks should be compared across the following:

- relevant sectors (business, government, not-for-profit, etc)
- different types of PFRO
- other relevant countries.

Wherever possible, existing data should be used. Careful consideration should be given to whether the collection of new data is crucial and could be justified under the Government's Competitiveness Agenda.

The use of metrics to assess the performance of the publicly funded research system may influence the behaviour of institutions that receive government funding, including universities and PFRO. It is important therefore that metrics are selected so that perverse incentives are not created, and the system is not distorted by them. It is also important that the exercise does not undermine the health and performance of the very system it assesses.

There are a number of established data collections that could be used, including:

- the Australian Research Council's (ARC) Excellence in Research for Australia (ERA), which evaluates the quality of research produced in Australian universities against national and international benchmarks at approximately three year intervals
- data on university research inputs, outputs, research income, publications and the research workforce from the Higher Education Research Data Collection (HERDC), higher education staff and student collections and the Australian Bureau of Statistics
- the National Survey of Research Commercialisation (NSRC), which captures data on research commercialisation outputs from universities, PFRO and MRI and provides for limited benchmarking with the US, Canada, the UK and, when data is available, the European Union
- international ranking systems which assess Australian universities performance against their international contemporaries annually
- internationally comparative data from the OECD, the World Bank and UNESCO on the proportion of basic and applied research in various countries and the percentage of business funded research and development (R&D).

Selection of potential indicators and implementation

The work done to date on whole-of-system indicators is useful but further work is required to shape and develop a new assessment tool before it could be considered for implementation. Preliminary analysis to date by the Department of Education and Training and the Department of Industry, Innovation and Science has identified the measurement options set out in Table 7. A number of these indicators are applicable to universities only at present and broadening the scope of indicators so that they are applicable to all institutions conducting publicly funded research will be a challenge.

Further development of the indicators and arrangements for implementation should be informed by consultation across the relevant portfolios referred to in this chapter. This

should commence in early 2016 so that it can inform the use of additional indicators in the second performance report to be produced in 2017.

Table 7. Possible benchmarks for assessing the research system against key principles

Principle	Short term measure	Long term measure
Responsiveness	Expenditure on basic and applied research and the alignment of public and private expenditure on R&D	R&D expenditure and alignment to National Science and Research Priorities
Return on investment	Research system efficiency: proportion of research outputs to research inputs (including patents filed and licensing/assignment income) Competitive grant efficiency: trends in success rates for competitive grants administered by the ARC and the NHMRC	New impact and engagement assessment framework for universities once implemented (refer to Chapter 6)
Engagement	Public sector R&D funded by industry, research income from industry, collaboration between industry and research institutions on innovation, and publications with co-authors and patent citations	Potentially also ATSE's new Research Engagement for Australia (REA) metrics and other new metrics developed as part of the new impact and engagement assessment framework (refer to Chapter 6)
Skilled workforce	Size of research workforce and PhD graduation rate, measurement of researcher mobility	Size of research workforce and PhD graduation rate, measurement of researcher mobility
High Quality	World research outputs and ERA	ERA ratings for quality and new impact and engagement assessment framework (refer to Chapter 6) — once implemented
Balance	R&D expenditure by sector as a proportion of GDP and government investment in R&D	R&D expenditure by sector as a proportion of GDP and government investment in R&D

Recommendations

25. The Minister for Education and Training, in consultation with the Minister for Industry, Innovation and Science, the Minister for Health and other relevant ministers, should take the lead on assessing and reporting on the performance of the publicly funded research system through:
    a. an annual public assessment of the performance of the Australian research system
    b. advice to the Cabinet annually on current and emerging policy implications to inform policy consideration at both the whole of government and portfolio by portfolio levels
    c. public release of the results of the assessment after the Cabinet's consideration.

26. Early work currently underway by the Departments of Education and Training and Innovation, Industry and Science to develop system-level performance measures should be accelerated and developed in consultation with the business and the university sectors.

27. The first assessment of the performance of the publicly funded research system should be produced by the end of 2016 using existing data collections.

8. Global university ranking systems: an Australian developed system?

The terms of reference for the review require it to:

> consider the development of measures of research-industry engagement and collaboration, including the availability of international rankings to compare performance and drive improvement over time.

This chapter discusses the feasibility of developing a global ranking system to help drive better collaboration between universities and business and other research end users.

There are currently more than twenty ranking systems that allow comparisons to be made among universities across the world. Some systems have been in existence for a decade or more, others are much more recent, and new systems are emerging regularly. Some of the newer systems are starting to include measures of end user engagement and collaboration, whereas this focus is largely absent in the longer standing ones.

The ranking systems and the resulting university rankings do significantly influence the behaviour of those involved in the higher education system. They are used by universities to compare their performance and help improve it, to market themselves to prospective students, and to show accountability to their stakeholders.[113,114] Students, particularly international students, use them to help choose their place of study.[115] Governments use them to compare the relative performance of universities within their country and to compare their university systems with those of other countries. Finally, employers and the community use them to help infer the prestige of the qualifications and research produced by individual universities.

Ranking systems are a well established part of the global university architecture, although they are not beyond criticism.[116] Adding just 'one more system' will not make a significant difference. However, developing a new system that measures the performance of universities across the world against metrics for business and end user collaboration may encourage Australian universities to focus more on end user engagement. Accordingly, the review considered the benefits of developing a new university ranking system focused on measuring research-industry collaboration, whether (if implemented domestically) it would attract the participation from other countries to enable it to become a new global ranking system, and whether there were other ways of achieving the same results.

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[113] QS Top Universities, 2014, *How do Universities Use Rankings?*
[114] Wedlin L, 2014.
[115] QS Top Universities, 2014, *A Decade of International Student Rankings; What do Students Think?*
[116] Stella A and Woodhouse D, 2008.

The established ranking systems

The three most influential and longest running world ranking systems are:

- Academic Ranking of World Universities (ARWU) — which was established in 2003 by the Centre for World-Class Universities and the Institute for Higher Education of Shanghai Jiao Tong University, China. The ranking system was initially started as an indicator to show the global standing of Chinese universities and help improve their performance.
- Times Higher Education (THE) World University Ranking — which was first published in 2004 by THE, a British publication, in collaboration with Quacquarelli Symonds (QS) and published independently from 2009
- QS World University Ranking — from 2004 to 2009, QS rankings were published in collaboration with THE. In 2010 QS assumed independent publication of rankings.

Another influential ranking system is the US News and World Report's 'Best Colleges Guide' which has ranked American colleges since 1983. The rankings are regarded as strongly influencing students' choice of college, college performance improvement and government higher education policy.[117] In 2014, US News and World Report established its Best Global University Rankings, although it uses a different methodology to its domestic rankings. The Global Rankings are expected to rapidly grow in influence given the strength of US News and World Report's US domestic rankings.

The established ranking systems are generally based on combinations of indicators which focus on research performance. They each use citation indexes as the most heavily weighted indicator of university research performance. Some ranking systems use specific graduate outcomes (such as a count of CEO) and the number of Nobel Laureates, which are not necessarily a fair representation of university performance. The choice of indicators in many ranking systems has led to criticism that these systems undervalue important aspects of university quality such as teaching. Almost all rankings have a quantity bias in the calculation of their outcomes, rewarding institutions that have large numbers of high profile academics.

The majority of ranking systems do not seek to capture teaching quality except to consider metrics such as teacher to student ratios. Others, for example U-Multirank, do include student survey data on items such as student satisfaction, teacher qualifications, graduating on time and the quality of courses and teaching. However, as with other data of this type, there are criticisms about the effectiveness of student perception as a measure of teacher quality.[118]

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[117] Morse R, 2008.

[118] The measurement of the teaching quality of a university is a controversial topic and without consensus for an appropriate metric. The main issue is identifying how the student has gained from the teaching experience. In effect it requires the testing of student before, during and after the university teaching experience and then somehow controlling for individual ability. Instead proxy style measures that survey students are used, though they are not without issues such as cognitive bias, individual perceptions of quality, and that students are not comparing experiences across universities but only at the university at which they are enrolled.

Finally, the established ranking systems have also been criticised because of their focus on a narrow, traditional view of research performance that privileges publication output and academic citations over indicators which measure collaboration with industry and commercial outputs, such as research spin-offs and publications co-authored with business.

Under the established systems, Australian universities fare relatively well, with approximately six or seven in the top 100 universities and around 20 universities in the top 500. The top-ranked Australian universities under these systems are also the nation's top performers in research quality and volume, reflecting the research focus of the ranking metrics.

The newer ranking systems

The number of international ranking systems is increasing and their coverage broadening. The scope of some existing systems is also being widened to include more universities in different parts of the world and, in some cases, different metrics.

Some newer systems include collaboration and innovation metrics. For example, the CWTS Leiden Ranking (established in the Netherlands by Leiden University's Centre for Science and Technology Studies (CWTS) in 2007) assesses collaboration performance based on the proportion of publications co-authored with one or more industrial partners.[119] Similarly, the SCImago Institutions Rankings (SIR) — established in 2009 in Spain by SCImago, a data-mining and visualisation group at the universities of Granada, Extremadura, Carlos III and Alcalá de Henare — includes 'innovation', measured in terms of the absolute and relative quantities of scientific research articles cited in patent applications.[120]

More recently still, U-Multirank (first released in 2014 with seed funding from the European Union and involving academic and industry partners from Germany, the Netherlands and Belgium) uses a range of metrics for knowledge transfer, including industry research income, joint industry publications, spin-offs and patents.[121] Unlike other major global ranking systems, U-Multirank ranks universities against each indicator and does not aggregate results into an institutional ranking. The aim of U-Multirank is to provide a user-driven form of university ranking, whereby the individual tailors the indicators to match their own priorities for a university.

THE is also developing 'innovation indicators' that aim to assess university-industry collaboration performance.[122] The four indicators THE uses are:

- **resources from industry** — quantity of research income received from industry
- **patent citations** — proportion of papers published by an institution that have been cited by patents, compared to those that have not

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[119] CWTS Leiden University, 2015.
[120] SCImago, 2015.
[121] U-Multirank, 2015.
[122] Bothwell E, 2015.

- **industry collaboration** — percentage of papers published by an institution that involve an element of working with industry directly, compared to those that do not
- **industry contribution** — proportion of research income that an institution receives from industry sources, as a percentage of their total institutional income.

When first trialled and published in August 2015 the new innovation indicators were applied only to STEM and medical research activity, rather than to the full disciplinary breadth of university research. This limits their usefulness as overall university research indicators.

THE published rankings for the top 15 institutions for each indicator.[123] There has been no attempt to produce a single innovation ranking. The institutions that performed well on the four innovation indicators were not the expected elite universities that usually feature prominently in major global university rankings.

A new Australian developed system?

In responding to the terms of reference, the review considered the large number of existing ranking systems, noting that Australian universities already participate in the major rankings and that these are important in terms of reputation and influence on student choice. The review also considered that while many established ranking systems do not include measures of industry engagement or commercialisation, some of the newer ones do, and that this trend is likely to continue. Further THE World University Ranking is intending to develop 'innovation' indicators to specifically measure performance in this area. THE intends to introduce these indicators into the existing rankings within the next few years. Australian universities participate in THE rankings and consequently will be ranked against the new indicators once they are introduced. Finally the review considered other possible ways to achieve the broad objectives of the terms of reference.

Consultations suggested there was no significant support for the development of a new Australian-led ranking system, whether developed or supported by the Australian Government, to focus on measuring universities' performance in terms of business and end user engagement and collaboration.

Australian universities already participate in the most influential global ranking systems and generally perform well. International education has considerable economic, social and cultural importance to Australia. Government development or sponsorship of a new system may send the wrong signal to international students as it may appear that, in taking this step, the Australian Government is turning away from those existing systems. International students studying in Australia reported that their choices were driven by course and institution reputation.[124] One of the main drivers of an institution's reputation is its standing in rankings. As our third largest export industry, worth $18 billion per annum, international

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[123] Ibid. Australia had only one research institution, and no universities, which ranked against any of the innovation indicators — the QIMR Berghofer Medical Research Institute ranked 6th on the patent citations indicator.

[124] Department of Education and Training, 2015, *International Student Survey 2014, Overview Report*.

education is of great importance to Australia, and two-thirds of that income comes from higher education. Any sense that, in committing to the development of a new ranking system, the government has lost faith in the existing systems that rank Australian universities highly may have a negative effect on that industry.

Further, global rankings systems are usually produced by non-government organisations and/or through universities with specific expertise in measuring higher education research systems. There may be little or no interest from other countries, and their universities, in joining a new system developed or even supported by the Australia Government, particularly given the crowded landscape of global rankings and the national and university sensitivity to the rankings themselves. If Australia developed a new global ranking system domestically and was unsuccessful in securing the participation of other countries to 'internationalise' the ranking, it would significantly reduce its standing and usefulness. Further, to introduce a new ranking system that needed data that may not be publicly available, or require the creation of new data sets, adds complexity and risk in trying to encourage international partners and universities and would present significant barriers to the creation of a new system.

Finally, and most importantly, there are other more powerful drivers than a new global university ranking system that can influence Australian university behaviour to encourage end user collaboration.

In sum, the review was not convinced that the development of a new ranking system led by Australia would be the most effective way to achieve the Government's objective of increasing university-end user engagement. This is more likely to be realised by introducing a system to assess engagement and the impact of university research (see Chapter 2 on Research Block Grants and Chapter 6 on Assessing Impact and Engagement for further details).

It would, however, still be open to Australia to seek to work with THE in a low key way on further development of its 'innovation indicators'. THE is currently seeking feedback on its new approach, including what other indicators might be developed, how they might be combined and whether it would be possible to work towards a full innovation and impact university ranking system.[125] This may provide an opportunity for Australia to encourage THE's work and help influence the development of the 'innovation indicators', including by contributing recent Australian experience on developing engagement, commercialisation and impact measures. This would draw on the standing of THE ranking and would capitalise on the work THE has already undertaken in consultation with universities around the world to identify potential innovation indicators for inclusion in an innovation ranking system.

It would also be open to Australia to collaborate with other university rating systems seeking to measure research-industry engagement and collaboration.

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[125] Bothwell E, 2015.

Recommendations

28. Australia should seek to influence the initiatives of existing and possibly new global ranking systems moving to incorporate innovation and industry engagement measures into their rankings.

Appendices

A. University approaches to research collaboration
B. List of consultations
C. List of submissions
D. References

University approaches to research collaboration

The terms of reference for the review call for advice on options which:

> encourage universities to engage in research commercialisation and knowledge transfer with industry and the broader community.

This review has considered how the Australian Government, through its policy and funding arrangements with universities and through business focused initiatives, can help to encourage increased collaboration between universities and business and other research end users. This appendix gives a brief overview of the strategies and specific initiatives undertaken by universities which focus on increasing engagement and collaboration.

As part of the review consultation process, universities were invited to submit case studies to highlight particularly productive relationships they had cultivated with end users of research. The review received 48 case studies from 32 universities. These involved collaborations across medical, agricultural, aerospace, manufacturing, mining, oil and gas and automotive industries. The case studies themselves are published in a separate volume 'Review of Research Policy and Funding Arrangements: Case studies on university-business collaboration'. The effort taken by universities in preparing these case studies is appreciated and the material provided was influential in framing the report's recommendations.

Universities and businesses alike agreed that cultural change is required in both sectors so that business can more easily identify, access and undertake relevant research in collaboration with universities. Over time, this culture change has the potential to achieve significant improvements in collaboration and engagement between the sectors.

However, consultations also highlighted the fact that the current academic rewards do not always encourage business collaboration. In this framework, the time taken to cultivate productive relationships with the private sector or other end user is sometimes regarded as a cost rather than a benefit for the researcher or the institution.

The review commended the range of strategies universities are employing to build more systematic and sustained relationships with business, moving away from transactional approaches centred on ad hoc research projects.

This appendix gives a brief overview of the strategies that universities are using to establish new research collaborations and build on their existing ones. It is by no means exhaustive and covers only some of the main strategies which include: co-location with industry, promotion of research strengths and dissemination of research outcomes, establishment of technology transfer and commercialisation offices, business access to research labs and large scale research infrastructure, business sponsored/funded academic chairs, staff exchanges between universities and the private sector, student placements, business experts on university committees and targeting research at local business needs.

In addition, some universities highlighted recent changes in their appointment and promotion policies which give significant weight to a track record in engagement with business and other end users alongside traditional measures of academic performance.

Building on research strengths

In five case studies, it was the track record of a university, or individual researchers, in a specific research field that attracted business to work with the university.

The Griffith University case study highlighted the importance of having a well known and well connected researcher lead the project. Associate Professor Mavin's practical experience as a professional pilot and a member of the Civil Aviation Safety Authority prior to becoming an academic, and his research on pilot training, were crucial to attracting Qantas, Air New Zealand and the Defence Science and Technology Group to collaborate on competency assessment and education programmes to improve and streamline pilot training. These commercial research and consultancy engagements have generated industry contributions in excess of $1.2 million.

The James Cook University case study highlighted its research in aquaculture and success in linking to a Melbourne-based energy company, MBD Energy, as the initial business partner. The partnership with MBD Energy, a project using algae to clean water and to develop stock feed and biofuels commenced in 2008 as a $250,000 trial project. It has since garnered $40 million of private equity and $30 million of government support. This led to a further partnership with Australia's largest prawn farm business, Pacific Reef Fisheries, in Ayr, North Queensland.

Seven case studies involved a number of universities pooling their research expertise to conduct multidisciplinary research projects, or one university working with many industry partners. This approach was featured in the case studies provided by the University of Western Australia, the University of Wollongong, the University of Newcastle, Bond University, Monash University, the Australian National University and Southern Cross University.

The University of Western Australia's INSAFE Joint Industry Project, which ran from 2008 to 2010 involved major oil and gas partners (ConocoPhillips, DONG Energy, ExxonMobil, and Shell), Oxford University, the National University of Singapore, state and federal regulatory bodies, surveyors, builders, owners and operators of references, and site investigation companies. While industry representatives provided records to the university, the university established and analysed a database of monitored offshore data on mobile drilling units. The project resulted in guidelines to improve the safety of offshore mobile drilling units which are becoming best practice in the industry.

Building relationships and focussing on local needs

Seven case studies illustrate the value in building on existing relationships and growing partnerships which start out in the context of small projects.

The Soil Health and Natural Resource Management Planning project, funded from 2012 to 2014 and led by the Centre for eResearch and Digital Innovation at Federation University Australia, was the result of a long standing partnership with Corangamite Catchment Management Authority (CCMA). Federation University and CCMA started with a small online knowledge management project, which has now developed into a 10 year partnership and includes projects such as the Corangamite Groundwater Bore and Research Database, the Corangamite Erosion and Landslide Database and the Corangamite Knowledge Base.

Universities understand the value in adopting a long term focus to their relationships with businesses and other end users. The University of Sydney and University of Queensland case illustrate the importance of this, defining successful partnerships as including repeat business, no matter how small the initial or even subsequent collaboration. Case studies from the University of South Australia, the University of Adelaide and the University of Queensland show that time invested in a relationship to build trust and confidence will generate follow-on projects over decades.

The collaborations highlighted in two case studies were assisted by the Australian Government's Research Connections programme or its predecessor, the Researchers in Business programme (more information on this programme is included in Chapter 4). Sirtex, a medical device and cancer treatment company, accessed the Research Connections scheme to facilitate meetings with the University of Sydney and build pilot research data. The University of Sydney then successfully applied for a Linkage project grant to further its collaboration with Sirtex.

Co-location of universities and end users

A number of case studies demonstrated the value in working with partner organisations in shared facilities or within an innovation district. For example, CSL, Australia's largest biotechnology company, relocated part of its Melbourne-based Protein Therapeutics Research Group to the University of Melbourne's Bio21 Institute of Molecular Science and Biotechnology. Subsequently, CSL has established close links with many of the University's researchers and higher degree students located in the Bio21 Institute. CSL's co-location has provided early career researchers and graduate research students with opportunities to work with the biotechnology industry.

Industry stakeholders have co-funded or sponsored campus research centres at the University of Adelaide, the University of Sydney and the University of Technology Sydney. The University of Adelaide's Fertiliser Technology Research Centre was established in 2007 in partnership with the Mosaic Company, the world's largest phosphate and potash fertiliser manufacturer. Mosaic agreed to fund research at the new centre in return for commercialisation rights and a share of the intellectual property, initially signing a $5 million five year agreement.

Technology transfer/commercialisation offices

Technology transfer or commercialisation offices should aim to build and extend engagement with business and other end users of research. These offices often have a key role in sustaining long-term relationships but need to be adequately resourced to do so effectively. Some universities and business submissions noted these offices are under-resourced and lack experienced facilitators or intermediaries in Australia who understand the language and cultures of both the research and business sectors. This is a concern that universities need to consider and, if necessary, seriously address.

UniQuest Pty Limited, the commercialisation company of the University of Queensland, has established its reputation as a successful commercialisation centre through its 30 year history of research translation in collaboration with industry. As described in the University of Queensland submission, UniQuest has an annual licence income which is double that of all the other Group of Eight universities combined. To date, products commercialised by UniQuest have generated more than $11.7 billion globally, the bulk of which stems from Gardasil, the world's first cancer vaccine. Given that Uniquest processes over 400 contracts each year, including repeat clients, their commercialisation centre is clearly active in connecting end users with researchers.

Staff secondments

Many case studies noted the importance of sharing project governance with the partner organisation to build trust, develop a common understanding of the desired outcomes and improve understanding of each partner's expertise and contribution to the project outcomes. The Australian National University partnership with Sirtex shows how a multidisciplinary leadership team — which included Sirtex's Chief Executive Officer and research and development (R&D) staff with scientific, medical or engineering backgrounds as well as the university researchers — ensure both partners are fully committed and engage in articulating the research problem and working collaboratively on solutions.

The University of Wollongong case study demonstrated the value of a shared leadership approach in its Steel Research Hub, launched in 2014. A Research Management Committee, with a membership drawn from industry, oversaw funding allocations to projects and assesses progress. Projects were jointly led by an academic researcher and an industry champion. The University of Southern Queensland and Monash University also provided examples of shared governance where business representatives were included on project boards and involved in defining the project scope, agreeing on the project's objectives and assessing progress against those objectives.

Another approach to promote culture change is to recognise the success of researchers in engaging with business or appoint business representatives to university bodies. RMIT, the University of Technology Sydney and the University of Queensland appointed 'Innovation Champions' to acknowledge those academics whose research has been successfully commercialised and demonstrated significant impact. Under the University of Queensland's programme, launched in 2014, Innovation Champions mentor early to mid-career researchers and serve on an advisory board to the University's Executive. Macquarie

University and the Australian National University have appointed industry Adjunct Professors and Industry Chairs as part of their approaches to engaging with businesses.

PhD placements in business and other end user organisations

Eight university case studies emphasised that PhD student industry placements were a crucial part of their partnerships with businesses and in some instances, provided higher degree by research students with employment on completion of their studies.

These included the University of South Australia, Monash University, Macquarie University, Southern Cross University, RMIT and Central Queensland University and two examples from Edith Cowan University. The iPrep training programme, developed and trialled by Edith Cowan University in 2014 as a six week industry placement for PhD students during their thesis examination period, is now a programme run by all five Western Australian universities.

In RMIT's partnership with ANCA, a tool grinding manufacturer, six PhD students were engaged in a more than three year collaboration. They spent a third of their project time at ANCA's facilities and attended regular project meetings. The PhD students worked to develop and ensure the commercial viability of a new grinding machine, undertaking a long-term placement which had the direct benefit for business of enabling the product to be rapidly developed and enter the market after only three years of development.

List of consultations

Ministers

1. Senator The Hon Simon Birmingham, Minister for Education and Training
2. Ms Kelly O'Dwyer, Minister for Small Business
3. The Hon Christopher Pyne, Minister for Industry, Innovation and Science

Universities

1. Australian Catholic University
2. Batchelor Institute of Indigenous Tertiary Education
3. Bond University
4. Charles Darwin University
5. Charles Sturt University
6. Central Queensland University
7. Curtin University of Technology
8. Deakin University
9. Edith Cowan University
10. Federation University Australia
11. The Flinders University of South Australia
12. Griffith University
13. James Cook University
14. La Trobe University
15. Macquarie University
16. MCD University of Divinity
17. Monash University
18. Murdock University
19. Queensland University of Technology
20. Royal Melbourne Institute of Technology
21. Southern Cross University
22. Swinburne University of Technology
23. The Australian National University
24. The University of Adelaide
25. The University of Melbourne
26. The University of Newcastle
27. The University of Notre Dame Australia
28. The University of Queensland
29. The University of Sydney
30. The University of Western Australia
31. University of Canberra
32. University of New South Wales
33. University of South Australia
34. University of Southern Queensland
35. University of Tasmania

36. University of Technology, Sydney
37. University of the Sunshine Coast
38. University of Wollongong
39. Victoria University
40. Western Sydney University

Research Institutes

1. Australasian Joint Research Centre for Building Information Modelling (BIM)
2. Centre for Macroalgal Resources & Biotechnology
3. Centre for Sustainable Tropical Fisheries and Aquaculture
4. Centre for Tropical Water and Aquatic Ecosystem Research
5. CSIRO
6. Edith Cowan University Security Research Institute
7. Harry Perkins Institute of Medical Research
8. Industry and PhD Research Engagement Program (iPREP)
9. Institute for Immunology and Infectious Diseases
10. James Cook University eResearch Centre
11. Western Australian Energy Research Alliance (WA:ERA)

University Cohort Groups

1. Australian Technology Network of Universities
2. Group of Eight
3. Innovative Research Universities
4. Regional Universities Network
5. Universities Australia

Funding Councils

1. Australian Research Council
2. National Health and Medical Research Council

Academies

1. Australian Academy of the Humanities
2. Australian Academy of Science
3. Australian Academy of Technology and Engineering
4. Australian Council of Learned Academies
5. Academy of Social Sciences in Australia

Peak Bodies

1. Association of Australian Medical Research Institutes
2. Australian Council of Graduate Research
3. Council of Australian Postgraduate Associations
4. Knowledge Commercialisation Australia
5. National Tertiary Education Union

Business

1. Australian Chamber of Commerce and Industry
2. Australian Industry Group
3. Brazier Motti
4. Business Council of Australia
5. Glencore Port
6. Mainstream Aquaculture
7. MBD Energy Ltd
8. Osmotion Ltd
9. Pacific Reef Fisheries
10. Port of Townsville Ltd
11. Queensland Airports Ltd
12. Rockfield Technologies Australia Pty Ltd
13. SeaLink Queensland Pty Ltd
14. Townsville Chamber of Commerce Board
15. Townsville Hospital
16. Townsville Enterprise Ltd
17. Wilson/Ryan/Grose Lawyers

Individuals

1. Mr Michael Chaney, Business member of the Commonwealth Science Council
2. Ms Jackie Fairley, Business member of the Commonwealth Science Council
3. Mr David Gonski, Chairman, ANZ
4. Mr Matthew Grounds, Chief Executive, UBS Australia
5. Mr Simon McKeon AO, Chairman of Macquarie Group Limited

Government departments
1. Department of the Prime Minister and Cabinet
2. The Treasury
3. Department of Finance
4. Department of Industry, Innovation and Science
5. Department of Health
6. Department of Education and Training
7. Office of the Australia's Chief Scientist

List of submissions

The review received a total of 76 written submissions. The following individuals and organisations have agreed that their submissions can be made public. Confidential submissions are not listed here.

1. Association of Australian Medical Research Institutes
2. Australian Academy of Humanities
3. Australian Academy of Science
4. Australian Academy of Technology and Engineering
5. Australian Advanced Manufacturing Council
6. Australian Business Deans Council
7. Australian Catholic University
8. Australian Council of Deans and Directors of Creative Arts
9. Australian Council of Graduate Research Inc.
10. Australian Housing and Urban Research Institute
11. Australian Library and Information Association
12. Australian Mathematical Sciences Institute
13. Australian National Data Service
14. Australasian Open Access Support Group
15. Professors Barnett, Graves and Clarke
16. Mr Steve Burdon
17. Professors Bruce Chapman and Prof Glenn Withers
18. Central Queensland University
19. Charles Darwin University
20. Charles Sturt University
21. Cooperative Research Centres Association
22. Council of Australian University Librarians
23. Council of Private Higher Education
24. Deakin University
25. Deep Exploration Technologies Cooperative Research Centre
26. Flinders University
27. Griffith University
28. Group of Eight
29. Innovative Research Universities
30. James Cook University
31. La Trobe University
32. Laureate Australia
33. Medicines Australia
34. Medical Technology Association Australia
35. Minerals Council of Australia
36. Monash University
37. National Disability Services
38. Mr Nigel Palmer
39. Pfizer Australia

40. Public Health Association of Australia and Council of Public Health Institutions of Australia
41. Queensland University of Technology
42. Research Australia
43. RMIT University
44. Southern Cross University
45. Swinburne University of Technology
46. The Australian National University
47. The Australian Technology Network
48. The Council of Australian Postgraduate Associations
49. The Regional Universities Network
50. The University of Melbourne
51. The University of New South Wales Australia
52. The University of Notre Dame Australia
53. The University of Queensland
54. University of Canberra
55. University of Divinity
56. University of Newcastle
57. University of Tasmania
58. University of Technology Sydney
59. University of the Sunshine Coast
60. University of Wollongong
61. Victoria University
62. Victorian TAFE Association
63. Western Sydney University
64. Universities Australia

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