ATSE

RESEARCH ENGAGEMENT FOR AUSTRALIA

MEASURING RESEARCH ENGAGEMENT BETWEEN UNIVERSITIES AND END USERS

A REPORT BY THE ACADEMY OF TECHNOLOGICAL SCIENCES AND ENGINEERING (ATSE)

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The Academy of Technological Sciences and Engineering (ATSE)

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Measuring research engagement between universities and end users

Report of a study by the Australian Academy of Technological Sciences and Engineering (ATSE)

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Executive Summary

The Australian Academy of Technological Sciences and Engineering (ATSE) advocates for a future in which technology, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing. ATSE believes that realising the benefits of Australia's world-class research system requires translation of its outputs into economic and societal benefits. The effective translation of research will be at the core of Australia's future competitiveness and prosperity.

This project, undertaken by ATSE, explores options for developing metrics to measure Australian universities' research engagement with private and public sector partners. This work is intended to ensure that research engagement is appropriately recognised and rewarded alongside research excellence, in line with the Government's Industry Innovation and Competitiveness Agenda. It is hoped that such research engagement metrics will help to increase the return on the public investment in research in science, technology, engineering and maths (STEM) and humanities and social sciences (HASS) alike.

This report focusses on developing metrics from existing data collections of Australian university research that can serve as indicators for research engagement, knowledge transfer and/or collaboration. The key and simplifying principle used in this report is to use external dollars attracted to support research from industry and other ends users, as a direct measure of research engagement. Using existing data that is submitted by universities to the Australian Research Council (ARC) for inclusion in Excellence in Research for Australia (ERA), three metrics have been developed: a metric for 'Engagement per FTE', a metric demonstrating the 'Share of National Engagement Activity' and a metric of 'Engagement Intensiveness'. These three metrics are derived by using income that is earned by university researchers for research done in collaboration with and/or for public and private sector partners. The metrics have been named 'Research Engagement for Australia' (REA).

Using the Australia and New Zealand Standard Research Classification (ANZSRC) Field of Research (FoR) codes, each metric is applied to two-digit research disciplines (e.g. Mathematical Sciences – FoR 01) for each Australian university, using de-identified data provided by the ARC.

Key findings:

- It is feasible to create meaningful research engagement metrics from existing data collections. Further, it is possible to use these as the basis for assigning rankings to universities based upon their performance in two-digit disciplines.
- Existing data collections are sufficiently detailed to distinguish between income that is awarded based on the participation of a non-university organisation (e.g. industry partner(s) in an ARC Linkage grants), or that has been derived from engaging a non-university organisation (e.g. contractual research), and research income awarded for researcher-led investigations (e.g. ARC Discovery grants).
- These research engagement metrics can identify activities in universities that are not well suited to the ERA quality evaluations.
- Research quality is an important, but not sufficient, condition of innovation.
- Taken alongside rigorous evaluations of research quality such as ERA, research engagement metrics provide a more complete picture of universities' research activities.
- Additional work needs to be completed around issues such as data integrity, methods for deriving rankings and/or ratings from the metrics and additional data that may be included in the metrics.

Introduction

Background

The Australian Academy of Technological Sciences and Engineering (ATSE) advocates for a future in which technology, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing. The Academy is empowered in its mission by some 800 Fellows drawn from industry, academia, research institutes and government, who represent the brightest and the best in technological sciences and engineering in Australia. The Academy provides robust, independent and trusted evidence-based advice on technological issues of national importance. ATSE fosters national and international collaboration and encourages technology transfer for economic, social and environmental benefit.

ATSE believes that realising the benefits of Australia's world-class research system requires translation of its outputs into economic and societal benefits. The effective translation of research will be at the core of Australia's future competitiveness and prosperity. Australia undertakes world-class scientific research through universities and other publicly funded research organisations, such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Australian Nuclear Science and Technology Organisation (ANSTO) and the Australian Institute of Marine Science (AIMS).

In the Australian university sector, there are effective financial and prestige incentives that focus researchers on producing high quality publications. Excellence in Research for Australia (ERA) encourages a focus on research publication by evaluating research using indicators such as peer review and citation metrics. The Federal Government's Department of Education and Training rewards this by allocating approximately $65 million per annum based in part on ERA outcomes through the Research Block Grants (RBG). The behaviours that ERA drives in our university sector have been even greater than might be anticipated from this small amount of funding, demonstrating that a metrics-based approach can achieve important behavioural change.[1]

While research excellence is desirable in its own right, it is not a sufficient driver of innovation and is only one dimension of the research endeavour. A focus on research excellence is often at the expense of other important activities such as university collaborations with the private and public sectors, entrepreneurial behaviour and knowledge transfer.[2]

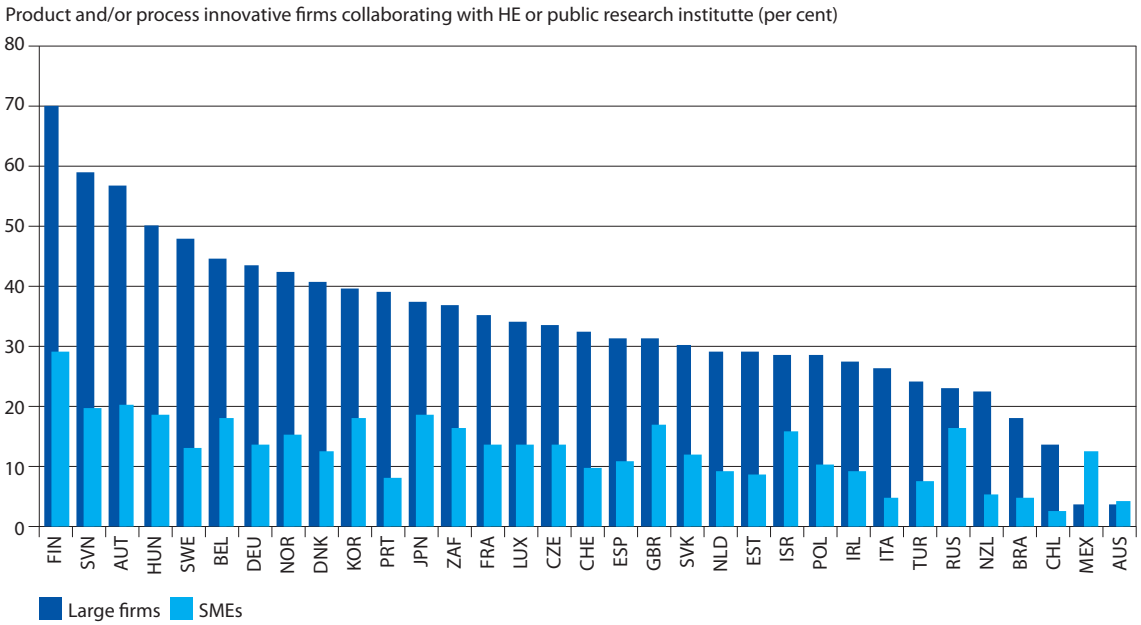
Indeed, OECD data show that Australian universities and publicly funded research institutes and industry in Australia are less engaged in collaboration than their counterparts in other countries (Figure 1). This is of particular concern for Australia given around 58 per cent of our researchers are employed in the higher education sector.[3]

Calls to address this have increasingly been heard from government and industry. As recently outlined in *Boosting the Commercial Returns from Research*, research translation is a key aspect of the Government's *Industry Innovation and Competitiveness Agenda*:

> Better translation of research into commercial outcomes is a key part of this [agenda] and will help drive innovation in Australia, grow successful Australian businesses and research capacity, and boost productivity and exports. It aligns with the Government's measures to reform the higher education sector and to realise the potential of health and other research.[4]

1 See ACIL Allen, 'Benefits Realisation Review of Excellence in Research for Australia.'
2 ACOLA, pp74-75
3 OECD, p99
4 Australian Government, p2

Figure 1 Firms collaborating with higher education or public research institutes.[5]



An important step in achieving this is to "improve assessment of the research system, including improved metrics on engagement and knowledge transfer with industry, as well as research outcomes and impact." [6]

This project, Research Engagement for Australia (REA), undertaken by ATSE, explores options for developing such metrics, to measure Australian universities' research engagement with private and public sector partners.

This work is intended to ensure that research engagement is appropriately recognised and rewarded alongside research excellence, in line with the Government's Industry Innovation and Competitiveness Agenda. The proposed metrics are intended to work in parallel with ERA and do not imply a loss of the value of basic, curiosity-driven research. It is hoped that such research engagement metrics will help to increase the return on the public investment in research in science, technology, engineering and maths (STEM) and humanities and social sciences (HASS) alike.

Scope

This project has been completed with the support of the Federal Government's Department of Education and Training, Department of Industry and Science and the Australian Research Council (ARC).

The scope of the project has been to:

- Identify definitions of key terms (e.g. research engagement, knowledge transfer etc.)
- Construct a matrix of what measures exist, or could be developed, for each of the terms, mapped across all individual discipline areas.

This will generate a matrix of measures that will ensure that the exercise is sensitive to disciplinary differences. While this report is focussed explicitly on developing metrics from existing data about university research, and does not consider the whole publicly funded research sector, the lessons learned here are applicable to consideration of research engagement more broadly.

5 OECD, p127
6 Ibid, p24

The project has been conducted in the following four phases:

- Phase 1: Scoping work to define terms, construct a matrix, and examine existing available data sets to determine the advantages and disadvantages of indicators to include in a new metric/s.
- Phase 2: Selection of a preferred set of metrics with accompanying data specifications, including the definition of assessment bands to be reported and the methodology to be used to determine the bands.
- Phase 3: Consultation with stakeholders on proposed metrics and approaches.
- Phase 4: Conduct a trial exercise with appropriate de-identified data already collected through ERA and HERDC as a means of testing the capacity of REA.

Through ATSE, a Steering Committee[7] was formed in October 2014 to provide expert and discipline-based input to this project. The Steering Committee included representatives from the Department of Education and Training, the Department of Industry and Science, the ARC, the Australian Academy of Science, the Australian Academy of Humanities, the Academy of Social Sciences in Australia, ATSE, and a number of other leaders from the higher education sector.

The first meeting of the Steering Committee took place on 26 November, 2014, with a second meeting taking place on 15 January, 2015. A third and final meeting was held on 27 February 2015.

Additional stakeholder consultation has been conducted with a number of groups throughout this process. This has included ongoing discussions and briefing sessions with the following groups: Universities Australia (UA), Group of Eight (Go8), Australian Technology Network (ATN), Innovative Research Universities (IRU), Regional Universities Network (RUN) and Knowledge Commercialisation Australasia.

Definitions

Much of the policy discussion in Australia around maximising the benefits of publicly funded research, and in particular university based research, has focussed on measuring research impact. Broadly defined, research impact is the "demonstrable contribution that research makes to the economy, society, culture, national security, public policy or services, health, the environment, or quality of life, beyond contributions to academia."[8] This approach is focussed on the late stages of a research process.

Research engagement, by contrast, is defined as follows:

> *Engagement describes the interaction between researchers and research organisations and their larger communities/industries for the mutually beneficial exchange of knowledge, understanding and resources in a context of partnership and reciprocity.*[9]

Policies focussed on research impact are limited by methodological difficulties around the attribution of impacts, establishing causal links between research and broader impacts, and the long time lags involved in research achieving impacts. Developing relevant and scalable metrics for assessing impact has thus remained elusive.

By contrast, indicators measuring earlier stages of the research engagement process are easily identifiable, broadly common across disciplines and readily available. Data on funding from partner organisations, and activities such as joint research projects with private and public sector partners, for example, are already collected or held by governments for a range of other purposes.

Implicit in these types of activities are two forms of research engagement – 'knowledge transfer' and 'collaboration.' Knowledge transfer is understood to be "deliberately embedding knowledge for use in

7 Appendix A includes a full list of members
8 Publicly Funded Research Agencies (PFRA)
9 Ibid

a context beyond the researcher's own sphere"; collaboration is understood as "researchers and research organisations engaging with other researchers and research organisations for mutual support and contribution to the conduct of research."[10] In this project, knowledge transfer and collaboration have been considered within the definition of research engagement i.e. knowledge transfer and collaboration are only considered where they occur between universities and the public (community) and/or private (industry) sectors. It should be noted that there are a range of important engagement activities undertaken in universities that are not being captured under this definition which relate to, for example, educational activities and broad community engagement. The aim of these definitions is to separate out research engagement from other important but distinct engagement activities. In this respect, the following definition of research from the Higher Education Data Collection (HERDC) should be taken as implied throughout:

HERDC definition of research

Research is defined as the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings. This could include synthesis and analysis of previous research to the extent that it leads to new and creative outcomes.

This definition of research is consistent with a broad notion of research and experimental development (R&D) as comprising of creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications.

This definition of research encompasses pure and strategic basic research, applied research and experimental development. Applied research is original investigation undertaken to acquire new knowledge but directed towards a specific, practical aim or objective (including a client-driven purpose).[11]

There are a number of practical advantages of this approach:

- While research impact may be 'assessed' through expert peer review, research engagement can be readily 'measured'.
- Activities and inputs of research engagement are quantifiable through direct measures, such as funding from the private and public sectors.
- In this exercise, the external dollars attracted into a research activity are used as a direct measure of research engagement.
- By using external dollars as a measure for engagement, the participants are clearly identifiable.
- In attracting such funding, there needs to be a successful review process by the funding company or organisation.
- Such measures are already broadly accepted and used elsewhere in the higher education sector (e.g. ERA and HERDC), where the returns are audited.
- Measures of engagement activities and inputs are time-bound, and occur in a relatively short timeframe, unlike, for example, case studies of research impact.

The university sector makes many contributions to society through both educational and outreach activities, in addition to the research context. These activities are substantial, critically important, and provide a major contribution by the tertiary sector to society. However, as REA is about developing metrics for research engagement, it is important that only research contributions, using the HERDC definition of research as outlined in Box 1, are used, and not additional contributions which fall into the educational and outreach category.

10 PFRA
11 Department of Education and Training, 2014c

Available data collections

A number of data sources were evaluated for inclusion in this project. Balancing the following considerations was foremost in identifying data:

- Data should be able to derive metrics that are relevant to different disciplines;
- Care should be given to minimise creating additional reporting requirements and additional costs for the higher education sector.

Two existing collections were considered primarily for the current project, the HERDC and the ERA exercise.

The HERDC is an annual data collection administered by the Department of Education and Training. It collects data on research publications, as well as research income across a number of categories.

ERA is Australia's national evaluation of university research quality, administered by the ARC. It uses metrics and peer review to inform expert committees as to the quality of Australian university research, measured against national and international benchmarks.

(1) Higher Education Research Data Collection (HERDC)[12]

HERDC includes data submitted at the university level and comprises research income, higher degree research student numbers and research publications data. Potentially relevant data for the current project included the range of income data outlined below.[13]

Category 1: Australian competitive grants

Category 1 consists only of income from those research schemes and programs listed on the Australian Competitive Grants Register (ACGR).

Category 2: Other public sector research income

Category 2: Other public sector research income includes:

- Australian Government – Non Category 1
- State or Territory government
- Local government
- Government business enterprises

Category 3: Industry and other research income

Category 3: Industry and other research income must be categorised in the following subcategories:

Australian

- Contracts
- Grants
- Donations, bequests and foundations
- Higher Degree by Research (HDR) fees for domestic students

International A: Competitive, Peer-reviewed research grant income
International B: Other income
International C: HDR fees for international students

12 Department of Education and Training, 2014a
13 Appendix B includes a detailed explanation of the HERDC categories

Category 4: CRC Research income

Category 4 comprises the following subcategories:

- Research income derived from Australian Government grants to CRCs
- Research income derived from industry and other non-Higher Education Provider (HEP) members of CRCs
- Research income derived from external parties contributing to CRCs

(2) Excellence in Research for Australia (ERA)[14]

ERA includes a range of data on research publications, research application, commercialisation and collaboration. Data are collected by four-digit Field of Research (FoR) code by university, and institutions must report data for all research active staff and affiliated researchers. Where available, ERA makes use of existing HERDC data.

Potentially relevant data for the current project included the range outlined below.

- Patents (sealed);
- Australian competitive grants income (HERDC Category 1 see above)
- Other Public Sector Income (HERDC Category 2 see above);
- Industry and Other income (HERDC Category 3, sub-categories 'Australian' excluding HDR fees for domestic students, 'International A' and 'International B' see above);
- CRC Income (HERDC Category 4 see above);
- Research commercialisation income (this includes income resulting from licences, options and assignments, including running royalties, cashed in equity and other types of income); [15]
- NHMRC endorsed guidelines; and
- Plant breeder's rights;
- Reports for an external organisation; and
- Registered designs.

Limitations of existing data collections

Both the HERDC and ERA data have limitations that have implications for this project. The advantages of the HERDC collection include that it is collected in the Categories listed in Table 1as a total for the whole institution – this allows the relevant components to be identified and included in metrics. For example, it is particularly important that the HERDC collection disaggregates 'Category 4 CRC Income' by the contributions from the Commonwealth from those made by other non-university partners and third parties. For a metric based on measures of research engagement, these are important distinctions to be able to make. Likewise, the detailed breakdown of 'Category 3 Industry and Other Income' into Australian contracts, grants, donations, bequest and foundations and HDR fees for domestic students is important – not all of these are necessarily relevant to the REA metrics, and being able to include or exclude elements is desirable.

Table 1 includes the relative contribution of the various HERDC categories for the year 2012. Care must be given to determining what income is 'relevant' to research engagement.

14 Australian Research Council

15 This includes only LOAs negotiated on full commercial terms, granting access to institutional intellectual property (patented or otherwise) in return for royalties or licence fees. Research commercialisation income earned by institution-owned subsidiaries and spin off companies is eligible for inclusion in ERA provided that the institution can account for this income in its audited financial statements.

Table 1 – HERDC income by sub-category source (2012)[16]

Source of funds	% of total HERDC
Commonwealth Schemes	43%
Rural R&D	2%
Non-Commonwealth Schemes	2%
Local Government	1%
State Government	12%
Commonwealth Government	13%
Australian Funding- Contracts	7%
Australian Funding- Grants	4%
Australian Funding- Donations Bequests and Foundations	4%
HDR Fees For Domestic Students	0%
International A: Competitive, Peer-reviewed research income	2%
International B: Other income	3%
International C: HDR fees for international students	4%
Funding derived from Commonwealth Grants to CRCs	2%
Funding derived from non-university participants in CRCs	1%
Funding derived from third parties contributing to CRCs	0%
Total (per cent)	100%
Total ($s)	$3,414,947,017

Equally important to having metrics which capture relevant activities, however, are metrics which can be determined for each discipline at the two digit FoR level, and which allow data to be compared on a discipline by discipline basis. This is the advantage of ERA, which includes data collected against four-digit and two-digit FoR codes. For each data element submitted to ERA, universities may choose a unique combination of FoR codes to represent its disciplinary content.

This importantly allows for the research effort of a discipline in one university to be directly compared to effort in that same discipline in another university. This is important for REA given that there are large differences between the disciplines for the metrics being used.

At present, however, neither data collection alone includes the ideal level of detail and attaches FoR codes to allow for within discipline comparison. The Department of Education and Training and the ARC are currently consulting with universities on ways to address this. A consultation paper on the possibility of streamlining the collection of the ERA and the HERDC data has recently been circulated to universities for comment. This has the potential to overcome the shortcomings of both collections, which would be an ideal case for refining the REA metrics outlined here.

16 Department of Education and Training, 2014b

Data included in the metrics

As outlined above, there is currently no data set that includes the lowest level of detail available as well as FoR codes. ERA data is used throughout the remainder of this report as the best available compromise. ERA includes a moderate level of detail and importantly has FoR codes attached to it.

The ability to compare results on a discipline by discipline basis is considered fundamental to developing REA.

For the present project, the ARC has provided de-identified ERA 2012 data under strict privacy provisions, and all analysis has been conducted with the limitations of those data.

Comparison within disciplines

The advantage of ERA data is that the same data are available across all disciplines. Table 2 shows the percentage distribution of the current data across two-digit FoRs.
In most cases the percentage share of a discipline is low in each category; however, the dollar amounts that underpin these figures are large enough to provide stable metrics.

Given divergent discipline shares across the sector it is important that all data are compared within the two-digit discipline. In other words, where 'Category 2' income is being used, it is important that the performance of a university in Mathematical Sciences (FoR code 01) is compared against other universities in Mathematical Sciences, and not, for example, with Medical and Health Sciences (FoR code 11) given the vastly different proportions of the national total amounts of 'Category 2' income that these disciplines represent.

In this project, each two-digit discipline in a university has been compared against the discipline in all metric calculations to avoid advantaging one discipline in favour of another because of its size, or share of national income.

Level of aggregation

The metrics that have been developed in this project are applied to each two-digit FoR code in each anonymised university that was evaluated in the ERA 2012 round. This is referred to as a Unit of

Reasoning behind developing metrics based on two-digit rather than four-digit FoR codes

Data around measures of research engagement are not well distributed across four-digit UoEs. There tend to be peaks and troughs, and the distribution does not easily allow for comparison by metrics. The higher, two-digit level of aggregation provides more stable data.

The metrics calculated at the four-digit level can often be skewed by very low numbers in a denominator. These are smoothed out at the two-digit level in almost all cases.

In some four-digit disciplines there are a very small number of institutions that are evaluated. This potentially means that a UoE will receive a good outcome by virtue of being one of a small number included in the analysis, and not because of its actual performance. The two-digit FoR codes have a more even number of UoEs and therefore no discipline is advantaged over another.

Table 2 – Percentage of total funding in each HERDC Category and for Research Commercialisation per two-digit FoR (ERA 2008-2010).

FoR	Cat 1[17]	Cat 2	Cat 3	Cat 4	Research Commercialisation Income
01 Mathematical Sciences	1.7%	0.9%	1.0%	1.2%	9.9%
02 Physical Sciences	2.5%	2.1%	1.4%	1.5%	0.4%
03 Chemical Sciences	5.6%	1.8%	2.3%	3.4%	1.0%
04 Earth Sciences	3.5%	2.6%	3.5%	4.5%	0.6%
05 Environmental Sciences	4.6%	4.1%	3.2%	10.9%	0.3%
06 Biological Sciences	10.9%	7.8%	9.8%	9.4%	1.2%
07 Agricultural and Veterinary Sciences	5.5%	4.7%	3.9%	14.5%	12.3%
08 Information and Computing Sciences	4.6%	3.3%	2.0%	4.4%	9.6%
09 Engineering	19.8%	9.0%	13.7%	29.4%	16.3%
10 Technology	1.7%	1.5%	1.0%	0.8%	1.2%
11 Medical and Health Sciences	12.7%	42.6%	41.7%	9.0%	45.3%
12 Built Environment And Design	2.0%	0.9%	1.0%	1.2%	0.0%
13 Education	3.5%	3.6%	2.6%	0.7%	0.5%
14 Economics	2.3%	3.0%	1.4%	0.7%	0.1%
15 Commerce, Management, Tourism and services	3.6%	1.3%	2.5%	4.2%	0.5%
16 Studies in Human Society	6.5%	4.8%	3.1%	1.6%	0.0%
17 Psychology and Cognitive Sciences	3.2%	2.5%	1.7%	1.3%	0.8%
18 Law and Legal Studies	1.1%	0.7%	0.7%	0.5%	0.0%
19 Studies in Creative Arts and Writing	1.2%	0.2%	0.4%	0.1%	0.0%
20 Language, Communication and Culture	1.4%	1.1%	1.3%	0.5%	0.0%
21 History and Archaeology	1.7%	1.3%	1.2%	0.1%	0.0%
22 Philosophy and Religions Studies	0.4%	0.2%	0.5%	0.0%	0.0%
Total (per cent)	100.0%	100.0%	100.0%	100.0%	100.0%
Total ($s)	$437,933,544	$2,365,960,108	$2,236,786,683	$362,950,240	$548,538,611
Grand total ($s)					**$5,952,169,186**

Evaluation (UoE) to mirror the language employed in ERA evaluations. The institutions have been anonymised by the ARC for this project by assigning a random 3 letter acronym.

Usefully, this has allowed for a comparison between the outcomes of the metrics here with ERA outcomes to determine if the metrics identify an aspect of university research performance that ERA does not.

17 See Table 3 below for details of which elements of Category 1 income are included.

Selection of inputs to use in the numerator of the metric:

In addition to the limitations imposed by the available data, additional considerations were given to which data elements to include from ERA. For example, data on non-traditional research outputs (including performance, design etc.) were not always considered to be readily consistent with a definition of research engagement; patents, for example, were not available in a large enough volume to be a stable input (in ERA 2012 there were only 781 sealed patents submitted across all disciplines, for all institutions in the three year reference period); research reports for external organisations, though considered to be measures of engagement, were also not available in large enough quantities from ERA 2012 data to be a useful measure. Thus, the data used in the current calculations are all income-based. While there are other important data that could be included, at present these are not available in sufficient enough quantities to meaningfully include. The current focus on income does, however, provide a standard and agreed set of measures across all disciplines.

The research engagement metrics proposed in this project include the following data:

- Major Category 1 Income that include a non-university partner contribution (including ARC Linkage Grants, NHMRC Development Grants and NHMRC Partnership Grants);
- Other Public Sector Income (HERDC Category 2);
- Industry and Other income (HERDC Category 3, sub-categories 'Australian', 'International A' and 'International B' – 'HDR fees for domestic students' has been excluded from 'Australia' and sub-category 'International C: HDR fees for international students' has also been excluded);
- CRC Income (HERDC Category 4); and
- Research Commercialisation Income.

A number of available elements from the HERDC categories have been excluded from the metrics – for example, HDR fees for domestic students and international students were both deemed to be irrelevant to research engagement in their current forms, even though they are included in the HERDC collection.

Table 3 provides a summary of the data elements included and excluded from the REA metrics. In each case, these are considered to be relevant measures of research engagement that are broadly comparable across disciplines.

For 'Category 1 Australian competitive Grants Income,' only a small number of large granting programs that regularly include the participation of a partner organisation (e.g. ARC Linkage, NHMRC Development Grants) have been included. This has been done to differentiate the metrics from other metrics that focus on traditional markers of academic quality, such as those included in ERA.[18]

Where a data element includes both Commonwealth and non-Commonwealth contributions (e.g. ARC Linkage grants, CRC income etc.), both types of contributions have been included in the present project. This is because there is some lack of clarity where the industry contributions appear in the HERDC returns and different institutions might list such returns under 'Category 1' and others under 'Category 2 or 3' of the HERDC return.[19]

As the Commonwealth contributions to ARC Linkage grants etc. have been counted in this exercise, for consistency the Commonwealth contribution to the CRC schemes have also been counted, even

18 A number of other programs would be potentially relevant, including those that fall under the Rural R&D Corporations, however at present these are not easily identifiable in existing data.

19 This issue can be addressed in further work described in the conclusion to this report when a number of universities will be asked to accurately describe the external partner monies that they are receiving for ARC Linkage, NHMRC Development grants etc.

Table 3 – data elements included in the metrics

ERA Category	HERDC Sub-Category	Included? (Y/N)
Category 1	Commonwealth Schemes	Y (for ARC Linkage, NHMRC Development and NHMRC Partnership Grants)
	Rural R&D	N[20]
	Non Commonwealth Schemes	N
Category 2	Local Government	Y
	State Government	Y
	Commonwealth Government	Y
Category 3	Australian Funding- Contracts	Y
	Australian Funding- Grants	Y
	Australian Funding- Donations Bequests and Foundations	Y
	HDR Fees For Domestic Students	N
	International A: Competitive, Peer-reviewed research income	Y
	International B: Other income	Y
	International C: HDR fees for international students	N
Category 4	Funding derived from Commonwealth Grants to CRCs	Y
	Funding derived from non-university participants in CRCs	Y
	Funding derived from third parties contributing to CRCs	Y
Research Commercialisation Income	-	Y

though the inclusion of these monies will have a major distorting effect on the returns, given that the Commonwealth contribution to CRCs ('Category 4') is 64 per cent of the total.

The inclusion of the 'Category 2' Government monies that are not part of the competitive granting scheme covered in 'Category 1' is important for the HASS disciplines where not-for-profit and public sector organisations are involved in research partnerships with universities.

Importance of not counting competitive government monies - example

Research Group A is successful in winning an ARC Linkage grant where the contribution for the grant is $400,000 from the ARC (Commonwealth), and $100,000 cash from the industry partner, for a grant total of $500,000.

Research Group B is successful in winning an ARC Linkage grant where the contribution for the grant is $400,000 from the ARC (Commonwealth), and $200,000 cash from the industry partner, for a grant total of $600,000.

If both Commonwealth and private sector funds are counted in the numerator of the REA metrics, then Group B will have an increase in their REA contribution for the grant which is 100/500 or 20 per cent greater than the REA contribution for Group A.

If only partner funds are counted in the numerator of the REA metric, then Group B will have an increase in their REA contribution for the grant which is 100/100 or 100 per cent greater than the REA contribution for Group A.

In the case of 'International A: Competitive, Peer-reviewed research income,' this has been included as it is considered that in many instances, this money is provided from large international public and private sector partners (e.g. The Gates Foundation), and being awarded this money is often considered a direct form of research engagement. In addition, this form of funding is considered as additional benefit

derived from the Australian Government's direct funding of research through the 'Category '1 grants and the RBGs and so is included.

The inclusion of 'Research Commercialisation Income' is considered a direct form of research engagement, given that in most cases this will have involved a partnership with the private sector, or has involved deliberately embedding knowledge for use in a context beyond the researcher's own sphere.

The range of data included will be more or less common to different disciplines – 'Category 2' income will be a common form for research engagement in HASS and STEM disciplines, whereas 'Category 3' and 'Category 4' will be more common for STEM disciplines. However, as outlined above, these data are compared within two-digit disciplines, and so in all instances 'like with like' comparisons are being made.

Selection of inputs to use in the denominator of the metric:

In order to derive meaningful metrics, additional data have been included as denominators. Each of three denominators is included to capture a distinct dimension of research engagement activities. The three denominators used are intended to compare performance on productivity, share of the national engagement activity and the focus or intensiveness of a university in a given two-digit discipline.

Two additional data elements have been included in the calculation of metrics to this end: FTE data and data on university research revenue. In both cases these have been included to adjust for the relative scale between universities in the metrics. This is done to ensure that a university is not disadvantaged or advantaged by being either small or large.

FTE data has been derived from ERA 2012 as per the other data elements. For ERA purposes, FTE only include staff that have either a) a 'research only' appointment, b) a 'teaching and research' appointment, or c) where the staff has an 'other function' (e.g. 'teaching only' or professional staff) but has produced eligible research outputs. In this respect, the FTE used in the metrics only include those who are research active by appointment type or by having research publications.

University revenue data has been taken from the Department of Education and Training's *Financial Reports of Higher Education Providers* collection. 'Total revenue from continuing operations' has been used.[21] This has been used in the current project, however, as outlined in the conclusion to this report, additional options will be explored in future work on this project.

Reference years

The data used is from the ERA 2012 round, which means that it includes data across the 3 year period 2008-2010. Using 3 years of data is preferred to ensure that yearly fluctuations in any one or more of the categories do not affect the performance of a university.

For FTE, data are used based on the ERA 2012 census date, March 31st 2011.

For 'Total revenue from continuing operations' data has been used for the year 2010 to align with the ERA data.

20 The income received under the Rural R&D Corporations is considered as relevant income, however at this stage, it is not able to be incorporated into the metrics from the existing data. A number of issues around the sources and types of income that fall under this scheme exist that need to be resolved. It is anticipated that these issues can be resolved and this income be included in future work on the REA.

21 Department of Education and Training, 2010.

Preferred metrics

Three metrics are presented below for REA: 'Engagement per FTE', 'Share of National Engagement Activity' and 'Engagement Intensiveness'. Each metric includes the data from Table 3 (above) divided by a distinct denominator. In each case, the UoE is the two-digit discipline in a university. A ranking is then assigned as outlined above, of 'A', 'B', 'C' or 'D' depending on which quartile the UoE falls within for its two-digit discipline (see discussion below for the results of this step).

Each metric presented below includes a description of the numerator, the unique denominator used, and the intended effect of applying it. A worked example is provided for clarification for each metric.

Engagement per FTE

Sum of inputs divided by FTE

In 'Engagement per FTE', the sum of the inputs for a UoE is divided by the sum of the FTE for the same UoE.

The resulting figure is the total amount of relevant income per FTE in a two-digit discipline in a university. This provides a productivity measure that is adjusted for the number of FTE in a discipline in a university, and that can be compared within disciplines.

For example, in Mathematical Sciences (FoR code 01) 'University of X' has $250,000 of ARC Linkage grants ('Relevant Category 1'), $40,000 'Other public sector income' (Category 2), $120,000 of 'Industry and other income' (Category 3), $20,000 of 'CRC income' (Category 4) and $10,000 of 'Research Commercialisation income' for a total of $440,000. There are 20 research active FTE in Mathematical Sciences at 'University of X.' The total is divided by the FTE, which results in a metric of $22,000.

Calculation

$$\frac{(\text{Relevant Category 1}_{UoE} + \text{Category 2}_{UoE} + \text{Category 3}_{UoE} + \text{Category 4}_{UoE}) + \text{Commercialisation income}_{UoE}}{\text{FTE}_{UoE}}$$

Share of National Engagement Activity

Sum of inputs divided by national FoR total

In 'Share of National Engagement Activity', the sum of the inputs for a UoE is divided by the sum of the same inputs for the relevant two-digit FoR nationally.

The resulting figure is the relative share for the university, of the relevant income, for that FoR nationally. This provides a volume based measure that can be compared within disciplines.

For example, in Mathematical Sciences (FoR code 01) 'University of X' has $250,000 of ARC Linkage grants ('Relevant Category 1'), $40,000 'Other public sector income' (Category 2), '$120,000 of 'Industry and other income' (Category 3), $20,000 of 'CRC income' (Category 4) and $10,000 of 'Research Commercialisation income' for a total of $440,000.

Nationally for Mathematical Sciences (FoR code 01) there are $7.5M of ARC Linkage grants, NHMRC Development Grants and NHMRC Partnership Grants ('Relevant Category 1'), $21M 'Other public sector income' (Category 2), $20.5M 'Industry and other income' (Category 3), $4.5M 'CRC income' (Category 4) and $15M of 'Research Commercialisation income' which results in an FoR total of $68.5M.

The total of 'University of X' in Mathematical Sciences is divided by the national total for Mathematical Sciences which results in a metric of 0.006.

Calculation

$$\frac{(\text{Relevant Category } 1_{UoE} + \text{Category } 2_{UoE} + \text{Category } 3_{UoE} + \text{Category } 4_{UoE}) + \text{Commercialisation income}_{UoE}}{(\text{Relevant Category } 1_{FoR} + \text{Category } 2_{FoR} + \text{Category } 3_{FoR} + \text{Category } 4_{FoR}) + \text{Commercialisation income}_{FoR}}$$

Engagement Intensiveness

Sum of inputs divided by total university expenditure

In 'Engagement Intensiveness', the sum of the inputs for a UoE is divided by the university's 'Total revenue from continuing operations'.

The resulting figure shows the relative focus of the university in a particular two-digit FoR code relative to its size. As distinct from volume and productivity, this metric provides information about the intensiveness of a university in a given discipline relative to its intensiveness in other disciplines, and relative to other universities.

For example, in Mathematical Sciences (FoR code 01) 'University of X' has $250,000 of ARC Linkage grants ('Relevant Category 1'), $40,000 'Other public sector income' (Category 2), '$120,000 of 'Industry and other income' (Category 3), $20,000 of 'CRC income' (Category 4) and $10,000 of 'Research Commercialisation income' for a total of $440,000.

The 'Total revenue from continuing operations' for 'University of X' is $750M.

The total of 'University of X' in Mathematical Sciences is divided by the 'Total revenue from continuing operations' which results in a metric of 0.0006.

Calculation

$$\frac{(\text{Relevant Category } 1_{UoE} + \text{Category } 2_{UoE} + \text{Category } 3_{UoE} + \text{Category } 4_{UoE}) + \text{Commercialisation income}_{UoE}}{\text{Total revenue from continuing operations}_{University}}$$

Discussion of the metrics

Assigning rankings or ratings

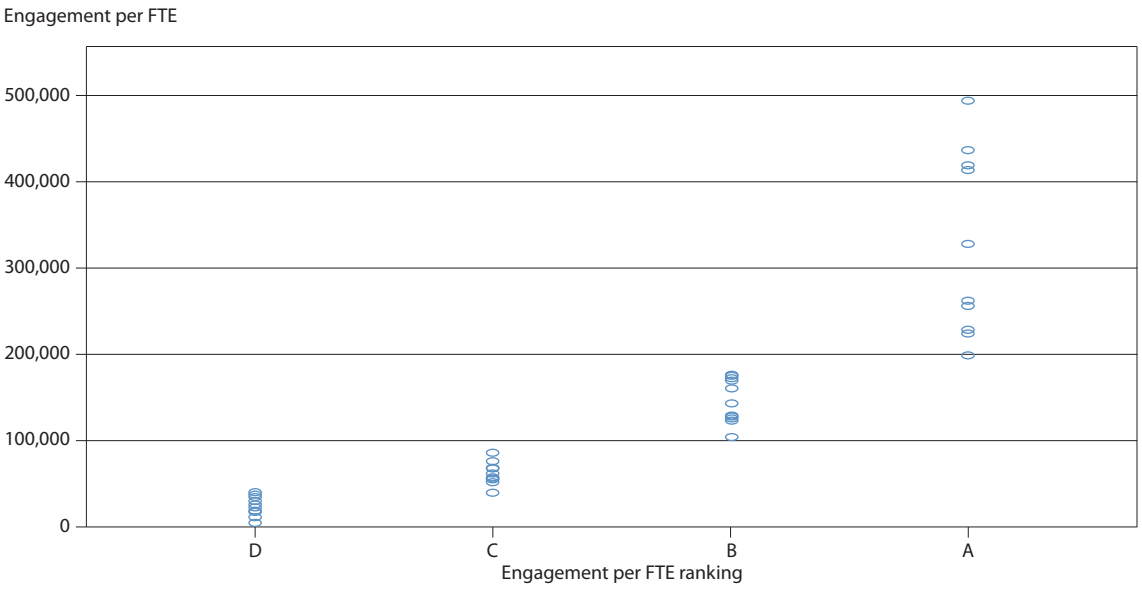
Throughout this project, a number of different methods for assigning rankings and/or ratings based on the metrics have been tested. In the end, a ranking system that divides the assessed UoEs into quartiles by two-digit FoR, and assigns 'A' to the top quartile, 'B' to the second quartile, 'C' to the third quartile and 'D' to the final quartile has been used.

This method has been preferred because it is easily applied within disciplines, and ensures that no discipline is advantaged or disadvantaged by the metrics i.e. under this ranking system each discipline will receive 25 per cent 'A' rankings, 25 per cent 'B' etc. The exception to this is that where the total assessed UoEs in a two-digit discipline cannot be divided into quartiles (i.e. the total UoEs is not divisible by four), quartiles have been rounded up, so that more 'A', 'B' and 'C' rankings are assigned than 'D' rankings. For example, in Mathematical Sciences (FoR code 01) there were 27 UoEs assessed; the rankings assigned to these 27 UoEs comprised 7 'A', 7 'B', 7 'C' and only 6 'D' rankings.[22]

Figures 2-7 below show the application of the present ranking methodology for two example disciplines – Medical and Health Sciences (FoR 11) and History and Archaeology (FoR 21).[23] In each case, the value for the given metric is presented against the distribution of the quartile rankings. Further discussion of the relevance of this method is provided later in this report.

In the examples for Medical and Health Sciences (Figures 2-4) a number of observations are apparent: first, there are distinct bands of performance but these do not correspond naturally with the quartile rankings, given the points separating one rank from the next are very close together in most cases; second, the spread of performance at each rank gets smaller from 'A'-'D' (i.e. whereas the spread for 'A' in all cases is very large, this decreases through the lower ranks). Given that, however, it is clear that the

Figure 2 Quartile ranking method applied to 'Engagement per FTE' for Medical and Health Sciences.



22 Appendix C includes a summary table of values calculated for each metric. This allows for comparison of the outcomes across metrics, rating points and disciplines.

23 These two examples are used throughout the remainder of this section to illustrate the REA applied to divergent disciplines.

Figure 3 Quartile ranking method applied to 'Share of national engagement activity' for Medical and Health Sciences.

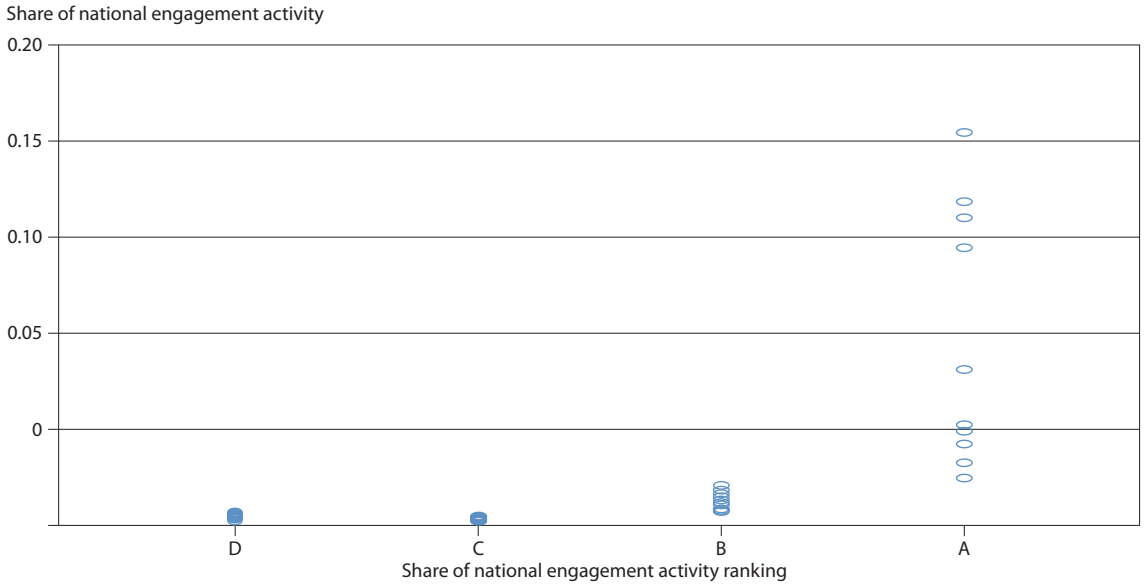
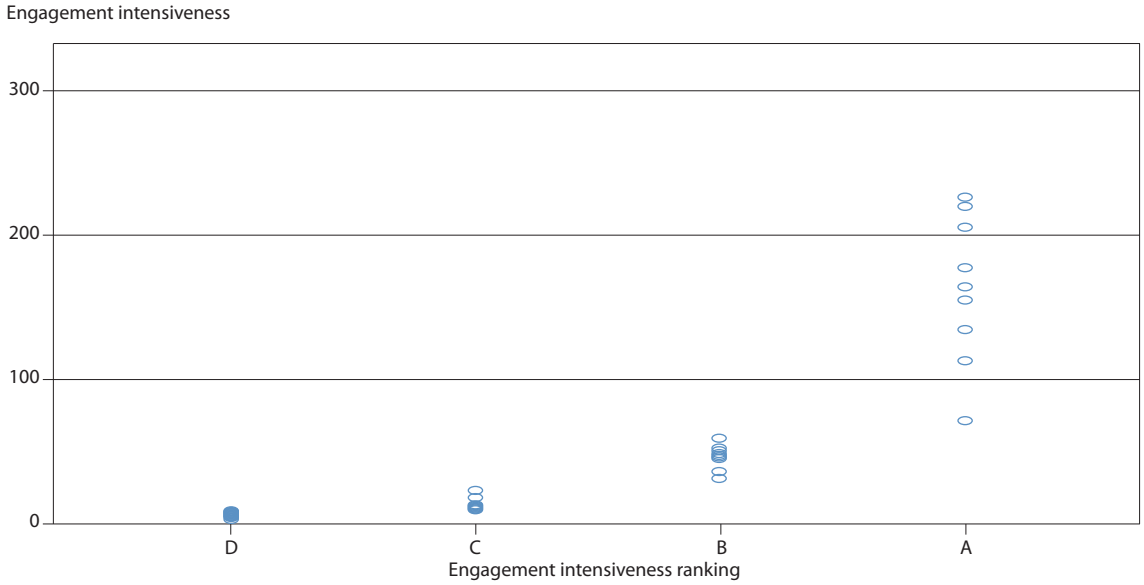


Figure 4 Quartile ranking method applied to 'Engagement intensiveness' for Medical and Health Sciences.



metrics themselves are capable of distinguishing better and worse performance, and that there is a clear rank order to this which naturally lends itself to grouping together of performance.

Figure 5 Quartile ranking method applied to 'Engagement per FTE' for History and Archaeology.

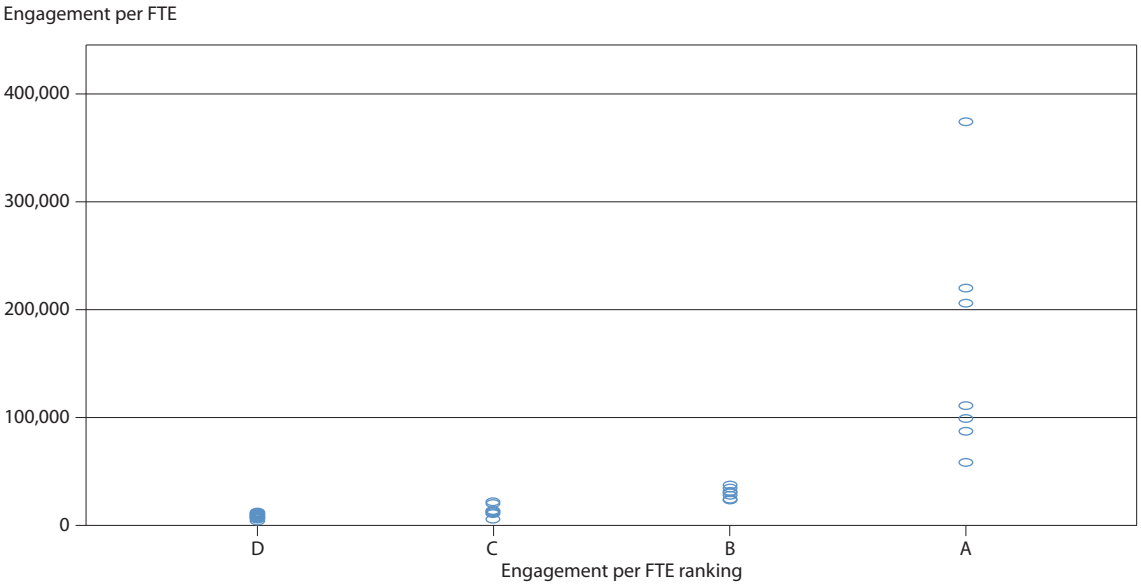
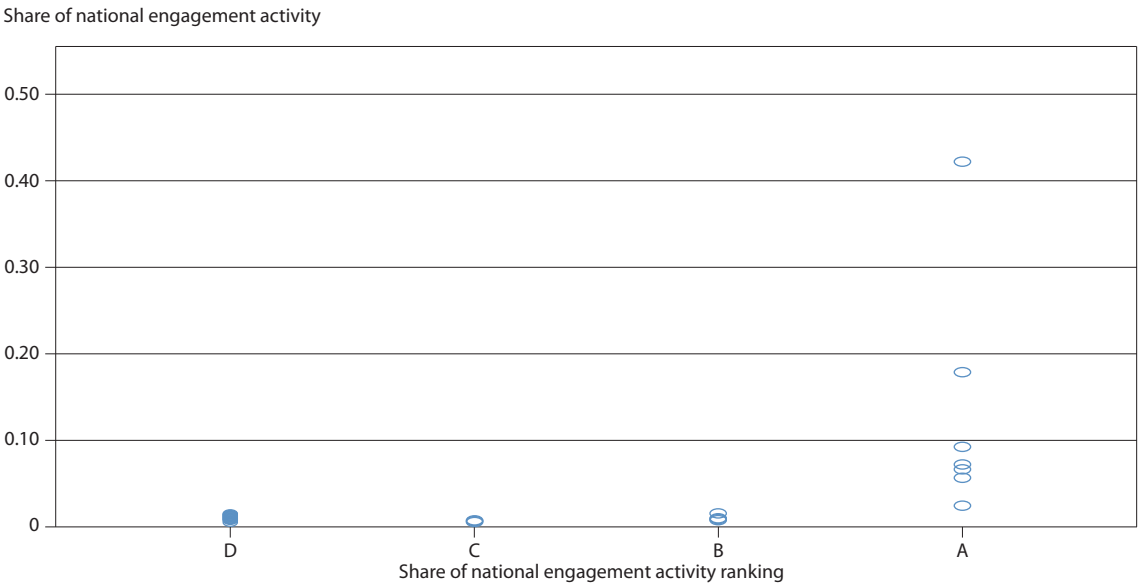


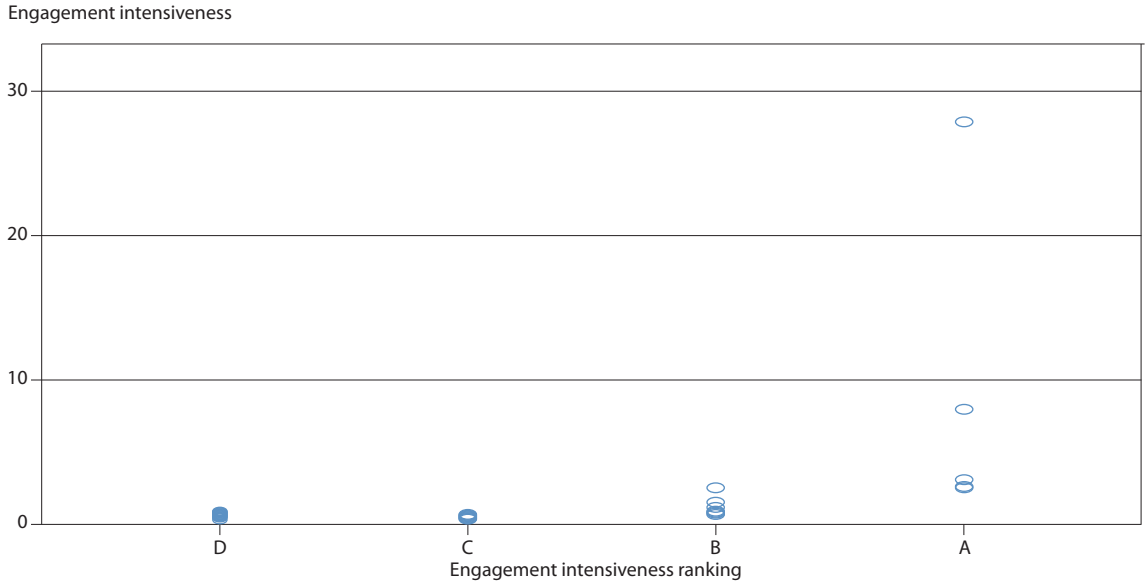
Figure 6 Quartile ranking method applied to 'Share of national engagement activity' for History and Archaeology.



Figures 5-7 show the application of the current ranking methodology to History and Archaeology. While the basic application is the same (i.e. the metrics distinguish a range of performance and the 'A'-'D' ranks capture this somewhat), there is one distinction to this example: in the case of the 'Engagement per FTE' (Figure 5) and the 'Engagement intensiveness' (Figure 7) metrics, the scale of the values is much smaller than those for Medical and Health Sciences discussed above. Importantly, this demonstrates that the relative rank within a discipline is both more appropriate than ranking between disciplines, but also applicable within disciplines. Even in a discipline where there is a much smaller quantum of inputs – such as is the case with Archaeology and History compared with Medical and Health Sciences – a ranking within disciplines still produces a robust indication of the relative performance of universities.

Additional discussion of possible methods for assigning ratings rather than rankings is included in the conclusion to this report.

Figure 7 Quartile ranking method applied to 'Engagement intensiveness' for History and Archaeology.

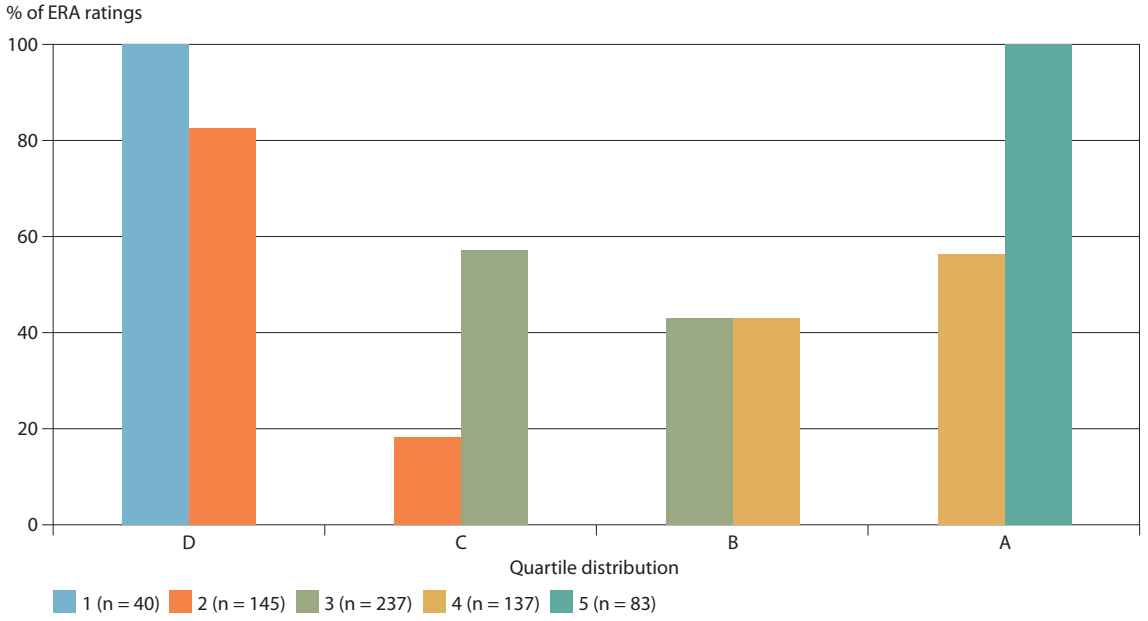


Analysis of the REA metrics

The following section provides a discussion of the application of the metrics and the accompanying rankings. It includes a comparison with the ERA ratings in order to determine if one or more of the metrics are identifying information that may not be currently included in ERA outcomes. The results from the three metrics have had the rankings of 'A', 'B', 'C' or 'D' applied as outlined in the previous section.

As discussed, the UoE that has been used to calculate the metrics for this project is the same UoE as assessed in the ERA 2012 round. This allows for a direct comparison of the outcomes, so, for example, while Mathematical Sciences at the 'University of X' may have received an ERA rating of '4' in the ERA

Figure 8 Reference case for a perfect correlation between ERA and REA quartiles.



2012 round, it may have received an 'A' for 'Engagement per FTE', a 'B' for 'Share of National Engagement Activity' and an 'A' for 'Engagement Intensiveness'. This may indicate that Mathematical Sciences at the 'University of X' is producing research considered to be 'Above world standard' on the ERA rating scale, has amongst the highest productivity nationally for research engagement in Mathematical Sciences, is amongst the second tier of Mathematical Sciences nationally in terms of its share of research engagement income, and that the university has amongst the greatest focus on Mathematical Sciences nationally relative to other disciplines within the university.

The figures below illustrate the extent to which the REA metrics identify activities that are not the focus of the quality-based evaluation of ERA. Figures 9-11 show summary data comparing the three

Figure 9 'Engagement per FTE' results compared with ERA results.

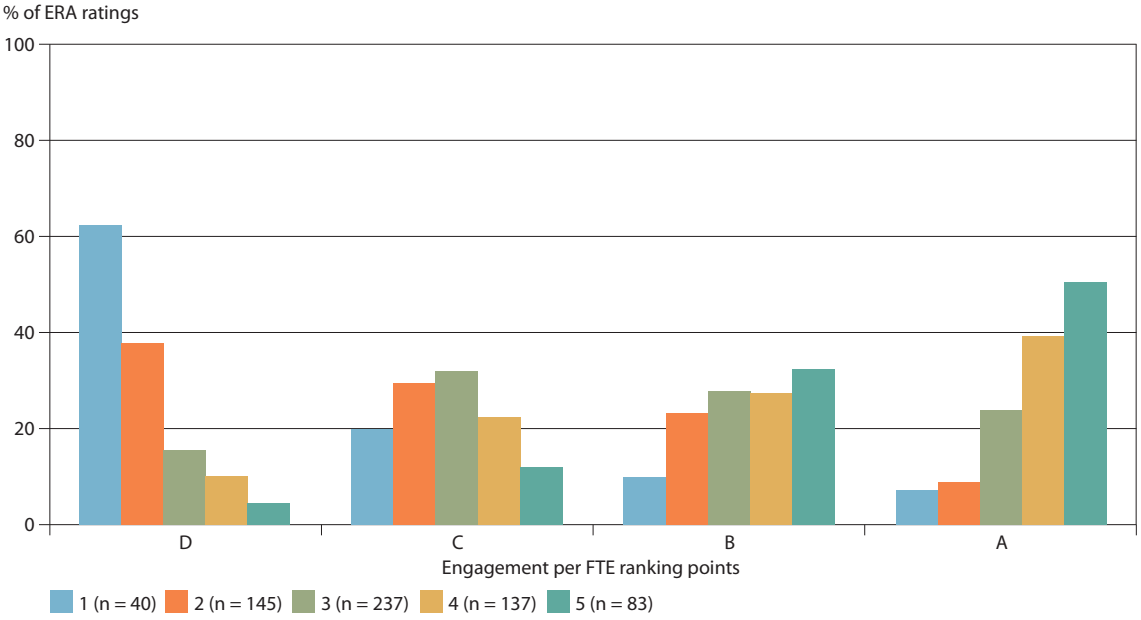
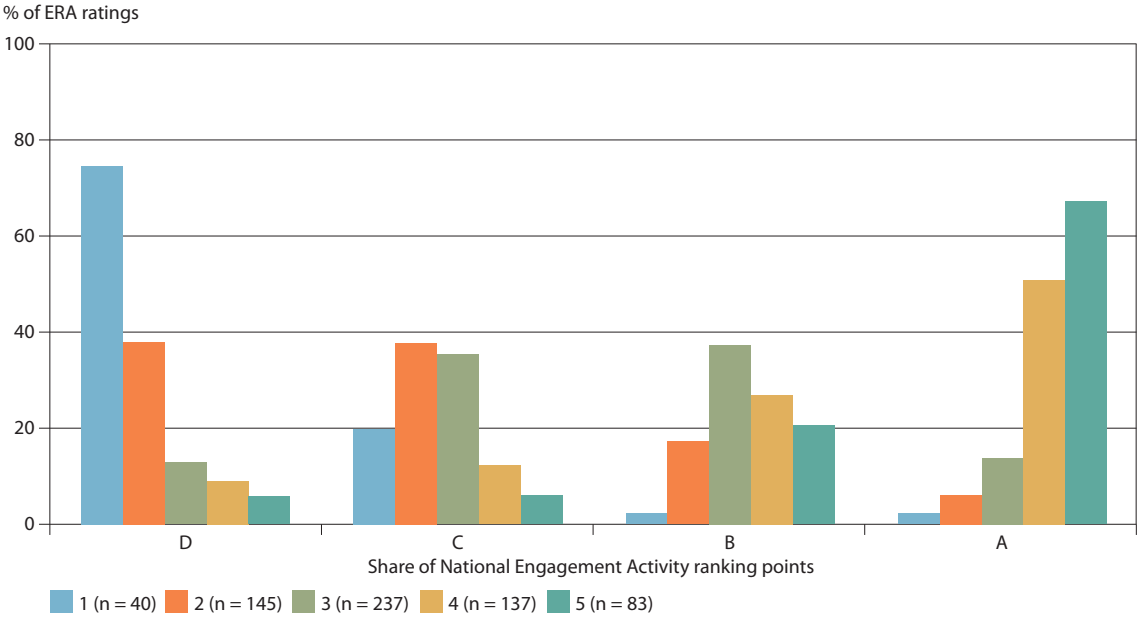
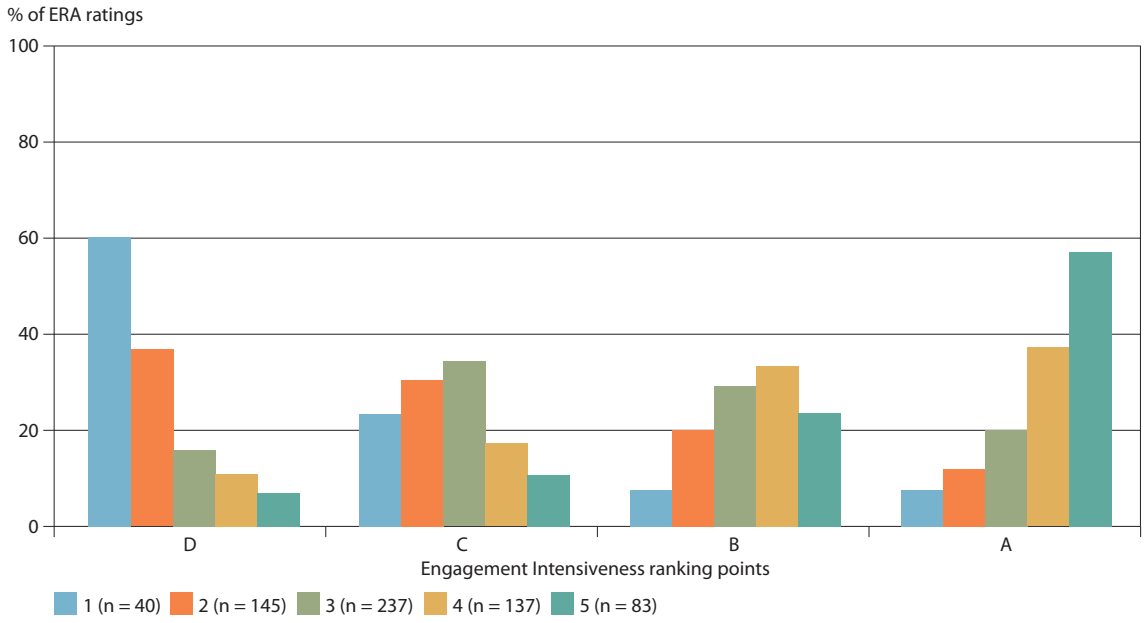


Figure 10 'Share of National Engagement Activity' results compared with ERA results.



24 Appendix D includes analysis of the relationship between these metrics and ERA results, conducted at the university level.

Figure 11 'Engagement Intensiveness' results compared with ERA results.



metrics with ERA ratings.[24] In each case, the percentage of UoEs that received a particular ERA rating are shown by each ranking point of the given metric (for example, in Figure 9, 51 per cent of all of the UoEs – 42 UoEs – that were rated as '5' in ¬ERA received an 'A' ranking for the 'Engagement per FTE' metric). As a point of comparison, Figure 8 shows what an absolute match between ERA and a quartile distribution would look like –100 per cent of ERA '5' ratings (83 UoEs) would be assigned to the top quartile ranking, 'A', along with 57 per cent (78 UoEs) of the ' 4' ratings; the second quartile, 'B', would be comprised of the remaining '4' ratings (59 UoEs) as well as 43 per cent of the ' 3' ratings (102 UoEs) and so forth, with each quartile comprised of 161 UoEs (25 per cent) from highest to lowest ERA rating. The degree to which the REA metrics do not follow this distribution is evidence of the extent that they are measuring another aspect of research activity.

Two broad observations are apparent from looking across the three comparison figures: first, in all cases the distribution of ratings in Figures 9-11 differ substantially from Figure 8; second, as should be expected, there are very few cases where a UoE received low ratings in ERA (ratings of '1' or '2') but received a high rating on any of the three REA metrics, and it is likewise not common to find UoEs that perform well on REA, but that are underpinned by low quality research.

What is further apparent from Figures 9-11 is that there are significant numbers of UoEs that perform better on REA metrics than on ERA, while there are also a range of UoEs that perform better on the quality-based metrics. In Figure 9, for example, for the UoEs that received the highest ranking of 'A', the most common ERA rating was '3' (24 per cent of 237 UoEs i.e. 57 UoEs), followed by '4' (53 UoEs), followed by '5' (42 UoEs). For ERA '5' and '4' ratings, 'A' was the most common quartile rank (51 per cent and 39 per cent respectively), whereas for ERA '3' ratings, the most common quartile was 'C' (32 percent). It is likely, then, that 'Engagement per FTE' identifies an aspect of research engagement activity that is not captured by ERA's focus on research quality. The data point to a large number of UoEs that include researchers who are highly productive in terms of attracting research engagement income, but whose work is not adjudged of the highest academic quality based on traditional proxies such as peer review and citation analysis.

Figure 10 appears slightly more closely aligned with the ERA rating scale and the comparison case in Figure 8. This is to be expected in many ways as this is a share-based metric and research income across all HERDC categories in Australia is concentrated in a small number of research intensive universities.

In this instance, 67 percent of ERA '5' ratings received 'A' rankings, along with 51 per cent of ' 4' ratings. However, there is still a substantial difference between this metric and ERA – for those UoEs that received the highest rank of 'A', the most common ERA rating was in this case a '4' (51 per cent of 137 UoEs i.e. 70 UoEs) , followed by '5', followed by '3'.

Again the metric appears to capture an aspect of research engagement that is distinct from research quality. The most apparent feature of 'Share of National Engagement Activity' is the high number of UoEs that received a 'B' ranking, but were adjudged a '3' in ERA – these account for 38 per cent of all the UoEs awarded ' 3' ratings. These results indicate that in the UoEs where researchers are undertaking the largest proportions of the national research engagement effort, their work is not adjudged of the highest academic quality based on traditional proxies.

Figure 11 shows the results for 'Engagement Intensiveness', which included university revenue as the denominator. In many ways, this metric is different to the others: in 'Engagement per FTE' and 'Share of National Engagement Activity', the denominator provided a means for comparing performance within disciplines; 'Engagement Intensiveness' shows the relative focus that a university has in any given discipline and what relative proportion of their resources are dedicated to it.

While an 'A' ranking is the most likely outcome for ' 5' and '4' ratings, what is apparent from the data is that 'A' is equally comprised of ' 3', '4' and '5' ratings (47, 52 and 48 UoEs respectively). In other words, for those universities that are focussed on research engagement in a given two-digit discipline, there is a broad and variable quality range. At the same time, however, it is apparent that those areas in an institution that are of the highest quality (ERA '5') are also the areas where there is a concentration of research engagement.

The results at the 'B' rank are dominated by ERA performance of '3' (29 per cent of 237 UoEs i.e. 69 UoEs) followed by '4' – this indicates that there are a large number of high quality research units that are not as focussed in research engagement. Similarly, the high number of '3' ratings that sit within the 'C' point for this metric indicates a large amount of 'World standard' research (on the ERA rating scale) that is not focussed on research engagement.

Assigning ratings

As outlined, the current method of assigning rankings has been to allocate A-D for each metric on a discipline by discipline basis across quartiles. This has been preferred for its ease and to avoid the need for expert review. However, a number of additional considerations have been raised throughout this project, including: assigning ratings based on performance above or below an average performance within a discipline; assigning ratings based on clusters of similar performance; combining the three metrics into a single rating or ranking. The analysis presented in this section demonstrates potential for combining the three metrics into a single rating.

Figures 12-17 below show a two dimensional comparison of the three metrics for the disciplines of Medical and Health Sciences (FoR 11) and History and Archaeology (FoR 21).

It is clear from Figure 12 that there is a small cluster of four UoEs in Medical and Health Sciences that are well above the others in terms of both 'Engagement per FTE' and 'Share of National Engagement Activity'. In other words, these four UoEs are far larger in terms of scale and in terms of productivity. While on the current ranking method these would inevitably receive 'A' on both metrics, a number of additional UoEs would also be awarded an 'A', in spite of their largely divergent profiles (given that 25 per cent of UoEs must receive an 'A').

Figure 12 'Engagement per FTE' compared with 'Share of National Engagement Activity' for FoR 11.

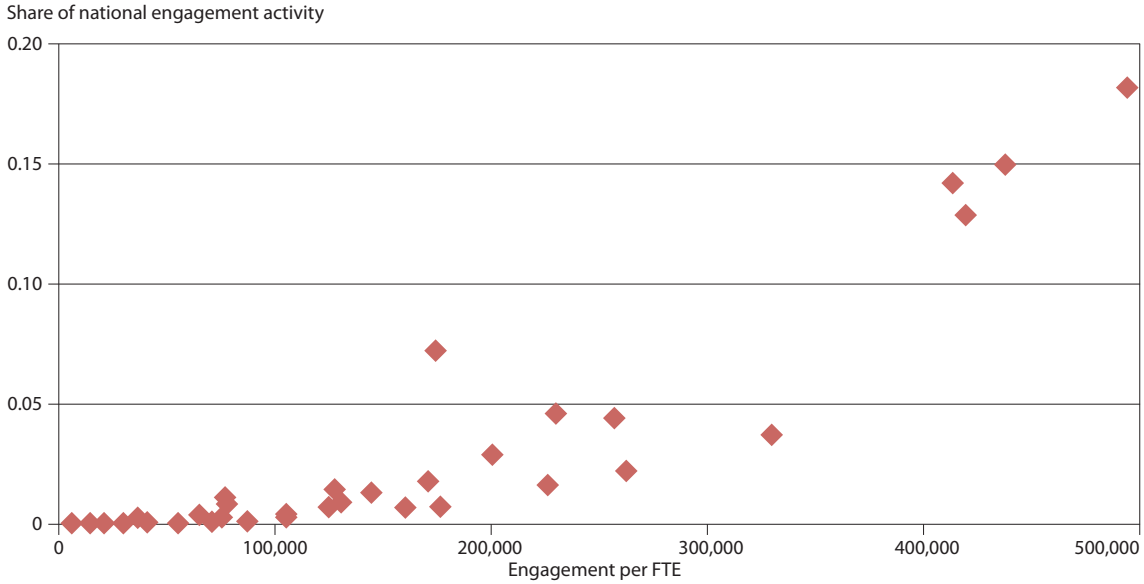


Figure 13 'Engagement per FTE' compared with 'Share of National Engagement Activity' for FoR 21.

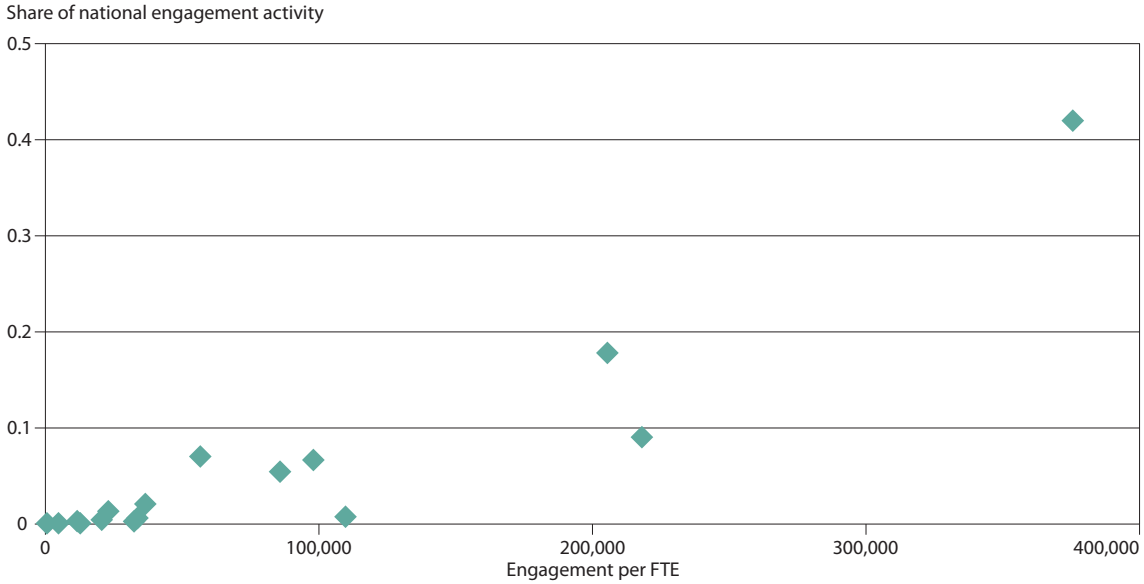


Figure 13 shows a similar distribution within History and Archaeology, with a small number of UoEs that are substantially larger than the others in terms of scale and productivity. This chart also shows the importance of making comparisons within disciplines – the scale of the x-axis in Figure 13 is significantly smaller than Figure 12 and it would be imprecise to compare between them. In spite of this difference, though, it is clear that the metrics are able to discriminate the better and worse performers from within this FoR group.

Figure 14 similarly indicates that the current method for assigning rankings may disadvantage a number of the highest performers, especially those who perform very well on 'Share of National Engagement Activity'. In this case, there appear to be three obvious clusters of performance – those UoEs doing very well on both metrics, those doing better than the majority on both indicators, and a large cluster that comprises the majority of the UoEs. In addition to the difficulties observed above (Figures 12-13) in this case, it would seem difficult to sustain four ranking points, given the clustering of the majority of the UoEs around the lower bounds for both metrics.

Figure 14 'Share of National Engagement Activity' compared with 'Engagement Intensiveness' for FoR 11.

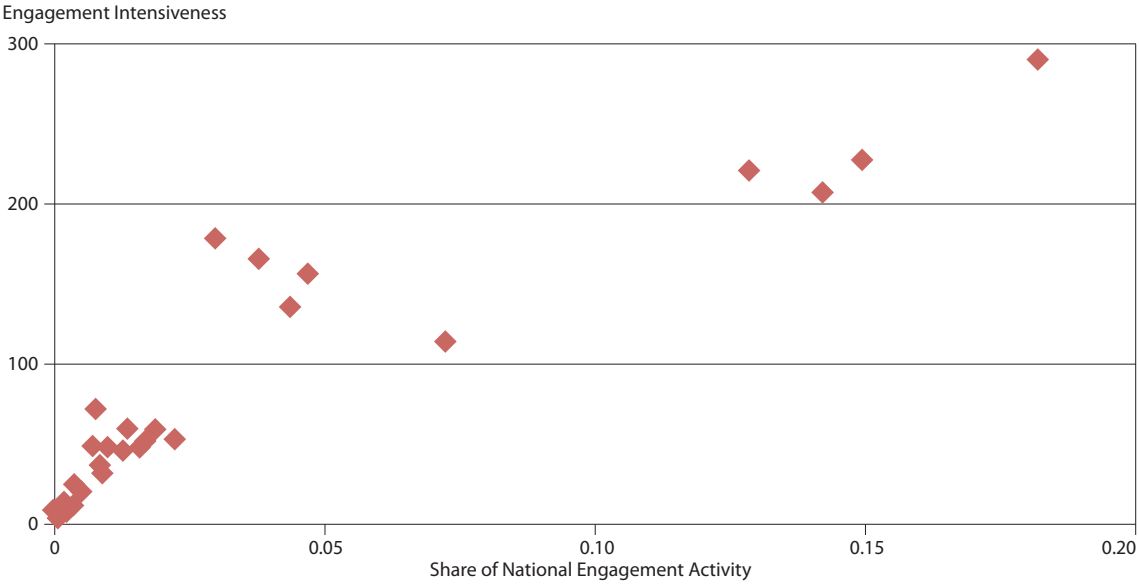


Figure 15 'Share of National Engagement Activity' compared with 'Engagement Intensiveness' for FoR 21.

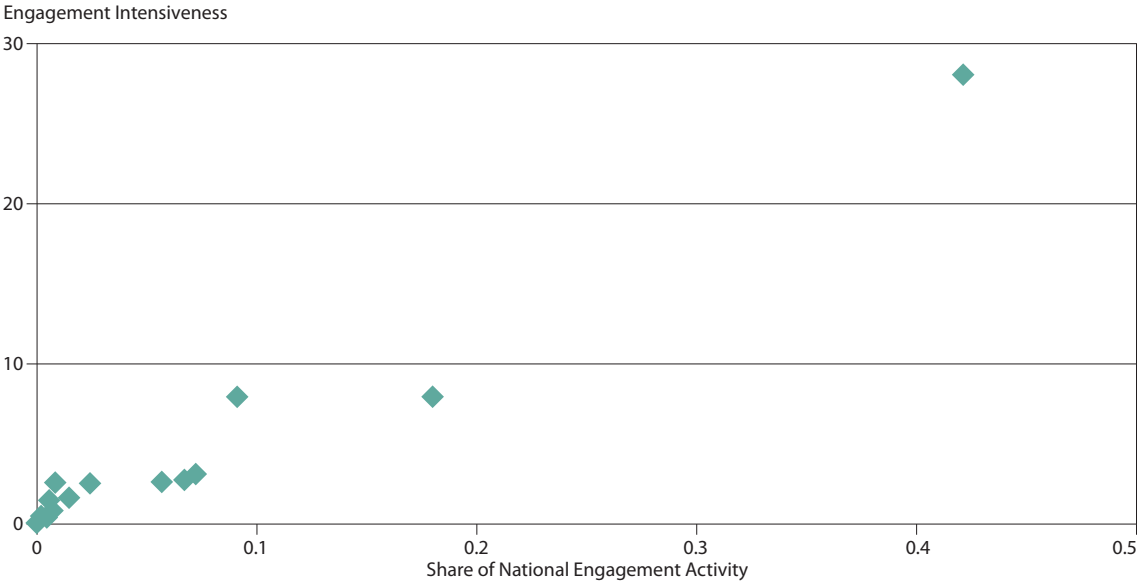


Figure 15 shows the same metrics calculated for History and Archaeology – as above (Figure 13), it is clear that the metrics are able to discriminate performance, irrespective of the different quantum of the data. In this case, the highest performance on the y-axis is 28, whereas in Figure 14 this goes up to 290. However, the performance of the highest UoEs in each case is equally impressive compared with the two-digit discipline cohort.

Figure 16 most graphically highlights the seeming arbitrariness of the current cut-offs for rankings. In the two highest rankings for both metrics presented, the range of performance would be large, while for the two lowest ranking points the range would be very small. In other words, the current method does not accurately reward better and worse performances.

Figure 17 confirms that throughout this two-digit FoR, there are a small number of UoEs that dominate on each of the metrics. In all cases, it is likely that the current methodology of enforcing a quartile

Figure 16 'Engagement per FTE' compared with 'Engagement Intensiveness' for FoR 11.

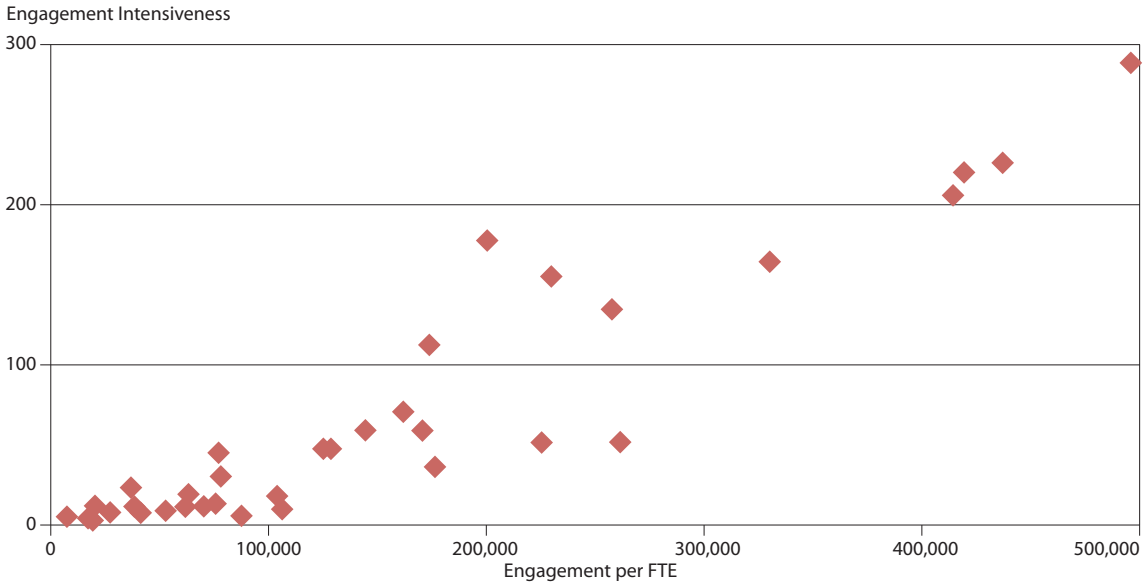
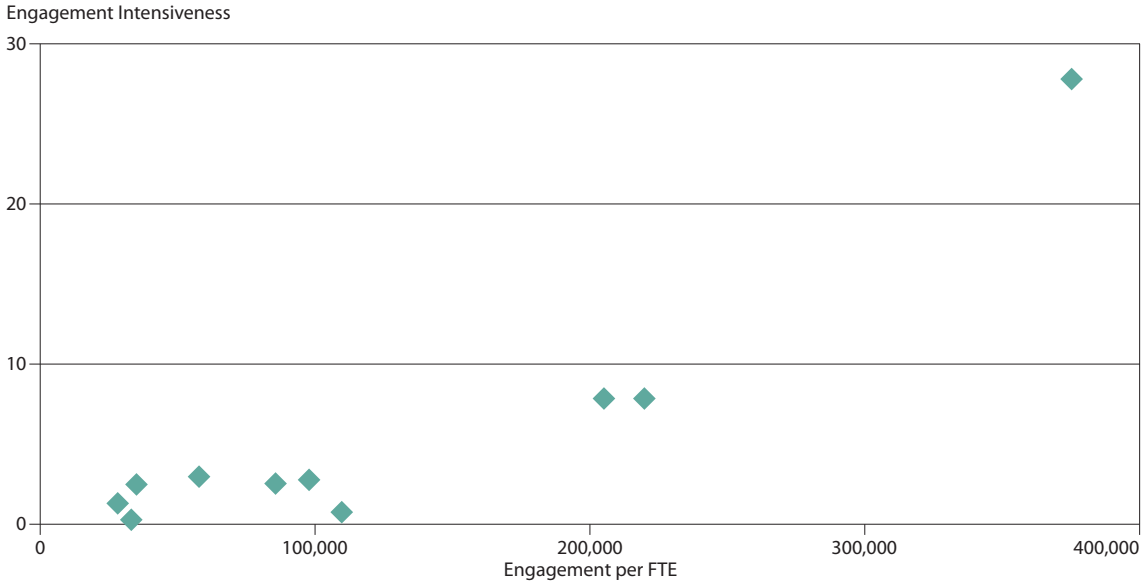


Figure 17 'Engagement per FTE' compared with 'Engagement Intensiveness' for FoR 21.



distribution would greatly downplay the significant disparity between these UoEs and the rest of the cohort.

Aside from highlighting the limitations of the current ranking method, these figures also demonstrate the possibility of combining the three metrics into a single rating. The relatively linear relationships in Figures 12-17 indicate that strong performance in one of the metrics is accompanied by strong performance in other of the metrics. In other words, a rating that took all three metrics as its inputs may result in a robust outcome.[25]

25 The current project has been focussed on demonstrating the feasibility of introducing a REA – significant additional analysis would be required before combining these metrics into a final rating of institutions by discipline.

Conclusions

Feasibility

This project has demonstrated the feasibility of REA, by demonstrating that it is possible to create meaningful research engagement metrics from data already available in existing collections. Further, it is possible to use these as the basis for assigning ratings to universities based upon their performance in two-digit FoR disciplines.

In spite of the limitations of the existing data collections the data have proven detailed enough to distinguish between income that is awarded based on the participation and funding of a non-university organisation, such as an industry or other end user of research, and research income from Commonwealth sources, that has been awarded for researcher-led investigations (e.g. ARC Discovery grants).

The analysis shows that REA can identify activities in the university that are not well suited to quality-based evaluations. In each case, the metrics were consistently showing divergent results from ERA ratings. It is reasonable to conclude that where groups are particularly productive in their research engagement, are undertaking a significant share of the national research engagement effort for a particular discipline, or where the university has a focus on research engagement in a specific discipline, these efforts are better represented through the REA metrics presented here than they are through ERA ratings.

In each metric there is a range of activities in institutions that are not captured by focussing on research quality. As a consequence, these activities are not incentivised nor rewarded through the ERA evaluation mechanism. While data around research engagement are submitted to ERA (i.e. the income data used here) they are not drivers of the ERA ratings.

That being said, it is important to note that performance on REA metrics does not appear in isolation from traditional markers of research quality such as used in ERA. There are not, for example, large amounts of research engagement being undertaken which are not underpinned by high quality research. Research quality in this respect may be seen as an important, but not sufficient condition of innovation.

The feasibility of the REA, therefore, involves a multi-dimensional set of metrics which indicate the 'productivity', 'volume' and 'intensiveness' of universities undertaking research engagement, and which can accompany the ERA evaluation of research quality. Any one of the metrics (ERA included) will only provide a partial account of the range of research activity. Taken together, however, the three metrics developed here for the REA provide a useful multidimensional snapshot of the relative performance of a university's research engagement. Taken alongside rigorous evaluations of research quality such as ERA, REA metrics provide a more complete picture of universities.

In subsequent work to this project, individual select universities will be asked to provide information to fine tune the REA metrics, using data held in their financial systems (which may or may not be reported in their HERDC and ERA returns) to identify exactly where industry and other end-user funds are received and reported. This will allow data to be used in the REA that only reflects the industry and other end user income, and not the Commonwealth component in addition for schemes like the ARC Linkage, NHMRC Development, CRC scheme etc.

Areas of further work

As identified throughout this report, there are some areas where additional work is still required in order to make more focussed metrics.

First, there is no ideal data set for creating these metrics. Both HERDC and ERA have their limitations. The level of aggregation of the HERDC data set is important as it allows for relevant elements to be included or excluded. A detailed data set would also allow for the inclusion of weightings into the metrics. Table 4 shows the relative contribution of the HERDC sub-categories to the higher level categories, for example, 92 per cent of Category 1 is from 'Commonwealth Schemes,' 5 per cent from 'Rural R&D' and the remaining 4 per cent from 'Non Commonwealth Schemes.' Given such information, it may be effective to weight these various components differently based upon one or other criteria (e.g. in 'Category 2, State and Local government' sources may be weighted more highly than 'Commonwealth Government sources', as this represents additional value derived from Commonwealth funding).

At present, however, this is not possible given that the HERDC data does not include FoR code assignments. Conversely, where ERA includes FoR code assignments, it does not include the level of detail that allows this kind of formulation.

Table 4 – within-category contributions by HERDC sub-category source.[26]

Category 1	Commonwealth Schemes	92%
	Rural R&D	5%
	Non Commonwealth Schemes	4%
Category 2	Local Government	2%
	State Government	46%
	Commonwealth Government	52%
Category 3	Australian Funding- Contracts	28%
	Australian Funding- Grants	17%
	Australian Funding- Donations Bequests and Foundations	16%
	HDR Fees For Domestic Students	0%
	International A: Competitive, Peer-reviewed research income	10%
	International B: Other income	13%
	International C: HDR fees for international students	16%
Category 4	Funding derived from Commonwealth Grants to CRCs	64%
	Funding derived from non-university participants in CRCs	26%
	Funding derived from third parties contributing to CRCs	9%

Even so, current data is sufficiently detailed that a distinction can be made between the different types of income; income that is awarded based on the participation of a non-university organisation, or that has been derived from engaging a non-university organisation, can be easily distinguished from research income for researcher-led income (e.g. ARC Discovery grants). In ERA, these data are appended with FoR codes, which allows a comparison within disciplines.

It is anticipated that the current consultation by the Department of Education and Training and the ARC on streamlining the collection of the ERA and the HERDC will address these shortcomings for future collections.

As outlined in the report, there has been considerable discussion regarding the method used of assigning the REA to four quartiles, 'A'-'D', each with 25 per cent of the outcomes. Specifically, subsequent work will allow for exploration of this issue by looking at using a different number of rankings (e.g. three or five rankings may be preferred) and at ways of combining the three metrics into a single ratings, based perhaps around natural clusters of performance.

26 Department of Education and Training, 2014b.

An additional consideration that has not been able to be made in the current report is the feasibility of including income derived through the Rural R&D Corporations. As outlined in this report, a detailed analysis of how this is reported and recorded in university systems would be required to properly assess which elements of this scheme should be included in REA. Future work on this project will further explore this question with the aim of including the appropriate income of the Rural R&D Corporations into the REA.

Further work is also required around the denominator used in the 'Engagement Intensiveness' metric. At present, this uses revenue including all university activities. It is anticipated that future work will focus on using only revenue generated from research activities to derive this metric.

Finally, the current data does not explicitly have a mechanism for capturing in-kind contributions from non-university partners. In many cases, the provision of expert staff or specialised facilities and data are integral parts of a research engagement that are not quantified in the ERA or HERDC data collections. This may be more or less common in different disciplines, and thus a mechanism to collect, audit and include these contributions may be a very important input into a metric.

Further work on REA will likely be undertaken with assistance from State and/or Territory governments throughout 2015, and a summary of this process will be provided to the Steering Committee, the Department of Education and Training and the ARC as a supplement to this report.

Final considerations

Research benefits beyond research engagement

While the present project has focussed on metrics of research engagement and the existing data sets (which can be easily audited, aggregated for different disciplines and compared) there may be other data suitable for inclusion that would recognise other forms of knowledge transfer, and which may capture broader research benefits across a range of disciplines. There are a number of other ways of embedding knowledge in settings outside of academia out into society, and which support research translation, where metrics could be developed.

For the purposes of generating a broader discussion, the following are suggested:

- **Consultancy income**[27] – is an important form of knowledge transfer and can frequently lead to additional engagement activities. It may also better accommodate the contribution of HASS disciplines than contract research, as well as engagement with organisations outside the private sector, such as government and the not-for-profit sector.
- **Income from professional publications** (e.g. trade publications) – is a mechanism for knowledge transfer and the amount of income derived reflects the value placed on this knowledge by non-academic audiences.
- **Income from professional development courses** (non-credit bearing) – courses targeted at people already employed in the workforce is another mode of knowledge transfer. This metric is used as an indicator of knowledge transfer performance in allocating funding under the UK's Higher Education Innovation Fund, which supports knowledge transfer activities.
- **Income from outreach activities/public events** – events aimed at the wider non-academic community are another forum for knowledge transfer.
- **Number of active license agreements** – how many IP licenses are currently being used indicates the intensity of a university's commercialisation activity and provides a more sophisticated picture than commercialisation income alone, which can be distorted by a small number of very large IP licensing agreements.
- **Number of research publications published in open-access repository** – making research outcomes freely accessible supports knowledge transfer, facilitating the widest possible uptake of research.
- **Number of research students and researchers in work placements outside the research sector** – research skilled individuals working in other sectors are vehicles for knowledge transfer. Counting this activity would not only recognize its role in knowledge transfer, but would also promote inter-sectoral mobility and more industry-engaged research training. There would need to be a minimum time period for placements to be eligible.
- **Number of university researchers on government committees or industry boards**

While further consideration of these metrics is warranted, any additional reporting burden would need to be considered as well. Some of this information may not currently be collected by universities and would increase reporting requirements, which is unlikely to be tenable in the current policy environment.

27 This includes consultancy income which does not meet the definition of research in the HERDC and ERA data collections.

28 The review of the NSRC is being undertaken by the Department of Industry and Science to ensure future collections are relevant, align with current and emerging priorities for research commercialisation in Australia, are targeted to sector priorities and comparable with international data sources. Consideration of new metrics including options to introduce research/industry engagement measures have been included in the scope of the review. A report on outcomes of the review will be produced in the first half of 2015. Subject to approval, a new survey instrument and performance framework will be developed, tested and implemented in 2015. The new framework is expected to enable the survey to incorporate new research/industry engagement metrics on an ongoing basis, as these are identified in consultation with the research sector and with industry.

There are other metrics that have been suggested, or are likely to be, but which are unlikely to be sufficiently robust or are simply impractical. This includes:

- **Metrics based on social media or online activity** – for example, the number of times a research article is viewed, downloaded or shared; number of, or nature of comments. Metrics based on the behaviour of online audiences are too easily manipulated and difficult to quality assure. For example, an article may attract a high number of views/downloads simply because it is controversial or contestable, not because it is considered good research. Also, in many cases the content is aimed at the online research community rather than non–academic audiences and thus is outside the scope of this proposal.
- **Number of staff employed in research commercialisation roles** – while supporting an institution's knowledge transfer capacity, it is not an indicator of knowledge transfer in itself.
- **Number of awards received for research** – in many cases awards are given based on scholarly impact rather than wider impact on society or the economy. It would be necessary to develop eligibility criteria and assigning different weightings to different awards based on their significance, and thus is particularly resource intensive.
- **Number of government reports or Hansard transcripts citing research** – it does show that knowledge has been adopted by policy makers, but government reports do not always cite research in a consistently rigorous way and it is likely to be a low volume measure. Practicality is also an issue - would be time consuming for institutions to monitor and verify.

Subsequent work will also allow a detailed investigation of whether universities currently collect other useful data as outlined above that could be incorporated into the metrics provided in this report, or additional metrics. This may include, for example, means of capturing in-kind contributions made to research engagement, or data collected through other Government reporting mechanisms such as the National Survey of Research Commercialisation (NSRC), which is currently under review.[28] It can be expected that the REA metrics and the revised NSRC will complement each other, with REA providing a more detailed understanding of comparative engagement performance of disciplinary areas within universities, and the revised NSRC encompassing a wider group of knowledge transfer indicators across the publicly funded research sector in Australia.

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Appendix A – Members of the Steering Committee

Professor Peter Gray FTSE (ATSE), Chair
Dr Alan Finkel AO FTSE (ATSE)
Professor Tanya Monro FAA FTSE (ATSE)
Mr Peter Laver AM FTSE (ATSE)
Dr John Bell FTSE (ATSE)
Professor Paul Greenfield AO FTSE (ATSE)
Mr Dom English (Department of Education and Training)
Ms Virginia Hart (Department of Education and Training)
Ms Lisa Schofield (Department of Industry and Science)
Professor Aidan Byrne (Australian Research Council)
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Professor Mark Western FASSA (Academy of the Social Sciences in Australia
Dr Oliver Mayo FAA FTSE (Australian Academy of Science)
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Professor Terry Nolan AO (University of Melbourne)
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Project Team

Dr Tim Cahill (Research Strategies Australia)
Dr Matt Wenham (Executive Manager, Policy & Projects, ATSE)

Appendix B - Detailed description of HERDC Collection

Higher Education Research Data Collection (HERDC)[29]

The Higher Education Research Data Collection (HERDC) includes data submitted at the university level and comprises research income, higher degree research student numbers and research publications data. Potentially relevant data for the current project included the range of income data outlined below.

Category 1: Australian competitive grants

Category 1 consists only of income from those research schemes and programs listed on the 2014 Australian Competitive Grants Review (ACGR).

Category 2: Other public sector research income

Category 2: Other public sector research income includes:

■ Australian government – Non Category 1:

This is any other income for the purposes of conducting research received from the Australian Government, whether via programs, grants or contracts, that are not eligible for inclusion as Category 1 research income.

■ State or Territory government:

This is income for the conduct of research received from state or territory government departments or agencies, whether via programs, grants or contracts.

■ Local government:

This is income for the conduct of research received from local government departments or agencies, whether via programs, grants or contracts.

■ Government business enterprises:

This is income for the conduct of research received from enterprises that are wholly or partly owned or funded by Commonwealth, state or territory, or local governments; have a board; and operate on a profit or cost-recovery basis.

Category 3: Industry and other research income

Category 3: Industry and other research income must be categorised in the following subcategories:

Australian

■ Contracts

■ Grants

■ Donations, bequests and foundations

■ HDR fees for domestic students

International A: Competitive, Peer-reviewed research grant income

International B: Other income

International C: HDR fees for international students

29 Department of Education and Training, 2014*a*.

- Australian:
  - contract research income provided by industry or other non-government agencies
  - grants for the conduct of research other than government provided grants (which should be reported in either Category 1 or Category 2)
  - donations and bequests for the conduct of research that have been received from Australian business, Australian non-profit organisations and Australian individuals
  - income received from syndicated research and development arrangements
  - funds received for providing the cost of a domestic student's HDR fee-paying place (but excluding Commonwealth supported places or places funded through the RTS). This includes tuition fees[30] that domestic fee paying students (non Commonwealth supported) pay to their HEP for a HDR program or HDR-related course of study.
- International A:
  - Competitive grants, peer reviewed grants for research from non-Australian industry or non-Australian Government agencies including non-Australian industry collaborative research grants.
  - Grants that can be included are those where:
    a) funds are provided on a competitive basis and are clearly for the conduct of research only; and
    b) there is a well-defined mechanism for competition and selection by a well-qualified panel.
  - Grants that are not eligible are those that provide:
    a) grants in kind such as the use of facilities, equipment etc. or subsidised travel or accommodation; and
    b) funding wholly or mainly for infrastructure purposes.
- International B:
  - contract research provided by non-Australian industry or non-Australian Government agencies including non-Australian industry collaborative research grants
  - non-competitive grants for research from non-Australian industry or non-Australian Government agencies including non-Australian industry collaborative research grants
  - donations and bequests for conduct of research that have been received from non-Australian business, non-Australian not-for-profit organisations and non-Australian citizens

- International C:
  - funds received for providing the cost of an international student's HDR fee-paying place (but excluding Commonwealth supported places). This includes tuition fees[31] that international fee paying students (non-Commonwealth supported) pay to their HEP for a HDR program or HDR-related course of study.

- For donations and bequests (Australian and international):
  - Where all, or a proportion, of a donation or bequest is invested then only the income earned from that investment which is available for expenditure on research in the reference year should be included.

Category 4: CRC Research income

Category 4 comprises the following subcategories:

- Research income derived from Australian Government grants to CRCs
- Research income derived from non-HEP members of CRCs
- Research income derived from external parties contributing to CRCs

30 As listed under section 7.3 of the HERDC submission rules, funds exclude fees that HEPs may charge those domestic HDR students who exhaust their RTS funding entitlement and continue their enrolment. Funds also exclude Commonwealth contributions paid by the Australian Government directly to HEPs for Commonwealth supported places.

31 As listed under section 7.3 of the HERDC submissionrules, funds also exclude Commonwealth contributions paid by the Australian Government directly to HEPs for Commonwealth supported places.

Appendix C – Summary of calculated values for Metrics 1-3

Table 5 includes the minimum and maximum values for each quartile band by two-digit FoR, for each of the three metrics. Importantly, this allows for a comparison across the quartile bands to ensure that they discriminate effectively between performance. For example, for Metric 1 ('Engagement per FTE') in Mathematical Sciences (FoR 01), the minimum value for being assigned to the lowest quartile, and therefore being awarded a 'D' was 0.000, while the maximum was 5267.184; the minimum value for being assigned to the second lowest quartile, and therefore being awarded a 'C' was 7754.337, while the maximum was 36882.212 etc. Importantly, the difference between the maximum value of the 'D' rating point and the minimum of the 'C' rating point appears qualitatively different, and the bandings therefore appear to effectively discriminate between better and worse performance in this case. Metric 2 is 'Share of National Engagement Activity' and Metric 3 is 'Engagement Intensiveness'.

Table 5 – summary of calculated values for Metrics 1-3 by two-digit FoR

FoR	Quartile rating	Min Metric 1	Max Metric 1	Min Metric 2	Max Metric 2	Min Metric 3	Max Metric 3
01	D	0.000	5267.184	0.000	0.002	0.000	0.287
	C	7754.337	36882.212	0.002	0.007	0.358	1.911
	B	38178.974	88446.184	0.009	0.026	2.084	2.823
	A	88639.190	1535126.979	0.034	0.357	4.638	76.840
02	D	0.000	28647.424	0.000	0.005	0.000	0.929
	C	36984.840	79987.680	0.009	0.023	1.163	3.628
	B	93407.762	135572.814	0.024	0.062	4.162	8.843
	A	139044.356	381552.469	0.065	0.204	9.209	20.809
03	D	475.463	16789.686	0.000	0.002	0.013	0.499
	C	29361.284	74238.159	0.002	0.019	1.004	3.951
	B	76262.390	110869.337	0.022	0.046	4.038	7.471
	A	113602.758	315462.451	0.060	0.125	8.391	21.480
04	D	96624.314	133221.011	0.008	0.017	2.226	4.330
	C	141978.469	212638.640	0.017	0.036	5.372	7.178
	B	224641.920	246709.693	0.038	0.059	7.975	16.839
	A	299412.913	507253.542	0.072	0.162	17.938	59.528
05	D	83946.485	181347.559	0.003	0.012	0.746	5.050
	C	197221.888	298375.593	0.013	0.022	5.716	10.533
	B	334217.526	371556.026	0.025	0.052	11.901	22.909
	A	417487.586	1024604.571	0.059	0.096	24.674	124.750
06	D	5061.201	73960.775	0.000	0.004	0.254	5.725
	C	84986.927	147582.805	0.004	0.017	6.879	16.830
	B	156443.493	173995.008	0.020	0.042	19.848	30.027
	A	179938.995	290899.103	0.051	0.175	30.614	68.061

FoR	Quartile rating	Min Metric 1	Max Metric 1	Min Metric 2	Max Metric 2	Min Metric 3	Max Metric 3
07	D	40162.562	125359.394	0.000	0.003	0.680	2.173
	C	132717.851	260719.568	0.005	0.014	4.390	8.195
	B	262674.815	340978.832	0.014	0.066	14.516	26.141
	A	402395.308	1333027.389	0.078	0.174	28.854	285.667
08	D	0.000	24237.864	0.000	0.003	0.000	1.806
	C	24437.333	52566.198	0.003	0.008	1.877	4.120
	B	58839.997	103517.505	0.010	0.021	4.367	7.514
	A	110887.233	1435158.832	0.032	0.253	7.608	105.105
09	D	45373.996	90551.369	0.001	0.003	3.213	6.522
	C	115075.055	185287.229	0.003	0.015	6.632	23.869
	B	187494.233	259020.854	0.020	0.045	25.309	51.638
	A	264567.352	573427.980	0.046	0.189	52.989	106.220
10	D	38548.692	118854.319	0.010	0.025	2.374	2.499
	C	127011.412	165541.027	0.030	0.049	2.758	6.155
	B	176033.930	291123.687	0.049	0.140	6.500	8.081
	A	315141.629	567185.857	0.161	0.237	8.446	13.619
11	D	5859.260	39800.692	0.000	0.001	2.542	9.147
	C	40740.738	86384.847	0.001	0.004	9.321	23.200
	B	103833.236	174918.101	0.007	0.019	31.173	59.069
	A	199245.680	493857.268	0.022	0.181	71.285	289.545
12	D	4018.935	21476.877	0.001	0.005	0.119	0.963
	C	22003.667	39485.498	0.009	0.017	0.997	2.298
	B	39962.258	71915.422	0.022	0.055	2.871	4.383
	A	87611.966	115552.908	0.060	0.171	4.522	12.724
13	D	2646.287	16400.362	0.001	0.006	0.801	1.922
	C	19086.291	34403.301	0.007	0.014	2.419	5.081
	B	36673.058	52899.827	0.017	0.030	5.110	10.820
	A	54892.907	249175.972	0.031	0.152	13.148	26.777
14	D	0.000	16554.056	0.000	0.004	0.000	1.243
	C	21568.538	58615.959	0.004	0.008	1.329	2.284
	B	62351.205	95567.153	0.009	0.025	2.573	5.581
	A	96051.160	379287.387	0.028	0.252	5.970	25.561
15	D	239.563	12337.338	0.000	0.005	0.036	1.765
	C	13903.214	22043.128	0.005	0.014	1.840	3.596
	B	22120.819	40285.600	0.016	0.033	3.783	6.167
	A	43857.704	112227.413	0.042	0.115	6.780	21.822
16	D	7861.016	38590.339	0.000	0.007	0.473	2.661
	C	43928.666	63511.600	0.007	0.012	2.765	6.849
	B	63517.055	113601.616	0.013	0.028	7.398	10.869
	A	115516.431	371118.862	0.035	0.166	11.165	44.995
17	D	622.430	19182.104	0.000	0.004	0.079	1.540
	C	24733.107	55700.365	0.005	0.015	1.550	3.534
	B	56607.195	121966.276	0.018	0.049	3.671	7.169
	A	127195.737	257893.766	0.050	0.122	8.260	18.229
18	D	0.000	2022.200	0.000	0.002	0.000	0.430
	C	5607.025	13807.978	0.007	0.010	0.448	0.962
	B	15086.002	33011.784	0.013	0.034	0.988	2.238
	A	33298.165	98335.921	0.034	0.164	2.457	8.199

FoR	Quartile rating	Min Metric 1	Max Metric 1	Min Metric 2	Max Metric 2	Min Metric 3	Max Metric 3
19	D	0.000	783.096	0.000	0.001	0.000	0.041
	C	1328.574	5713.598	0.001	0.010	0.052	0.319
	B	8070.643	15840.246	0.015	0.023	0.473	1.024
	A	16600.600	50041.590	0.040	0.176	1.209	2.856
20	D	0.000	5145.071	0.000	0.002	0.000	0.341
	C	5204.634	19280.818	0.003	0.011	0.367	1.412
	B	22710.132	34084.150	0.016	0.035	1.502	2.072
	A	44928.507	249333.074	0.042	0.216	2.314	26.111
21	D	0.000	4691.672	0.000	0.001	0.000	0.144
	C	4986.360	21459.996	0.001	0.005	0.161	0.645
	B	21951.758	36335.238	0.006	0.016	0.655	2.524
	A	57643.675	374369.033	0.024	0.422	2.540	27.916
22	D	0.000	503.468	0.000	0.000	0.000	0.000
	C	1575.654	15765.557	0.001	0.018	0.013	0.277
	B	20482.603	34393.897	0.018	0.040	0.322	0.616
	A	35746.724	81611.801	0.050	0.315	0.903	8.778

Appendix D – University-level comparison of results with ERA

Figures 18-20 below compare the results of the three metrics with ERA results at the institutional level. For each metric, two elements are presented in the figures – first, each institution's percentage of ERA '4' or '5' results is compared to its percentage of 'A' and 'B' rankings; second, the figure shows whether this percentage was higher for ERA ratings or for the relevant metric.

Figure 18 includes only a small number of universities that overall perform higher on ERA than on the 'Engagement per FTE'. Of those institutions that are performing better on 'Engagement per FTE', they are performing significantly better than on ERA. For the institutions marked orange in Figure 19 the mean percentage of ERA '4' and '5' ratings is 21 per cent (range 0 per cent to 57 per cent), whereas the mean 'A' and 'B' rankings is 52 per cent (range 7 per cent to 100 per cent). This may indicate that there are a number of institutions for whom a productivity-based research engagement metric incorporates significant activities in the university that a quality based system like ERA does not consider.

Figure 18 'Engagement per FTE' 'A' and 'B' institution performance compared to ERA 4 and 5 performance.

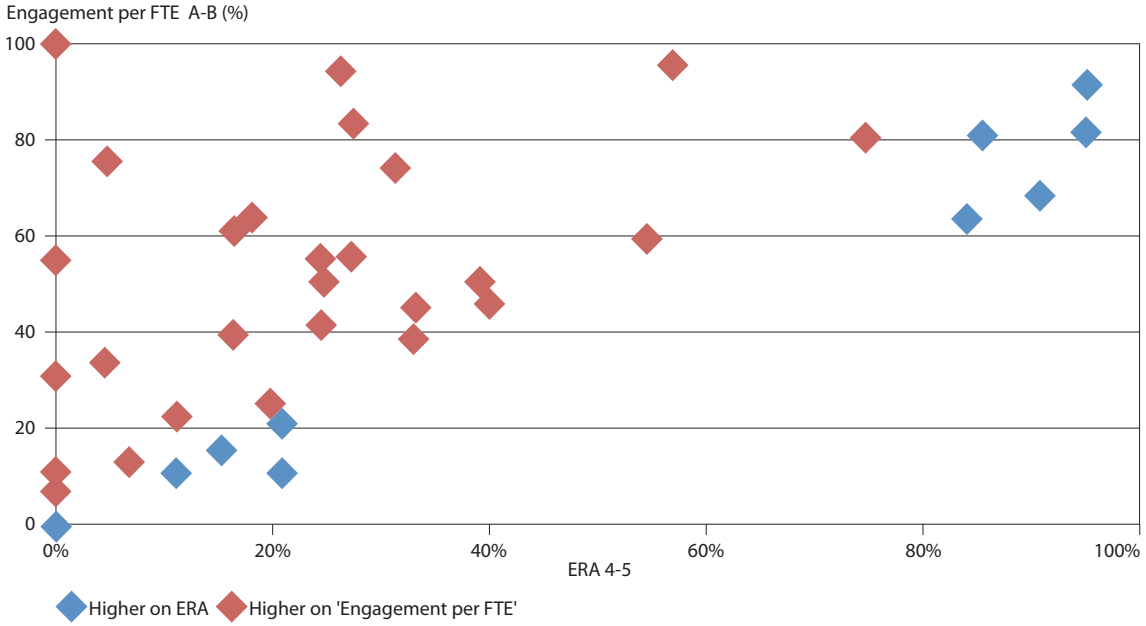
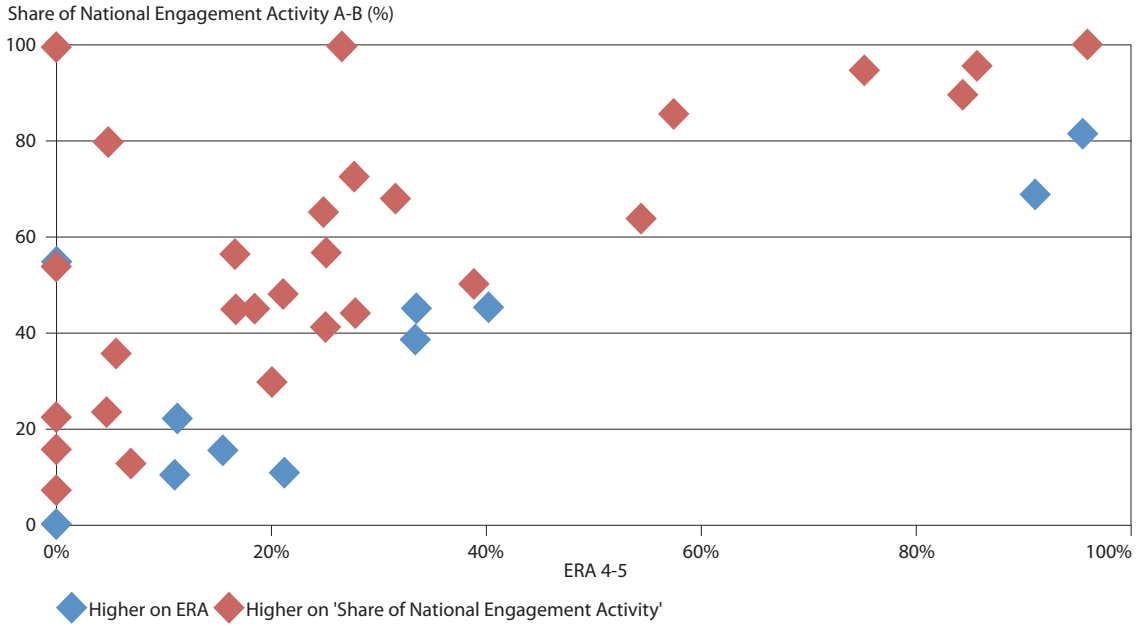


Figure 19 similarly includes only a small number of universities that perform higher on ERA than on the REA metric. The distribution of this performance is also very similar – for those institutions marked orange in Figure 19 the mean percentage of ERA '4' and '5' ratings is 20 per cent (range 0 per cent to 75 per cent), whereas the mean 'A' and 'B' rankings is 51 per cent (range 7 per cent to 100 per cent).

It should be noted that the relative order of the universities in Figure 18 and Figure 19 is often different. This indicates that while related, the two metrics are discreet measurements. Again, the results may demonstrate that there are institutions for whom a quality based system like ERA does not incorporate significant activities across the university, and which in this case a volume based research engagement metric does.

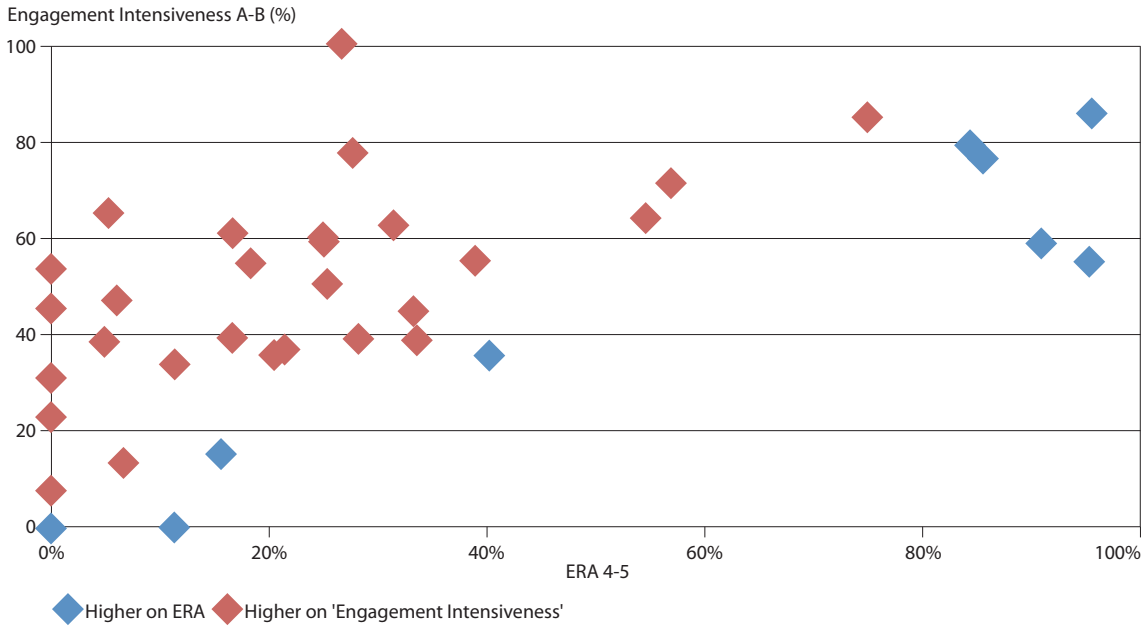
Figure 19 'Share of National Engagement Activity' 'A' and 'B' institution performance compared to ERA 4 and 5 performance.



As with 'Engagement per FTE' and 'Share of National Engagement Activity', 'Engagement Intensiveness' (Figure 20) includes a small number of universities that perform higher on ERA than on the metric. For those institutions that perform better on 'Engagement Intensiveness', the mean percentage of ERA '4' and '5' ratings is 21 per cent (range 0 per cent to 75 per cent), whereas the mean 'A' and 'B' ranking is 49 per cent (range 7 per cent to 100 per cent).

In each case, there are institutions that present significantly better on the REA metrics than on ERA. This indicates that there are a range of activities in those institutions that are not captured by focussing on research quality.

Figure 20 'Engagement Intensiveness' 'A' and 'B' institution performance compared to ERA 4 and 5 performance.



Glossary

AAH	Australian Academy of Humanities
AAS	Australian Academy of Science
ACGR	Australian Competitive Grants Register
ACOLA	Australian Council of Learned Academies
AIMS	Australian Institute of Marine Science
ANSTO	Australian Nuclear Science and Technology Organisation
ASSA	Academy of Social Sciences in Australia
ARC	Australian Research Council
ATSE	Australian Academy of Technological Sciences and Engineering
CRC	Co-operative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ERA	Excellence in Research for Australia
FoR	Field of Research
FTE	Full Time Equivalent (staff)
HASS	Humanities and Social Sciences (disciplines)
HDR	Higher Degree Research (student)
HEP	Higher Education Provider
HERDC	Higher Education Research Data Collection
NHMRC	National Health and Medical Research Council
OECD	Organisation for Economic Co-operation and Development
PFRA	Publicly Funded Research Agency
REA	Research Engagement for Australia
RBG	Research Block Grants
STEM	Science, Technology, Engineering and Mathematics (disciplines)
UoE	Unit of Evaluation (as per ERA)

ATSE – in brief

The Academy of Technological Sciences and Engineering (ATSE) is an independent, non-government organisation, promoting the development and adoption of existing and new technologies that will improve and sustain Australia's society and economy.

ATSE consists of some 800 eminent Australian Fellows and was founded in 1976 to recognise and promote outstanding achievement of Australian scientists, engineers and technologists.

ATSE provides a national forum for discussion and debate of critical issues about Australia's future, especially the impact of science, engineering and technology on quality of life.

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RESEARCH ENGAGEMENT FOR AUSTRALIA
Measuring research engagement between universities and end users

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