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Australian Government
Australian Research Council

2015

2016

State of Australian
University Research
Volume 1 ERA National Report

MINISTER'S FOREWORD



I am pleased to present the *State of Australian University Research 2015–16: Volume 1 ERA National Report (ERA 2015)*, a comprehensive assessment, by discipline, of the quality of research conducted in Australia's higher education institutions.

In Australia, and around the world, high quality research is driving innovation that saves lives, answers social and environmental imperatives, improves economic productivity and growth, and creates the jobs of the future. The Australian Government will invest \$9.7 billion in 2015–16 into research across education, industry, health, defence, environment and agriculture that will help ensure the Australia of the future is agile, creative and innovative, and able to compete with the best in the world.

ERA 2015's internationally benchmarked data shows that Australia's research effort, conducted in universities across the nation and in every broad discipline group, continues to perform well—above world standard.

It also showcases the rich research diversity, strength and excellence across the spectrum of Australian universities.

With ERA 2015, Australia now has longitudinal data on our research effort since 2003 — an invaluable resource for universities, industry and other users of research, and policymakers.

This will be used to help map progress in meeting the Australian Government's Science and Research Priorities, and corresponding Practical Research Challenges.

ERA is also a quality assurance mechanism for Australia's universities, which reported \$9.9 billion in research income between 2011 and 2013.

Encouraging stronger incentives for research–industry collaboration and better translating research into commercial outcomes — as promoted by the Government's Boosting the Commercial Returns from Research strategy — is a high priority so as to maximise the economic and social outcomes of Australia's high-quality research.

I congratulate the Australian Research Council and all of the universities that contributed to ERA 2015 for their commitment to Australian research investment, performance, and discovery.

A handwritten signature in blue ink, which appears to read "Simon Birmingham". The signature is fluid and cursive.

Senator the Hon Simon Birmingham
Minister for Education and Training

CEO'S FOREWORD



This is the inaugural *State of Australian University Research 2015–16*.

In the past, the ARC has released the ERA results through an ERA National Report and Volume 1 of this *State of Australian University Research 2015–16* continues that tradition. It comprehensively details the quality of Australian university research benchmarked against world standards.

With three rounds of ERA now complete, this unique dataset covers all Australian university research outputs, staffing and activity from 2003 to 2013, and research income and research application data from 2006 to 2013.

Over the coming year the ARC will produce additional volumes based on analyses of this longitudinal data, which will provide further insights into the state of Australian university research. Volume 2 will be released in April 2016.

ERA is the primary mechanism to assure Government of its research investment in Australian universities.

ERA 2015 results clearly demonstrate that Australian universities are diverse and that much of their research meets world standard or better.

This report identifies the excellence in research across a broad range of universities and the outstanding performances in areas of specialisation. Overall the quality of Australian university research continues to improve.

The data also shows solid growth of the sector from the previous ERA round. For ERA 2015 data for over 430,000 unique research outputs and 67,000 researchers was collected from the 41 participating universities. There were 2,460 units of evaluation assessed, including 1,802 four-digit and 658 two-digit disciplines.

ERA would not be possible without the support the ARC receives from the sector. In addition to sector-wide consultations to help refine the ERA 2015 process and the work of all universities during the submission stages, there were 155 Research Evaluation Committee members and about 1,300 peer reviewers from Australia and overseas appointed to conduct the evaluations.

This strong sector engagement maintains the confidence that ERA is the most rigorous and effective measure of research quality in Australia's universities. I would like to take this opportunity to thank all those involved at various stages of the ERA process and in particular the ARC ERA staff.

I strongly encourage universities, industry and other research users to make use of the valuable information that ERA provides.

A handwritten signature in black ink, appearing to read 'Aidan Byrne'.

Professor Aidan Byrne

Chief Executive Officer

Australian Research Council

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ABBREVIATIONS

AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
ANZSRC	Australian and New Zealand Standard Research Classification (ANZSRC) 2008
ARC	Australian Research Council
BB	Biological and Biotechnological Sciences discipline cluster/Research Evaluation Committee
CRC	Cooperative Research Centre
EC	Economics and Commerce discipline cluster/Research Evaluation Committee
EE	Engineering and Environmental Sciences discipline cluster/Research Evaluation Committee
EHS	Education and Human Society discipline cluster/Research Evaluation Committee
EPO	European Patent Office
ERA	Excellence in Research for Australia
FoR	Fields of Research (ANZSRC)
FTE	Full-Time Equivalent
HCA	Humanities and Creative Arts discipline cluster/Research Evaluation Committee
HERDC	Higher Education Research Data Collection
HESDC	Higher Education Staff Data Collection
JPO	Japan Patent Office
MHS	Medical and Health Sciences discipline cluster/Research Evaluation Committee
MIC	Mathematical, Information and Computing Sciences discipline cluster/Research Evaluation Committee
NHMRC	National Health and Medical Research Council
NTRO	Non-traditional research outputs
PBRs	Plant Breeder's Rights
PCE	Physical, Chemical and Earth Sciences discipline cluster/Research Evaluation Committee
REC	Research Evaluation Committee
SRE	Sustainable Research Excellence
UoE	Unit of Evaluation
USPTO	United States Patent and Trademark Office

GUIDE TO THE REPORT

The *State of Australian University Research 2015–16: Volume 1 ERA National Report* presents a comprehensive assessment by discipline of the quality of research activity conducted in Australia's higher education institutions. This volume provides information on the discipline-specific research activity of each eligible Australian higher education institution (see **Appendix 1: Eligible Institutions**), and the contribution of each discipline to the national landscape.

The *ERA National Report* is divided into six sections which are listed below:

- › The **Introduction** provides an overview of the ERA framework and methodology
- › **Section 1: ERA 2015 National Overview** provides a national summary of world standard research performance, a summary of all data submitted for the purposes of the ERA evaluation, some comparative data for ERA 2010, ERA 2012 and ERA 2015, and some preliminary analysis of the ERA 2015 submission data
- › **Section 2: Overview by Two-Digit Fields of Research (FoR) Code** provides a summary of two-digit FoR codes for the suite of indicators presented in ERA
- › **Section 3: Results by Fields of Research (FoR) Code** provides a summary of evaluation outcomes and data for each FoR code, including key volume and activity information and ERA rating outcomes
- › **Section 4: National Profiles by Fields of Research Code** provides a detailed breakdown of ERA data by two- and four-digit FoR codes
- › **Section 5: ERA 2015 Institution Report** provides the ERA ratings for each assessable Unit of Evaluation (UoE) for each of the 41 institutions eligible for ERA.

Enquiries about the *State of Australian University Research 2015–16: Volume 1 ERA National Report* should be directed to:

Leanne Harvey

Executive General Manager

Australian Research Council

Tel +61 (02) 6287 6755

Email era@arc.gov.au

This report is available on the ARC website at: arc.gov.au/excellence-research-australia

If you have issues with obtaining any information or document on our website, please contact the ARC on +61 (02) 6287 6600 or web@arc.gov.au.

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Introduction

In 2015, the Australian Research Council (ARC) conducted the third full Excellence in Research for Australia (ERA) evaluation. The evaluation collected data regarding the quality of research activity undertaken at all eligible higher education research institutions¹ within the ERA 2015 reference period. These data were then evaluated by eight Research Evaluation Committees (RECs), established at a discipline cluster level, and comprised of distinguished and internationally-recognised researchers with expertise in research evaluation.²

This National Report provides an overview of the data collected and the outcomes of the ERA 2015 evaluation process.

Objectives of ERA

ERA aims to identify and promote excellence across the full spectrum of research activity, including both discovery and applied research, within Australian higher education institutions.

The objectives of ERA are to:

1. establish an evaluation framework that gives government, industry, business and the wider community assurance of the excellence of research conducted in Australia's higher education institutions
2. provide a national stocktake of discipline-level areas of research strength and areas where there is opportunity for development in Australia's higher education institutions
3. identify excellence across the full spectrum of research performance
4. identify emerging research areas and opportunities for further development
5. allow for comparisons of Australia's research nationally and internationally for all discipline areas.

Use of Information from ERA

ERA provides Government, universities, industry, and prospective students with valuable information about research performance in Australian universities. For example, ERA data and outcomes:

- › inform a range of advice to Government across the various portfolios of Government
- › assist universities with strategic planning
- › inform funding allocations for Sustainable Research Excellence in Universities (SRE) block grants
- › specifically inform the development of research policy in Government and the wider sector, including:
 - › Research Engagement for Australia: Measuring Research Engagement between Universities and End Users (Australian Academy of Technological Sciences and Engineering)
 - › Mapping Australia's Science and Research Priorities (Department of Industry and Science)
 - › Mapping the Humanities, Arts and Social Sciences in Australia (Australian Academy of the Humanities)
 - › Development of the Defence Trade Controls Act (Department of Defence)
 - › Draft National Strategy for International Education (Department of Education and Training).

¹ See **Appendix 1** for a list of eligible institutions.

² A list of ERA 2015 REC members is available at: arc.gov.au/era-2015-research-evaluation-committee-rec-members

Definition of Research

For the purposes of ERA, 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, inventions and understandings. This could include synthesis and analysis of previous research to the extent that it is new and creative.

Institutions must ensure that all research outputs submitted to ERA meet this definition of research. Outputs that do not meet this definition may be excluded from submissions during the ERA submission process or, where they are not excluded from submissions, their inclusion may adversely affect the quality rating assigned by RECs during the evaluation process.

Fields of Research (FoR) Codes

For the purposes of ERA, disciplines are defined as two- and four-digit Fields of Research (FoRs) codes as identified in the *Australia and New Zealand Standard Research Classification (ANZSRC) 2008* released by the Australian Bureau of Statistics and Statistics New Zealand. The ANZSRC provides 22 two-digit FoR codes, 157 four-digit FoR codes, and an extensive range of six-digit codes.

The FoR codes as used in ERA 2015 are listed in **Appendix 2**. ERA undertakes evaluation at both the two- and four-digit FoR code level. Institutions submitted data to ERA at the four-digit level and these were aggregated to form the two- and four-digit Units of Evaluation (UoEs).

The two-digit FoR code is the highest level of the ANZSRC hierarchy; it relates to a broad discipline field, for example, Physical Sciences (02) or History and Archaeology (21). A two-digit FoR code consists of a collection of related four-digit FoR codes.

The four-digit FoR code is the second level of the ANZSRC hierarchy and relates to a specific discipline field of a two-digit FoR code. For example, Astronomical and Space Sciences (0201) or Archaeology (2101).

ERA 2015 Reference Periods

Data for the following reference periods was collected for ERA 2015:

Data Type	Reference Period	Years
Research Outputs	1 January 2008 – 31 December 2013	6
Research Income	1 January 2011 – 31 December 2013	3
Applied Measures	1 January 2011 – 31 December 2013	3
Esteem Measures	1 January 2011 – 31 December 2013	3
Staff Eligibility Period	As at 31 March 2014	Census Date

ERA 2015 Evaluation Process

Evaluation of data submitted for ERA 2015 was undertaken by eight Research Evaluation Committees (RECs),³ broadly representative of eight discipline clusters. The ERA 2015 Research Evaluation Committees were comprised of 155 individual distinguished and internationally recognised researchers from Australia and overseas, with expertise in their fields and in research evaluation.

Further details concerning the ERA 2015 Evaluation process, including moderation and conflict of interest procedures, can be found in the *ERA 2015 Evaluation Handbook*.⁴

ERA 2015 Discipline Clusters

The ERA 2015 evaluation collected data and undertook evaluations across eight discipline clusters. Discipline clusters are a construct developed primarily to assist in balancing workload across the various FoR codes. The discipline clusters for ERA 2015 are:

- › Biological and Biotechnological Sciences (BB)
- › Humanities and Creative Arts (HCA)
- › Economics and Commerce (EC)
- › Education and Human Society (EHS)
- › Engineering and Environmental Sciences (EE)
- › Mathematical, Information and Computing Sciences (MIC)
- › Medical and Health Sciences (MHS)
- › Physical, Chemical and Earth Sciences (PCE).

See **Appendix 2** for a full list of FoR codes and their discipline cluster for ERA 2015 purposes.

ERA 2015 Indicators

ERA is based on the principle of expert review informed by indicators. The ERA 2015 evaluations undertaken by RECs were informed by four broad categories of indicators:

1. Indicators of research quality

Research quality was considered on the basis of a publishing profile, citation analysis, ERA peer review, and peer reviewed Australian and international research income

2. Indicators of research activity

Research activity is considered on the basis of research outputs, research income and other research items within the context of the profile of eligible researchers

³ See arc.gov.au/era-2015-research-evaluation-committee-rec-members for a list of REC members.

⁴ The ERA 2015 Evaluation Handbook is available from: arc.gov.au/excellence-research-australia

3. Indicators of research application

Research application is considered on the basis of research commercialisation income, patents, Plant Breeder's Rights, registered designs, and National Health and Medical Research Council (NHMRC) Endorsed Guidelines. Some other measures, such as publishing behaviour and some other categories of research income, can also provide information about research application

4. Indicators of recognition

Research recognition was considered on the basis of a range of esteem measures.

More detailed information about each of the ERA indicators is available in the *ERA 2015 Evaluation Handbook*.

The ERA indicators are underpinned by the ERA Indicator Principles. The ERA Indicator Principles were developed by the ARC in accordance with international best practice and informed by the ERA Indicator Development Group with analytical testing of data from the Australian higher education sector.

The ERA indicator suite was developed to align with the research behaviours of each discipline. For this reason, there are differences in the selection of indicators. The indicators that apply to each discipline (as defined by two- or four-digit FoRs) are shown in the *ERA 2015 Discipline Matrix*.⁵

Unit of Evaluation

The Unit of Evaluation for ERA is the research discipline for each institution as defined by FoR codes.

Evaluations occurred at the two- and four-digit FoR code levels for UoEs that met the low volume threshold. UoEs do not correspond to named disciplines, departments or research groups within an institution.

National-level profiles of disciplines aggregated across institutions at the two- and four-digit FoR code level include information from all submitting institutions, including from those which did not meet the low volume threshold and were therefore not assessed.

Low Volume Threshold

Two- and four-digit UoEs were only assessed where there was a meaningful level of data to be evaluated. An institution is only evaluated in ERA in a two- or four-digit discipline if the number of research outputs submitted reaches the low volume threshold.

For disciplines where citation analysis was used, the low volume threshold was 50 apportioned indexed journal articles. No evaluation was conducted for the FoR at a given institution if the submitted number of apportioned indexed journal articles over the six-year research outputs reference period was fewer than 50 in any two- or four-digit FoR.

For disciplines where peer review was used, the low volume threshold was 50 apportioned weighted outputs. For these disciplines, books were given an effective weighting of 5:1 compared with other research outputs. Books were weighted only for the purposes of determining the low volume threshold; in every other instance they were regarded as a single research output. Portfolios of works were counted as one output for the purposes of determining the low volume threshold. No evaluation was conducted for an FoR at a given institution where, over the six-year research outputs reference period, there were less than the equivalent of 50 apportioned weighted research outputs submitted.

⁵ The *ERA 2015 Discipline Matrix* is available at: arc.gov.au/era-2015-submission-documents

For some FoRs at some institutions, there was insufficient research volume to undertake a valid analysis at the four-digit FoR level, but sufficient research volume at the two-digit FoR level. In these instances, evaluation took place at the two-digit FoR level only.

Where the low volume threshold was not met, the UoE for a given institution was automatically treated as 'not assessed due to low volume', and is reported as 'n/a'. This means that data submitted on research outputs, research income, applied measures and esteem measures for the relevant two- or four-digit FoR for that institution was collected but not evaluated under ERA 2015. The institution, therefore, was not considered as research active for that discipline for the purposes of ERA 2015. However, the data submitted still contributed to the construction of the ERA benchmarks and all ERA data was aggregated for national-level reporting irrespective of whether any FoRs within a specific institution met the low volume threshold.

ERA Rating Scale

ERA utilises a five-point rating scale. The rating scale is broadly consistent with the approach taken in research evaluation processes in other countries to allow for international comparison.

Rating	Descriptor
5	The Unit of Evaluation profile is characterised by evidence of outstanding performance well above world standard presented by the suite of indicators used for evaluation.
4	The Unit of Evaluation profile is characterised by evidence of performance above world standard presented by the suite of indicators used for evaluation.
3	The Unit of Evaluation profile is characterised by evidence of average performance at world standard presented by the suite of indicators used for evaluation.
2	The Unit of Evaluation profile is characterised by evidence of performance below world standard presented by the suite of indicators used for evaluation.
1	The Unit of Evaluation profile is characterised by evidence of performance well below world standard presented by the suite of indicators used for evaluation.
n/a	Not assessed due to low volume. The number of research outputs does not meet the volume threshold standard for evaluation in ERA.

Notes on the Rating Scale

- › 'World Standard' refers to a quality standard. It does not refer to the nature or geographical scope of particular subjects, or to the locus of research nor its place of dissemination.
- › Each point within the rating scale represents a quality 'band'. For example, one UoE might be rated highly within the '4' band and another rated lower within the same band, but the rating for both will be a '4'. Only whole ratings are given (not 4.2, 4.5 etc).
- › The 'banding' of quality ratings assists RECs in determining a final rating. If, for example, a Unit of Evaluation has a preliminary rating at the top margin of the '4' band based on the assessment of the quality of the research outputs, other indicators (e.g. income or esteem measures) may be sufficient to raise the rating into the '5' band. The lack of such indicators will not, however, be used to lower a rating.
- › The ERA evaluation measures research quality, not scale or productivity. Volume information is presented to the RECs for the purposes of providing context to the research.
- › The methodology and rating scale allow for UoEs with different volumes of output to achieve the same rating. So, for example, a UoE with a small number of outputs can achieve a rating of 5 where the UoE meets the standard for that rating point, similar to a UoE with a large number of outputs.
- › Each UoE is assessed against the absolute standards of the rating scale, not against other UoEs. One of the key objectives of ERA is to identify excellence across the full spectrum of research performance.
- › RECs exercise their knowledge, judgment and expertise to reach a single rating for each UoE. In reaching a rating, RECs take account of all of the supporting evidence which is submitted for the UoE. RECs do not make comment about the contributions of individual researchers.
- › The rating for each UoE reflects the REC's expert and informed view of the characteristics of the UoE as a whole. In all cases the quality judgments relate to all of the evidence, including the entire indicator suite, and the ERA rating scale. In order to achieve a rating at a particular point on the scale, the majority of the output from the UoE will normally be expected to meet the standard for that rating point. Experience has demonstrated that there is normally a variety of quality within a UoE.

Further details concerning the ERA evaluation process can be found in the *ERA 2015 Evaluation Handbook*.

Additional Reporting for ERA 2015

Gender Data

Institutions were required to submit gender data for each eligible researcher. Gender data was used for aggregate reporting and analysis purposes only. This data was not made available to peer reviewers or Research Evaluation Committees (RECs) and did not form part of the evaluation process.

Open Access

Institutions were required to state whether a research output is available in an open access repository. Open access data was used for aggregate reporting and analysis purposes only. This data was not made available to peer reviewers or Research Evaluation Committees (RECs) and did not form part of the evaluation process.

For the purpose of ERA 2015, an open access repository is as per the ARC's Open Access Policy.

See: arc.gov.au/arc-open-access-policy.

New Category of Non-Traditional Research Outputs

There is a new category of non-traditional research outputs for ERA 2015, entitled 'research report for an external body'. It consists of four subcategories of reports: Public Sector; Industry; Not-For-Profit; and Other.

Non-traditional research outputs (NTROs) only apply to some disciplines. The exception is the NTRO category 'research reports for an external body' which applies to all disciplines. However, for citation disciplines, while 'research reports for an external body' form part of the publishing profile they do not form part of the citation analysis information. In addition, 'research reports for an external body' submitted within citation fields of research will not be eligible for peer review.

Further detail on the changes to the submission guidelines for ERA 2015 can be found in the *ERA 2015 Submission Guidelines*.

Key ERA 2015 Documents

There are several documents that provide more detailed information about various aspects of the ERA 2015 evaluation. These include:⁶

- › *ERA 2015 Submission Guidelines* — provide guidance to institutions about ERA 2015 submission rules and components
- › *ERA 2015 Discipline Matrix* — shows the indicators that apply to each FoR code
- › *ERA 2015 Evaluation Handbook* — provides detailed information about the ERA 2015 indicators, evaluation approach and process
- › the *ERA 2015 Submission Journal List*, *Submission Conference List* and *Submission Publisher List* (copies of these lists were supplied to participating universities in July 2014).

Further information about ERA is available on the ARC website at: arc.gov.au/era-2015

⁶ ERA 2015 key documents are available at: arc.gov.au/excellence-research-australia

Use of the ERA National Report

The *ERA National Report* presents data submitted as part of a comprehensive assessment by discipline of the research quality and research activity within Australia's higher education institutions.

Coverage

ERA retrospectively evaluates the quality of research conducted within the specific reference periods (as shown previously). As the ERA 2015 research outputs reference period ended on 31 December 2013, research quality may have changed since that time.

Comparison across Data Items

Each UoE is assessed against the ERA rating scale. As no comparisons are made between UoEs, ERA ratings cannot be used as a ranking device. Further, as each ERA rating point might include a range of performances, and the gap between rating points is not defined, it is not appropriate to average ratings even within disciplines.

ERA has been designed to provide flexibility for, and recognition of, discipline-specific research behaviours at both the two- and four-digit FoR levels rather than comparison between disciplines or disciplinary clusters. ERA evaluations are conducted by discipline experts interpreting the indicators for each UoE in the context of their own expert knowledge of the discipline. Different indicators apply to each discipline, as outlined in the *ERA 2015 Discipline Matrix*. For this reason it is not appropriate to make productivity statements about or comparisons between disciplines.

Where possible the data presented in this report is de-duplicated. This does not represent the exact data submitted to ERA 2015 for the purposes of evaluation (which potentially contained duplicate data submitted by multiple institutions).

Please note: numbers are generally rounded to one decimal place in tables throughout this report and income is rounded to whole dollars. Totals may be different to the sum of parts due to rounding.