Research Assessment in Australia:
Evidence for Modernisation

ACOLA
AUSTRALIAN COUNCIL OF LEARNED ACADEMIES™

Combining the strengths of
Australia's Learned Academies

EXPERT WORKING GROUP

Professor Kevin McConkey AM FASSA (Chair)

Professor Ana Deletic FTSE

Professor Louisa Jorm FAHMS

Professor Duncan Ivison FAHA

Professor Robyn Owens AM FAA FTSE

Professor Jill Blackmore AM FASSA

Professor Adrian Barnett FASSA

Kate Thomann (March–June 2023)

Caroline Hughes AM (June–September 2023)

Professor Andrew Peele FTSE

Dr Guy Boggs

Associate Professor Raffaella Demichelis

ACOLA AND ASSA RESEARCH/PROJECT TEAM

Mr Ryan Winn

Dr Lauren Palmer

Ms Eden Whitlock

Dr Ella Relf

Dr Chris Hatherly

Dr Sylvia Laksmi

Dr Kyle Peyton

CONTRIBUTING AUTHORS

Kevin McConkey, Adrian Barnett, Jill Blackmore, Guy Boggs, Ana Deletic, Raffaella Demichelis, Caroline Hughes, Duncan Ivison, Louisa Jorm, Robyn Owens, Andrew Peele, Kate Thomann, Tony Willis, Kate Williams, Ryan Winn, Chris Hatherly, Lauren Palmer, Sylvia Laksmi, Ella Relf, Eden Whitlock.

ACKNOWLEDGEMENT OF COUNTRY
ACOLA acknowledges all Aboriginal and Torres Strait Islander Traditional Custodians of Country and recognises their continuing connection to land, sea, culture and community. We pay our respect to the Elders both past and present. We acknowledge the Ngunnawal people on which ACOLA and ASSA's main offices are based, in Canberra, and the lands of the Whadjuk Noongar (Perth), Turrbal (Brisbane) and Wurundjeri (Melbourne) people.

Contents

Summary

Australia seeks to be a leading global hub for innovation and knowledge, and to have an exceptional research workforce that is highly skilled, motivated and talented. To achieve this objective, understanding systems of research assessment and how they impact on the practice of science and research is critical. Research assessment can improve research management, output and attractiveness to industry partnerships. However, the reliance on particular indicators and metrics can have unintended consequences and can impact researchers' career paths and research focus. Understanding the positive and negative consequences will help inform the future of research assessment in Australia.

This report explores the nature and influence (positive and negative) of research assessment (broadly defined) on individuals, including career progression and cross-sector mobility. The report covers all organisations that employ researchers (public or private), all stages of the research endeavour and career, and all disciplines.

The report provides evidence on how research institutions nationally evaluate researchers. It delves into how research activities can not only lead to various outputs, but can also be an indicator for other critical organisational skills such as leadership, mentorship and participation in industrial or governmental bodies. The report is inclusive and considers researchers from diverse career stages, backgrounds and disciplines, as well as considering various types of research outputs and impacts.

The findings from the report show that research assessment practices differ across organisations and disciplines, reflecting their respective strategic and operational objectives. These differences, along with unintended consequences, must be recognised and accommodated when evaluating researchers and the quality of research.

The findings highlight how assessment shapes the research workforce (for example, career progression, diversity, and mobility between sectors) and how assessment influences not only the decisions of individual researchers (for example, publishing approaches, research focus, collaboration, and research methods) but also the decisions of research organisations (for example, research culture, appointments, and strategic investments).

A significant number of researchers expressed dissatisfaction with current research assessment processes. They considered that their research and capabilities are not being accurately, fairly and transparently recognised, which in turn is affecting their recruitment, promotion and research pursuits. Transitioning between sectors also posed challenges as employers struggle to understand the transferability of skills, which is hindering the recruitment of researchers with the necessary capabilities.

There are multiple and varied forms of research assessment across disciplines, and assessment processes need to acknowledge these differences. A modern, outward-facing research assessment should not only acknowledge but also celebrate the different ways in which research quality, excellence and impact are understood and measured. This includes the time it takes for research to have an impact and that not all high quality, valuable research will result in commercialisation or a policy change in the short- to medium-term.

The report underscores the importance of modernising research assessment practices, rewarding and incentivising innovation, promoting groundbreaking and risky research, and encouraging interdisciplinary approaches and collaboration.

Overview of scope and research method

In the context of substantial international and national consideration of the purpose, principles, processes and uses of research assessment, Australia's Chief Scientist commissioned the Australian Council of Learned Academies (ACOLA), in partnership with the Academy of the Social Sciences in Australia (ASSA), to prepare this report on modernising research assessment in Australia. The project was guided by an independent and multidisciplinary group of experts, including Fellows from Australia's five Learned Academies. The Expert Working Group was chaired by Professor Kevin McConkey AM FASSA.

The scope of the project was to examine how research assessment affects research culture and the behaviours and choices of Australian researchers across the research and innovation system. It sought to understand how research assessment influenced the diversity of Australia's research workforce and shape research quality, outputs and impact.

The approach considered the landscape of research and innovation in Australia. This involved desktop reviews of domestic and international research, alongside extensive consultations with stakeholders, including 11 roundtables, 25 formal interviews, and received survey responses from over 1,000 individuals and more than 50 research organisations.

'Research assessment' is defined as the processes and metrics used to evaluate the performance of researchers and research institutions, including the quality, excellence and impact of various outputs. It can include standardised forms of both qualitative and quantitative measurement and reporting.

Assessment and review of various evaluation and assessment processes, such as the Australian Research Council's (ARC) Excellence in Research for Australia (ERA) and Engagement and Impact (EI), were out of scope. However, as noted in the Australian University Accord Panel's Interim Report, national research performance evaluation is vital not least for providing research funders with evidence of value for money.

Innovation and commercialisation metrics were also out of scope, with previous work by the Australian Government and the Australian Academy of Technological Sciences and Engineering considering these in the Innovation Metrics Review.[1]

Other complementary work includes: the Diversity in STEM review; the refresh of Australia's National Science and Research Priorities; the Review of the Australian Research Council Act 2001; the development of the Australian Universities Accord; work by the National Health and Medical Research Council (NHMRC) and ARC to increase diversity in research funding; and the NHMRC Research Quality Strategy.

Appendix 1 provides an overview of the formal project aims and scope. Further information about the research method can be found in Appendix 2.

Report setting

Every piece of research conducted, and every report written, occurs within a context and this report is no exception.

Within the context of the project scope, we have sought to understand and explore several tensions in relation to research assessment that impact individuals' careers. These broader issues and tensions are outlined as a way of framing the content of this report. We believe that this report provides a fair and balanced account within the scope, information and time available.

Wider reform context

- This project is occurring in the context of other federal government reviews and strategic discussions concerning the higher education, research and science systems.

- This meant that there were various streams of inquiry that were beyond the project's scope. For instance, the role and nature of a country's science priorities, funding mechanisms (such as those set by the ARC), and funding and governance of universities were all out of scope and are dealt with in separate reviews.

- In the relevant literature, there is an argument that various forms of research assessment are based on data that is limited in validity and reliability, and research assessment should be based on open access information; this is a separate and live debate and briefly explored later in the report.

- The emerging use, consideration and discussion of the regulation of emerging/evolving technologies, especially artificial intelligence (AI), may be of value and may also be a hindrance for research and research assessment. The report comments briefly on these issues of emerging technologies.

Organisational context

- Research assessment occurs within broader systems. For instance, as with much else in society, research assessment occurs within a system that largely reflects older, white, English-speaking, male, hetero-normative assumptions and values, and this can lead to biases, intentional or not.

- Research assessment is also shaped by how research is funded. In Australia, the systematic underfunding of research over a long period has resulted in a reliance on international student fees to subsidise research activities, particularly in our most research-intensive universities. This, understandably, influences organisational behaviour, including how universities respond to global 'league tables' that play a role in international students' decision-making about which universities they may wish to attend. This can have consequential effects in relation to the kind of research that universities ultimately pursue and assess as being of value. We do not explore these issues in depth in our report, but they remain an important background condition of Australia's research and development system in need of further consideration.

- It is difficult to differentiate the impacts of broader systemic culture and bias versus those purely related to research assessment. Regardless, these do reinforce each other.

Consultation limitations

- Like any gathering of information, there were inherent limitations in the consultations that we conducted. For instance, the individual and organisational surveys, as well as the roundtables, were convenience and purposive samples, and there were challenges in capturing a representative workforce, especially in industry and from diversity groups.

- There were areas where consultations provided information that differed from that in the literature, and these are identified in the report.

- In some instances, survey and roundtable inputs were not consistent with the formal policy positions of organisations. The report points to the gap that is sometimes seen between organisational strategy and/or policy and on-the-ground culture and understanding.

Lack of a common language and terminology

- Although the project covers all disciplines, the 'language' of research assessment, nationally and internationally, largely focuses on traditional science and technology.

- Similarly, the existing language largely reflects the 'basic/foundational' end of research and does not capture well the needs of translational or multidisciplinary work, or research in industry.

- Language also reflects, intentionally or not, conceptual frameworks and assumptions. For instance, although the use of terms such as 'research metrics' would technically imply a theory of measurement, this is not always the case, perhaps wrongly conveying a perception of precision to various indicators or measures or proxies of research and researcher excellence and impact.

- Although this report cannot change the language typically used, we do attempt to be clearer that research assessment is usually about proxy assessment rather than direct assessment.

Confusion with individuals about research assessment

- The surveys, consultations and literature reviews showed that there is substantial variability, if not confusion, nationally and internationally about 'what is being assessed' in an individual's career. For instance, it is sometimes the research, sometimes the researcher (including their skills and competencies) and sometimes both. Also, what is being assessed can sometimes be a team or a discipline, and sometimes a whole organisation.

- One or more of these can then be applied to the evaluation of an individual in terms of career advancement.

- Several international projects are working through this variability to better ensure that research assessment works to optimise the value of individuals conducting research and organisations engaged in research, as well of the quality and impact of the research being conducted.

Findings

The work and evidence collected have generated six main findings:

1

Assessment is undertaken in all organisations to evaluate current and potential employees and their research, but this varies by organisation, depending on their purposes and the skills and capabilities their organisations require. All organisations use research-specific indicators and metrics. In universities, international and national frameworks for research quality, integrity, excellence and impact influence business processes and performance indicators, with funding and publication output metrics having a significant impact on individual researchers. Indicators and metrics are evolving and increasingly focusing on rewarding excellence, impact and engagement. This can help support researchers to achieve measures of success relative to their career stage. There are various examples of good practices in organisations and of individuals, and any improvements should recognise and build upon these.

2

Research assessment can have unintended consequences, such as limiting the scope of research, mobility, innovation (into commercial and policy outputs), collaborations and career opportunities. This can be especially the case for academic researchers, women, researchers from underrepresented groups (including Aboriginal and Torres Strait Islander peoples, people with disability, people from low socioeconomic backgrounds, and those in rural and regional Australia) and those working in new or less dominant fields of research (for example, where disciplinary or cultural differences impact publishing and research activity). The speed at which research outputs are expected to be produced also has unintended negative consequences, especially for those interested in research with Indigenous communities. Researchers and organisations understandably seek to optimise assessments of their performance; however, these strategies can lead to perverse incentives (for example, fostering a risk-averse culture which limits groundbreaking and long-term research), alignment with narrow metrics (for example, reinforcing the 'publish or perish' culture and higher university rankings) and barriers to the translation of knowledge. Some assessment processes also enable more experienced and better-resourced researchers to 'out-optimise' those without these benefits in ways that don't truly reflect differences in research excellence, impact and engagement.

(3) Researcher mobility is shaped by research assessment. Mobility between employers and across sectors plays an important role in facilitating the transfer of skills and knowledge and fostering a productive research ecosystem. However, for many researchers, moving from university to industry or government, or vice versa, is often a one-way journey, as employers incentivise and value specific skills, experiences and capabilities which may not transfer well or be valued equally in different organisations. In this context, mobility tends to be easier for researchers very early in their career, when skills are relatively general and undeveloped, or much later in their career, where management and leadership skills are more central than research activity.

(4) Increased transparency and accountability are needed in research employment decisions, particularly related to research performance evaluations, to support a fair and diverse workforce. Employment practices naturally introduce competition among candidates. However, many researchers expressed concerns about the transparency and accountability of these processes, especially the dominance of metrics in evaluating outputs and impacts without due regard for disciplinary and contextual differences, the opportunity for 'gaming' (that is, deliberate and sometimes unscrupulous manipulation of data or reporting to improve assessment outcomes) as well as perpetuating ongoing biases.

(5) Research assessment impacts research culture and vice versa. The ways research is assessed can serve to enhance or hinder organisational and team culture, and often reinforce the status quo. Consultation data revealed a widespread perception that many organisations have the right assessment indicators but that they are not consistently implemented, including perpetuating biases. Prioritising publication and grant funding metrics often reinforces an individualistic culture in research and directly influences the kinds of research projects undertaken, publishing behaviours, interpersonal and inter-group competition, and time allocated to functions, such as external engagement, mentoring or commercialisation. Conversely, processes that prioritise research impact (including long-term) and excellence metrics, including commercial outcomes or innovation, can foster a collaborative team-based culture and support interdisciplinarity.

(6) Research assessment is continuing to evolve. Emerging domestic and international approaches to research assessment highlight opportunities for system-wide changes in Australia, such as narrative approaches, multi-stage assessment of research proposals, and lottery or strategy-based systems for research funding allocation. Other approaches that hold promise are efforts to develop data-driven algorithms and machine learning approaches to identify potential assessment bias and predict researcher potential, inclusion assessment of environmental impact, progress against the United Nations Sustainable Development Goals, and positive engagement with Indigenous people and communities. However, these approaches are relatively underdeveloped, complex to implement (given the more sophisticated nature of these improved indicators) or may have drawbacks and intrinsic bias for individuals or disciplines if inappropriately developed or prematurely applied.

Improving the foundations for the assessment of research

Sensible and systemic assessment of research and researchers is important. However, rigorous assessment of research can be time and resource intensive and have unintended consequences for individuals and disciplines. It is important to ensure the purpose and conduct of research assessment in general is closely linked to advancing the quality of research and researchers, by:

- developing the next generation of researchers

- ensuring innovative or 'risky' research is not avoided in the interest of short-term gains

- providing funders/employers with a way to understand return and value for money

- giving the public confidence that Australia's research is adding to the public good and our place in the world.

While organisations implement indicators and metrics (direct or proxies) in ways that are relevant to their own values, missions and objectives, experiences from the Netherlands show that there are ways that Australia's research assessment can still be modernised to improve national accountability and transparency, foster workforce mobility and ultimately improve Australia's research excellence.

Australia's current research assessments have been built on widely used systems for benchmarking university citation performance against international comparators and tracking traditional performance of those generally seen as high-performing researchers who do not face inherent bias, discrimination or bullying. The use of research impact assessment processes in many government and private sector research organisations has also ensured a strong focus on applied outcomes of research. There are beneficiaries of the current system, however, it also creates challenges and ingrains distortions and biases that in aggregate have a greater negative than positive impact on the innovation and effectiveness of our research sector.

'Publications should be seen as inputs of knowledge into the innovation system and a quality control step that validates the generation of knowledge, rather than the endpoint.'
Shaun Coffey FTSE CRSNZ FAIA FAICD

Australia can be bold and proactive in engaging with international research metrics and assessment processes. Figure 1 outlines key pillars for a modern and effective research assessment system: reliable and consistent assessments and valid, accurate information at the core of research assessment driven by leadership, collaboration, transparency, collegiality, integrity, and equity and diversity.

Introducing changes may not be easy, as much depends on the culture within organisations, but the results could be significant for Australia's research and innovation ecosystem. But equally, actions across all stakeholders will help drive a more positive culture.

This report is a valuable resource for organisations and policymakers seeking to improve assessment practices in Australia's research system. The report emphasises the importance of supporting innovation, creativity, and Australia's research and researchers in positive ways. Chapters 6, 7 and 8 explore alternative models and approaches to metrics, including potential actions for Australia.

Leadership

In responsible assessment, metrics innovation, and open research.

Transparency

Framework of standardises competencies, metrics and expectations.

Collaboration

Recognise and reward collaboration, dual-sector roles and non-traditional research outputs.

Valid, accurate information

Reliable consistent assessments

Integrity

Fair, open and accountable assessment or research and researchers.

Collegiality

Promote and recognise supervision and service roles.

Equity and diversity

Reduce bias; promote cultural understanding; enhance Indigenous Knowledges ownership and assessment.

Figure 1: The pillars of modern research assessment

Research assessment indicators

A primary conclusion of this work is that a fair and modern approach to research assessment requires considered use of metrics (defined measures of performance or outcome) and indicators (proxies of such). These should be applied in the context of the sector and disciplines in which research takes place, and with consideration of the availability of resources and individual factors including career stage, 'relative to opportunity', cultural, gender or linguistic factors. Table 1 provides a summary of the range of established and emerging indicators that have been covered in this report, as relevant to different parts of the research ecosystem. It is important to note that the balance of these indicators may change depending on strategic priorities, and on whether the focus of assessment is on the individual or the organisation.

Table 1: Established and emerging research assessment indicators

Primary indicators metrics	Unis/ MRIs	PFRAs and gov't depts	Industry	Think tanks and NFPs	Notes
Knowledge creation					
Bibliometrics/citation-based metrics (raw and field normalised)	Valuable	Context	Limited	Limited	Citation of research by peers is a key measure of academic relevance and can be an indicator of research excellence. Presents challenges for interdisciplinary and multidisciplinary research and new/niche fields, and reliance on it has created system distortions and perverse incentives. Volume-based metrics are relevant to some global rankings, but no longer generally considered an appropriate metric.
Publication outlets: impact factors and quality rankings	Context	Context	Limited	Limited	Standards and applications vary across disciplines. Journal impact factors are declining in relevance in a digital context.
Creative works and portfolios	Context	Limited	Limited	Context	Primary focus for arts and creative disciplines. Work is underway to standardise assessment frameworks.
Competitive research funding: grant outcomes	Valuable	Context	Context	Context	Valuable for researchers, disciplines and organisations that rely on grant funding. Grant application volume no longer considered.
Reproducibility	Context	Context	Not valuable	Limited	Emerging focus on reproducibility but lack of standard indicators and frameworks for collection.
Transparency: open access publication/data	Valuable	Valuable	Not valuable	Valuable	Emerging focus/funder requirement on open access publication and open data. Lack of standard indicators and frameworks for collection.
Translation and impact					
Commercialisation metrics, including revenue and patents	Valuable	Context	Valuable	Not valuable	Relevant for commercial research organisations, for some disciplines in universities/MRIs and for many PRFAs.
Media engagement	Valuable	Limited	Limited	Valuable	Can be a useful indicator of influence on public discourse. Limited value for government and commercial research.
Influence on public policy and legal decisions	Valuable	Valuable	Context	Valuable	Emerging standards and platforms for collecting and tracking impact, including through global services like Overton.
Public exhibitions, events (curated or produced), and creative works (live performance, recorded or rendered).	Context	Limited	Limited	Limited	Relevant for arts and creative disciplines. Work is underway to standardise assessment frameworks.

Legend:
- **Valuable** — Valuable for most researchers (dark green check)
- **Context** — Valuable, depending on area/context group (light green check)
- **Limited** — Limited value for most in this group (orange minus)
- **Not valuable** — Not valuable for this group (red cross)

Primary indicators metrics	Unis/MRIs	PFRAs and gov't depts	Industry	Think tanks and NFPs	Notes
Engagement					
External relationships and networks	Valuable	Valuable	Depends	Depends	No standard indicators or framework: relies on self-report and referees.
Participation in industry or government advisory groups	Valuable	Depends	Depends	Valuable	Useful indicator of policy impact and engagement, but no standard framework for measurement.
Research collaborations: cross disciplinary	Valuable	Valuable	Depends	Valuable	Can be useful, depending on research area/question.
Research collaborations: cross sector (that is, higher education, private industry, public entities, government agencies and departments)	Valuable	Valuable	Depends	Valuable	An emerging priority for many areas, particularly as pathway to impact.
Service and leadership					
Editorial and peer-review service	Valuable	Limited	Not valuable	Not valuable	Important component of most academic roles; less relevant in other sectors.
Higher degree research completions	Valuable	Not valuable	Not valuable	Not valuable	Important component of most academic roles.
Invited conference or public-speaking presentations	Valuable	Depends	Depends	Depends	Important indicator of peer and disciplinary regard.
Organisational leadership roles	Valuable	Valuable	Valuable	Valuable	Important component of most mid-career and senior roles across the research ecosystem.
Supervision/mentoring roles	Valuable	Valuable	Valuable	Valuable	Important component of most mid-career and senior roles across the research ecosystem.
Association/society service (including committees and conferences)	Valuable	Limited	Limited	Limited	Somewhat relevant in academic contexts.
Attendance at seminars/events	Not valuable	Limited	Limited	Not valuable	Value is limited and various researchers can face some, if not significant, travel barriers
Other indicators					
Awards and prizes	Valuable	Limited	Limited	Depends	Well-established and high-profile awards considered highly; variable utility of other awards. Criteria often opaque.
Election to prestigious societies (for example, Academies, professional associations).	Valuable	Depends	Valuable	Depends	Highly valued in university and industry research contexts.
Team-based outcomes	Depends	Valuable	Valuable	Valuable	Key indicator for industry and PFRAs; variable in academic contexts and challenges with respect to assessment.

Legend: Valuable = Valuable for most researchers · Depends = Valuable, depending on area/context group · Limited = Limited value for most in this group · Not valuable = Not valuable for this group

Structure of the report

This project sought to understand the experience and practices of people and organisations across the Australian research sector in research assessment. The report is structured in three parts, as follows:

DEFINING RESEARCH ASSESSMENT

- Chapters 1 and 2 define research assessment and the various terms used and provide an overview of the background and context of research assessment in Australia.

THE NATURE AND IMPACTS OF ASSESSMENT ON RESEARCHERS AND AUSTRALIA'S RESEARCH SYSTEM

- Chapter 3 provides an overview of strengths and challenges of research assessment.

- Chapter 4 examines system-level impacts of research assessment metrics on Australia's knowledge system and discusses broad gaps and shortcomings that arise from the current metrics-based lens.

- Chapter 5 focuses on the researcher in more detail, exploring the extent to which current metrics have promoted sustainable research careers and an equitable research culture.

THE WAY FORWARD

- Shifting to a future focus, Chapter 6 explores alternative models and approaches to metrics, as well as suggestions for improvement that have emerged from grey literature and consultations.

- Chapter 7 brings together the different themes addressed in this report to present an overarching way forward for research assessment in Australia. This includes how the purposes, principles and processes of research assessment might work together with greater harmony to provide more consistent and reliable understanding of the value of research, and better recognise, assess and reward the outputs and impacts of researchers.

- Lastly, Chapter 8 provides a summation of findings and a framework for possible future actions.

The report includes an array of additional information in appendices, including details of the report and survey method (Appendix 2).

DEFINING RESEARCH ASSESSMENT

1 Context

Research plays a pivotal role in society. Through research, we gain new understandings, test theories and make discoveries, leading to the advancement of human knowledge and new ideas. Research also has a substantial impact on economic growth, helping to develop industries, attracting investments[2] and creating technological advancements. Additionally, research has a profound influence on society by shaping policy decisions, addressing societal challenges and improving the overall wellbeing of communities.

In 2021, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) quantified Australia's return to innovation, noting that every $1 of research and development (R&D) investment in Australia creates an average of $3.50 in economy-wide benefits (Figure 2). Additionally, a recent report assessing the impact of ARC-funded research found that every $1 of research funded through the National Competitive Grants Program generates $3.32 for the Australian economy.[3] The report also estimated that ARC-funded research from 2002 to 2021 will increase the economic output for Australia by $184.3 billion, increase the real income of Australians by $152.5 billion and create 6,570 jobs per year across Australia.

As research outcomes are of great interest to stakeholders, especially investors and funders, various processes have been developed to quantify and qualify the impact of research, researchers and research organisations.

In Australia, the Australian Government is the largest single investor in R&D, with approximately $13.2 billion invested in 2022–23.[4] Australian businesses, less Australian Government R&D tax incentives, combined spent nearly $16 billion in 2019–20 on R&D[5] (1.8% of gross domestic product (GDP) in 2019), which is comparatively lower than global counterparts, including the United States (3.2% GDP in 2019), Japan (3.2% GDP in 2019), Germany (3.2% GDP in 2019) and China (2.2% of GDP in 2019).[6]

This is partly due to the private sector in Australia being predominantly composed of small to medium enterprises (SMEs), which have limited need or capacity to invest in research due to business needs, time and financial constraints. As a result, most private sector research undertaken in Australia is in-house, with low levels of university–industry collaboration due to cultural and skill differences and intellectual property (IP) barriers.[7]

CSIRO has quantified the relationship between:

domestic gross expenditure on research and development (**GERD**) and

GDP per capita growth

to estimate the return on investment (**ROI**) **to innovation** for Australia.

The most conservative estimates state that:

$1 of R&D investment in Australia

creates an average of **$3.5 in economy-wide benefits** in today's dollars

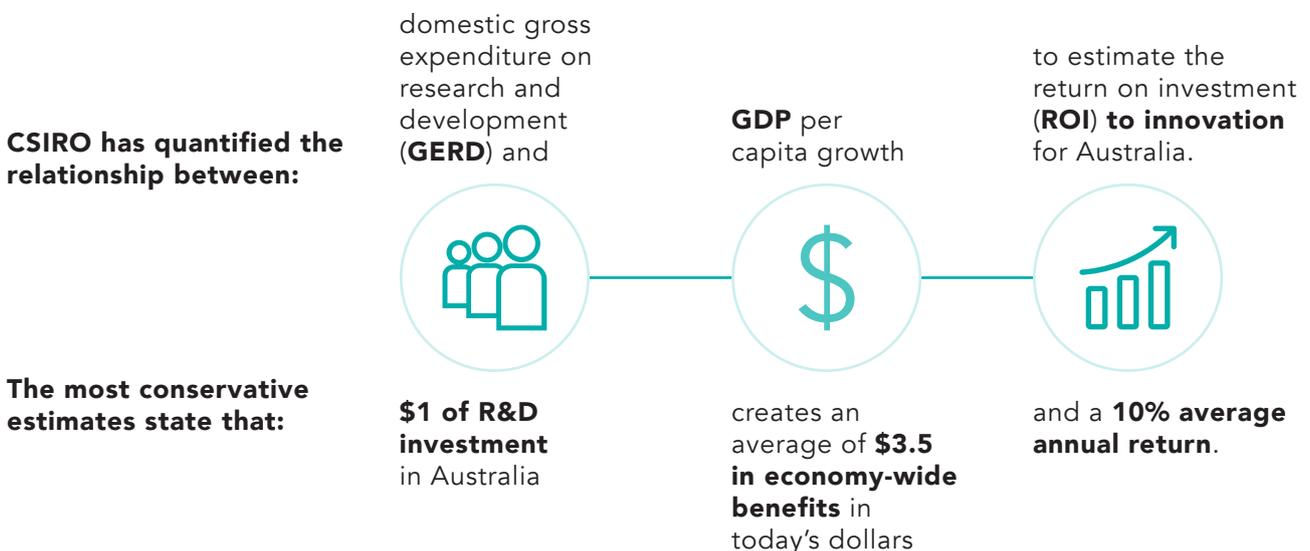and a **10% average annual return**.

Figure 2: Australia's return to innovation (Source: CSIRO[2])

It is crucial to acknowledge that researchers are employed across a range of sectors and organisations, including universities, private companies, consulting firms, medical research institutes (MRIs), hospitals, government departments and research bodies, not-for-profit organisations, and galleries, libraries, archives and museums (GLAM). It is also important to note that researchers often work in multidisciplinary teams in highly diverse settings. Employers have multifaceted goals for investing in a research workforce, including meeting consumer demands, generating new knowledge and products, contributing to societal benefits, and assessing organisational performance. Reflecting this, organisations employ a variety of metrics and proxy measures to assess the skills, talent, capabilities and outputs of researchers. These characteristics can also be evaluated at multiple levels. This contributes to the complex tapestry and challenges for practical approaches to assessment.

This project aims to provide a better understanding of how research assessment processes affect research culture and the behaviour and choices of Australian researchers across the research and innovation systems. The findings from the project, and subsequent actions taken by the research community, industry and government, will lead to better flexibility, mobility and diversity in the workforce.

1.1 Defining research assessment: understanding research excellence and impact

As noted, research assessment refers to the processes and metrics used to evaluate the performance of researchers and research institutions, including the excellence and impact of their various outputs. For purposes of this report, the following definitions are used:

- Research assessment: methods used to evaluate the nature and quality of researchers' work and skills and/or to assess research outputs.

- Research metrics: in a strict sense, 'metrics' implies the presence of a theory of measurement; however, the term research metrics has a broader use to cover defined measures of research performance or outcomes and is used in this way in this report.

- Research assessment indicators: proxy measures of research performance or outcomes.

Research metrics and assessment indicators can include standardised forms of both qualitative and quantitative measurement and reporting. This is explored in further in section 2.1.

Research assessment is an integral part of the research landscape, aiming to benefit researchers, institutions and the broader society by providing feedback and accountability on research efforts and ensure the best available individuals and teams are engaged and supported. When designed carefully and implemented thoughtfully, assessment frameworks can improve accountability, transparency, discipline diversity and excellence. They can provide governments, industry and the broader community reassurance about the quality of the research being conducted, as well as the benefits it creates for the country.

Research assessment is a vast and dynamic area involving multiple stakeholders and actors, nationally and internationally. In recent years, there has been a significant expansion of assessment systems by various organisations, driven by requirements for external evaluations of research. However, this expansion has anecdotally raised concerns about the prevalence of 'management by metrics.'

The emphasis on metrics and quantitative indicators, including but not limited to citations, journal impact factors (JIFs), number of awards, h-index, altmetrics, innovations, patents, university rankings and teaching, has led to a broader discussion in the research community, especially in academia, about a potential mismatch between what society values and what is incentivised and rewarded in and across research organisations, funding bodies and award processes. This raises questions about how to adequately capture the true values and relevance of research in assessment systems,[8] and the balance between quantitative and qualitative metrics.

Both in Australia and overseas, organisational approaches to research assessment (by both employers and funders) has been shifting towards prioritising the quality of research over the quantity, and striking a balance between output and impact.

As the landscape of research assessment evolves, it is essential to strike a balance between quantitative metrics and qualitative evaluation and reflect the multidimensional nature of research impact. By addressing these concerns and fostering a more holistic approach to research assessment, Australia can move away from a focus on quantity (for example, number of publications, citations, grants received) towards valuing research quality, excellence and impact.

In 2023, Australia's Chief Scientist released a paper called *Trust in Science*, which outlines the elements of quality science and describes the systems underpinning quality science. The paper explores the distinction between research integrity, quality, excellence and impact. The paper uses the following descriptors:[9]

- **Integrity** is behaviour based and requires adherence to the ethical principles and professional standards essential for the responsible conduct of research.

- **Quality** is process orientated and requires the best research design, the right methods, measurements, data analysis, reporting and supervision standards. This relates to the rigour of the research undertaken. Quality research is rigorous, transparent and in-principle reproducible.

- **Excellence** refers to the highest-quality research that will contribute new knowledge, complexity of thinking, new thinking, breakthroughs in understanding difficult concepts and transcendence of boundaries.

- **Impact** is focused on the benefits of research outside academia, such as economic, social and other benefits.

Quality also incorporates best practice principles for research design and publication, such as open access and data principles, that is, FAIR (Findable, Accessible, Interoperable and Reusable) and CARE (Collective benefit, Authority to control, Responsibility and Ethics).

This report focuses on excellence and impact, while recognising the importance of integrity and quality.

1.1.1 Excellence

When people talk about quality or high-quality research, they may mean different things, especially depending on the context and institution. Usually, they mean 'research excellence', which focuses on the impact and value the research has within the research field or discipline. Relying on excellence as a shared concept has been argued to be a major contributor to poor research culture and practice, and systems that focus purely on excellence do not always lead to good research.[10] This is consistent with consultations during this project, which found that a focus on excellence can mean that more 'risky' research (that is, research that is more exploratory, unpredictable and potentially groundbreaking), especially from a publishing perspective, may not be prioritised for funding and supports.

Excellence is evolving beyond citation- and bibliometric-based proxies to a more comprehensive approach that addresses processes, outputs and impacts.[11] This reflects the complexity of quality research and requires a comprehensive assessment that considers the entire research journey from start to finish. Alternative models and approaches to metrics are explored in Chapter 6 and current citation impact approaches are outlined in Appendix 3.

1.1.2 Impact

Assessing the impact of research plays a vital role in conveying its value and effectiveness. This goes beyond academic contributions and focuses on how research benefits our economy, society and environment. This is supported by frameworks developed by CSIRO[12] and the ARC, with the NHMRC further acknowledging the potential impact of research on knowledge itself, given the focus of most NHMRC research being the understanding and improvement of human health, surpassing the boundaries of academia.

The project's analysis, including consultation, revealed that international best practice suggests a combination of case studies, narratives and metrics to present the full picture of impact (see Chapter 6, and Appendices 6–8). This provides a more equitable approach for researchers to effectively illustrate the benefits of their work, inspire further research and secure funding. The assessment of impact in research is crucial to demonstrate the value of research beyond academia. It highlights the potential benefits and value that research holds for society, the economy and the environment.

Australia has developed and adopted a range of tools for assessing research, which are explored in this report's subsequent chapters and appendices. Broadly, these formal structures include:

- national government assessment tools, most notably ARC's ERA and EI

- organisational-owned frameworks, such as CSIRO's impact framework

- organisational comparative analysis, such as university rankings and league tables.

- research impact analyses, such as those developed and made available from data analytic firms Clarivate and Elsevier, which involve journal and citation metrics, but also increasingly include data on other research outputs and impacts, such as those developed by Overton, an innovative data start-up, which focuses on research impact into policy, and has data partnerships with Elsevier and BMJ.

1.2 Intended purposes of current research assessment approaches

Research assessment should serve the purpose of maximising the quality and impact of research. It employs research assessment frameworks to achieve various objectives, including:

- assessing the value, including monetary value and return on investment, for supporting specific types of knowledge generation, with a focus on the process and pursuit of research

- distinguishing the quality and usefulness of the knowledge generated, focusing on the outputs and translation of research

- providing assurance to governments and the community that the research being conducted is of high quality and the investment justified

- understanding the performance and capabilities of researchers, focusing on the individuals who produce the research

- evaluating the quality of institutions, platforms or contexts involved in facilitating research, such as universities, journals or laboratories.

Assessment methods can approach these objectives from different angles, including from the lens of the research organisation, the researcher or the research output itself. Further, laying across all the various objectives are different needs and approaches according to the nature of the research, particularly from a disciplinary perspective (for example, how to assess a creative thinker who contributes lastingly to Australia's view of itself, compared to a molecular biomedical scientist identifying a new fundamental cell process).

Research assessment outcomes often determine further investment opportunities in organisations and teams and for individual researchers. Outcomes also inform strategy development, investor confidence, quality assurance, publicity and marketing, and recruitment and promotion of students and academics. Research funders also rely on research assessment to make informed decisions regarding funding allocations. Ultimately, all research assessment approaches have some effects on the choices, behaviours, careers and opportunities of researchers.

1.3 The role of assessment in driving commercialisation and innovation

Collaboration between universities and other sectors benefits all parties, particularly in a highly competitive global landscape with rapidly evolving technology. It facilitates skill development, knowledge acquisition, knowledge transfer and entrepreneurship. Collaborations are crucial for economic development, and studies have shown that collaboration with universities increases companies' innovation capability.[13] As a result, entrepreneurial universities[i] have emerged, focusing on opportunities beyond traditional academic research, with an emphasis on driving effective university–industry interactions. Fruitful cooperation between universities and industry enhances innovation efficiency, promotes the growth of entrepreneurial universities, and drives economic development for the country.[14]

---

i 'Entrepreneurial universities' refers to the evolution of a third mission to the role of the university (the first and second missions being education and research): economic development through the transfer of research results from the laboratory to the economic system (Feola, R., Parente, R. & Cucino, V. (2021) The Entrepreneurial University: How to Develop the Entrepreneurial Orientation of Academia. Journal of the Knowledge Economy 12, 1787–1808. https://doi.org/10.1007/s13132-020-00675-9).

Commercialisation often involves research that leverages activities in industry and academia, to develop solutions that realise economic and social benefit to the Australian community. Similarly, good policy benefits collaboration between researchers and government. However, research assessment can hinder collaboration and these activities.

Universities are investing in research with social and economic impact; however, research assessment creates competing incentives for undertaking research with commercial, social or policy potential. For example, universities have a focus on generating income from teaching, with the attraction of international students linked to global rankings (Appendix 4), which prioritise indicators such as citations and JIFs. While impact of research (for example, commercialisation, policy impact) is a prominent consideration in non-academic organisations, where it is rewarded through promotion, hiring and compensation processes, it is becoming more prevalent as a consideration and receiving a greater focus in academic institutions.

Some companies are adopting innovation strategies to collaborate with universities and leverage external sources of knowledge. Simultaneously, universities have evolved from the traditional roles of teaching and pure research to include a 'third mission' focused on societal and industry needs and economic growth. This dynamic has given rise to entrepreneurial universities, which place more emphasis on opportunities beyond traditional academic research, including the commercialisation of research and exploring mechanisms to incentivise and enhance partnerships with businesses. It should be noted, however, that different disciplines have different capacities to commercialise research[15] and partner with other organisations including industry and government.[16]

1.4 External factors influencing the adoption of research metrics

External factors, such as the national research funding system, international rankings, government systems and research priorities, impact employers' decisions about their workforce, choice of metrics, and, as a result, the careers of current and prospective researchers. The priority placed on specific metrics often reflects the diversity of an organisation, its purpose and strategic objectives. However, external influences can also affect the approaches and metrics organisations use to engage and promote their research staff:

- Australia's national research funding system does not cover the full breadth of university research. Supplementary income is needed from sources such as student fees and philanthropic sources, which in turn affects university research assessment strategies (for example, pursuit of global rankings and highly cited researchers to attract students).

- Government research grant funding formulas can drive assessment behaviours – both positive (for example, ERA in the early rounds) and negative (for example, Research Block Grants focus on research income driving excessive grant applications to the ARC and NHMRC).

- Government measures of excellence and impact play a key role in determining organisational research funding allocation and pursuit, encouraging organisations to focus on tangible outcomes, and aligning research efforts with national priorities to secure funding.

- Government research priorities influence research themes and subsequent hiring decisions, as organisations and universities align themselves with the national research agenda to secure funding.

These are explored in further detail in Appendix 5.

2 Differences in research assessment across sectors

Research assessment practices vary substantially by sector, with different institutions and organisations having their own goals and structures. Assessment can involve measuring the quantity and quality of research outputs, the amount of research income generated, the number of research students supervised, and the societal impact of the research. However, there is no universal method for evaluating researchers, which leads to a wide variance in assessment practices across countries, sectors and research fields.

This chapter explores research assessment practices in: universities, government institutions, think tanks, industry, publicly funded research agencies (PFRAs) and research funding agencies. Each sector utilises distinct research assessment approaches aligned with their objectives. Universities assess researchers using metrics like research outputs, citations and funding success. These assessments shape research allocation and career advancement. PFRAs use similar research metrics to universities (for example, publications and research outputs), but also have broader metrics related to leadership, stakeholder engagement and communication skills. In other areas of government, where research assessments are used to measure the organisation's performance and inform the effectiveness of policy decisions, metrics focus on organisational fit, project management and communication skills, and policy translation. Think tanks focus on evaluating ongoing projects and related outputs. Media and ministerial uptake and their researchers' contributions to organisational goals are assessed through specific metrics such as media commentary, public influence and policy uptake. Industry employs research assessment to gauge company performance and further devise business strategies, with metrics used to assess researchers including organisational fit, stakeholder engagement and project management skills. Sections 2.2 and 2.3 outline assessment metrics used across sectors in more detail (see also Table 1).

Careers solely within one sector can also be variable. This includes researchers moving from being a sole researcher to working in teams and back, shifts or movement into another discipline, responding to the different types of institutions where a researcher works, and responding to new technologies and the different possibilities they bring.

Despite differing approaches, all sectors are shifting towards quality monitoring to continuously enhance research practices, identify areas for improvement, and maximise the impact and effectiveness of their research endeavours. This moves away from traditional metrics alone and aims to optimise the research process for success.

2.1 What are research metrics?

The terms 'measures', 'metrics' and 'indicators' are often used interchangeably, and their definitions vary across different documents and organisations. Generally, an indicator 'indicates' something, while a measure or metric specifically measures something, whether it be directly or as a (indirect) proxy.

Many organisations have frameworks, or at the least role descriptions during recruitment exercises, that identify individual performance expectations and guide and support decisions about recruitment and promotion, including for different levels of seniority. Several universities make frameworks available,[17] but this is not the case for most employers, including government-funded research agencies, nor is there an overarching national framework to guide organisations in assessing researchers.

Many annual reports of organisations provide insights into their organisational-level research performance indicators, especially those that are research focused; however, it can be difficult to measure individuals' performance directly against these.

Organisations use different forms of evidence to showcase the skills and capabilities of research staff, aligning with research and engagement criteria and often organisational strategy. This evidence, known as indicators of individual performance, plays a crucial role in determining the suitability of researchers for promotion. To support researchers in presenting their case for employment and promotion, organisations recognise the availability of diverse forms of evidence, which often align with organisational strategy and research and engagement priorities, to assess the researcher.

Indicators currently used in Australia to measure individuals' performance, identified during consultations, are presented in Figure 3. However, the value that is placed on any specific indicator, how often it is used, and the way it is assessed varies by organisation, reflecting the importance placed on aligning these to organisational objectives, for example leadership in the research field, organisational leadership, organisational goals, and impact into government, industry and society.

Research criteria

Undertaking impactful research, evidenced by meeting or exceeding aspirational output targets, high citation metrics, prizes and awards, positive reviews of books/chapters and media mentions.

Competitive research funding successes.

Journal roles: editorial and review roles.

Election to Learned Academies and other prestigious/recognised societies.

Higher degree research completions.

Achievements of PhD students: prizes, prestigious employment, and students' publications.

Research performance of early- and mid-career researchers as a result of mentoring support.

Performance of research teams: increase in research funding, media mentions, awards and prizes.

Influence on public policy, such as through authoring policy papers or providing evidence at inquiries.

Commercialisation metrics: patents, registered designs and inventions.

Engagement criteria

Participation in industry, universities, not-for-profit or government advisory groups.

Research collaborations.

High quality research grant submissions.

Invitations to present, exhibit or perform at seminars, events and live performances.

Improvements in learning and teaching outcomes, e.g., mentoring of junior colleagues and students.

Box office reports, visitor numbers, online reviews.

Quality and breadth of external relationships and networks.

Conference roles, especially plenary talks, linked to metrics e.g., conference feedback and attendance.

Individual performance indicators

Figure 3: Individual performance indicators in research-focused organisations

2.2 Evaluating the research workforce

Research-active organisations must make decisions that align with their business needs, taking into account the social, cultural and economic constraints they face. To achieve their organisational objectives and improve their overall business performance, they assess and evaluate current and future employees at selection, for promotion, through success at securing funding, and in the delivery of outputs. This allows them to make informed decisions that benefit their bottom line. Organisations that are more focused on translatable knowledge outcomes, whether developing products, policies, exhibitions or displays, utilise metrics that are more closely focused on the degree of success of research translation, rather than measuring the research activity as a product in its own right. This is most starkly visible when organisations are focused on prototype systems towards a commercial outcome, or for humanities, arts and social sciences (HASS) researchers, focused on human use outcomes (for example, policy, practice, human useability of products).

Research intensive organisations consider broader evaluation practices. According to the organisational survey conducted for this project, publication and grant funding metrics were used by the majority of research-focused organisations (including 21 university respondents and all 10 MRIs), while fewer than half of organisations collected researcher-articulated metrics, which are more common in the humanities and arts disciplines.

With respect to the relative importance of these traditional research metrics, academic publications were most important to almost half of organisations (primarily universities and MRIs), followed by research impact, grant funding, research commercialisation and external engagement. Metrics related to research collaboration, training, leadership, awards and research service were secondary considerations for all organisational respondents.

Researchers in creative disciplines often produce non-traditional research outputs (NTROs), such as creative works, public exhibitions and live performances, in addition to traditional scholarly publications like journal articles and books. Non-traditional research metrics can include invitations to curate exhibitions, requests to provide input into policy, invitations to speak, exhibit or perform, reviews online and in print, media mentions, box office reports and visitor numbers. Research assessment involving Indigenous Knowledge covers both traditional and non-traditional research outputs. However, researchers in this area often faces significant barriers, including limitations in publishing in scholarly journals and complexities with IP, which can impact their ability to align with research assessment metrics associated with publication and citation outputs. This is explored in further detail in section 5.4.

In striving to achieve organisational objectives, researchers may encounter numerous challenges (discussed further in Chapter 5). Individuals may also adopt strategies to optimise or manipulate assessment outcomes in their favour, inadvertently affecting research culture. For instance, at one university, a success indicator is defined as having research outputs 1.2–1.5 times higher in volume than the disciplinary average set by the ARC. This can result in senior researchers pressuring junior colleagues to be included as authors on papers to meet volume targets. Such expectations can have considerable implications for employees' health and wellbeing.

2.3 Variation by sector

The following section presents in more detail the assessment metrics used across Australia's research ecosystem. As reflected in Table 2, sectors evaluate and tailor their research and metrics to their needs.

Different organisations place different weight on each area of impact and category of activity. Equally, what success looks like varies by job level. The demonstration of outcome is especially important at more senior levels, such as Associate Professor and Professor in the academic context.

For junior staff, the outcomes or impact of an activity can be understandably less substantial when compared to senior staff. Several universities publish these frameworks, showing, with varying levels of specificity, the nature of indicators relevant at each career level, such as research output, citation index, awards, mentoring, creative works, public presentations and leadership in research projects.

Table 2: Research assessment metrics across sectors

Organisation type	Key objectives of research activity	Primary organisational impact assessment related to research (that is, KPIs)	Indicators and capabilities sought from researchers									
			Organisation fit	Stakeholder engagement	Commercial translation	Project management	Communication skills	Policy translation	Academic publications	Grant record and awards	Supervision (quantity)	Subject matter knowledge
Industry	• Commercial value	• Return on investment • Customer satisfaction	P	P	P	P	P				S	P
Government departments and agencies	• Support design and delivery of government policy	• Ministerial satisfaction • Public policy outcomes	P			P	P	P				P
Think tanks and not-for-profit organisations	• Translatable knowledge • Support and influence public policy	• Public influence • Policy uptake • Media commentary	P	P		P	P	P	S		S	P
Government research-intensive agencies, for example, CSIRO, ANSTO	• Translatable knowledge	• Impact frameworks • External engagement • Publication metrics	P	P	P	S	S	S	S	S	S	P
MRIs	• Health outcomes • International standing	• Grant success • Clinical outcomes • Publication metrics	P	P					S	P	P	P
Non-research-intensive universities	• Disciplinary specialisation • Applied outcomes	• Publication metrics • Grant success • Impact case studies	S	S				P	P	P	P	P
Research-intensive universities	• International and national standing • Applied outcomes	• Global ranking • Publication metrics • Grant success • Impact case studies	S	S				P	P	P	P	P

P Primary Indicator   S Secondary Indicator

When discussing research assessment indicators used in industry, stakeholders also mentioned various types of metrics, such as impact assessment, collaboration and multidisciplinary work, startup and entrepreneurship involvement, industry partnerships, patent-based metrics, metrics specific to different disciplines, metrics based on end-user impact, causality and attribution, and commercialisation metrics. Externalities related to organisational performance indicators, such as the quality of research facilities, goals set by the industry, assessment of societal and commercial impact, and effective communication between academia and industry, contribute significantly to the achievement of research employees.

'What is assessed and how it is assessed are an indication of what the organisation values. You only assess what you care about. Values and culture drive assessment.'

Interview respondent

Think tanks and not-for-profit policy institutes value credible and rigorous academic research but are primarily focused on translatable policy knowledge, understanding of the current policy landscape, impact and engagement of outputs, and addressing challenges to drive progress in policy. With a focus on influencing policymakers, researchers are seeking ways to directly impact decisions and actively seek feedback. Think tanks use various metrics to measure the impact of their research, such as the number of reports published, downloads, media mentions and citations in official documents, and engagement with politicians. For example, at one prominent think tank, effective communication is crucial in their form of applied research and therefore media potential is considered from the initial stages of project planning, especially as journalists prefer experts who can provide reliable and concise information, and is incorporated into an employee's metrics. Universities, on the other hand, usually prioritise academic journals and completing research reports over media-based impact metrics.

Some think tanks have established grant programs to fund academics to work on relevant policy topics. Grant recipients are selected based on the proposed research method and approach. Anecdotally, we understand that assessment is based on the quality of the proposal alone, rather than solely on traditional academic criteria or metrics as indicators of quality. This reflects an organisational focus on engaging with the policy community and stakeholders and showcasing collaboration rather than focusing on publishing in high-profile journals.

While recognising the value of research, government agencies, except those that are research-intensive, focus on the demonstration of domain expertise, project management and stakeholder management. Evaluation of these capabilities is usually more important than academic credentials, and in some circumstances anecdotal feedback suggests that too much academic experience or an inability to communicate the relevance of this to the employer (especially in curriculum vitaes (CVs) and selection criteria responses) is seen as a negative in recruitment processes.

Research-intensive government agencies, often known as PFRAs, which include organisations such as CSIRO, the Australian Institute of Marine Science and the Australian Nuclear Science and Technology Organisation (ANSTO), often take a mixed approach to assessment, reflecting their role in seeking to bridge the gap between academia, industry and government, and tackle much larger problems, such as challenge/mission-based research, in areas like climate change. Given government reporting requirements, such as under the *Public Governance, Performance and Accountability Act 2013* and Senate Estimates, these bodies typically need to be more transparent in their framework and assessment approaches than academic institutions. Relatively few researchers from PFRAs and government agencies responded to the researcher survey in comparison to university researchers. However, of the respondents, there were no significant differences in the perception of the value of research assessment between these researchers and those in universities, despite the relatively lower importance of research metrics in determining their career opportunities and career progression in these organisations.

CSIRO is increasingly placing greater emphasis on skills and competencies such as leadership, agility and interdisciplinary skills. In their recent recruitment of 200 early and mid-career researchers (EMCRs)[ii], CSIRO shifted its focus to prioritise diversity of thinking and agility rather than solely technical and academic competencies.

CSIRO currently applies recruitment strategies that have increased the deviation from traditional academic-style assessment methods. These include the Science Leaders Program and the 'Impossible without you' campaign. Researchers in the Science Leaders Program collaborate with researchers across the innovation system and can bridge the gap between research commercialisation and fundamental science. However, finding individuals with strong leadership skills can still be challenging, and while these new practices have been successful, some researchers indicate hesitancy in joining CSIRO due to its industry focus and thus potential in limiting a return to academia.

In the arts, measuring program impact has become increasingly important, focusing on social impacts beyond ticket sales. Unlike academic research, government research does not prioritise metrics when evaluating individual researchers. An organisation in the arts sector provided feedback that it values relevant skills over publications and academic visibility when hiring research program managers.

The focus of assessment and recruitment processes is on understanding program impact and recognising transferable skills. The organisation also aims to help artists understand their value outside the art industry. While most arts awards prioritise aesthetics, one respondent also considered social impacts in their awards. Winners are determined through a peer panel judging process, with nominees addressing assessment criteria for funding. Three main criteria are utilised, including assessment of artistic and cultural activities, viability and outcome.[18] Funding is allocated through peer assessment, using a scoring system to consider different categories, including aesthetic contribution.

---

ii An EMCR is an individual who actively engages in research, either as a researcher or in a role that substantially supports the delivery of research and that requires substantial research training and experience. It includes researchers in academia, industry, government, public, commercial and not-for-profit sectors. For the purposes of the report and data collection, we have defined an EMCR as someone between 0 and 15 years (0 and 5 years for early career; 5 and 15 years for mid-career) of graduating from a PhD or equivalent (discounting career interruptions).

THE NATURE AND IMPACTS OF ASSESSMENT ON RESEARCHERS AND AUSTRALIA'S RESEARCH SYSTEM

3 Current state of research metrics in Australia

Australian organisations use a range of approaches for assessment of research and researchers for different purposes. Some of this assessment takes place in the context of consistent national frameworks (for example, the ARC ERA assessment processes), or at scale at organisational level (for example, CSIRO's impact framework), but much is not specific to organisation business units, disciplines or even individuals.

This section outlines the strengths and challenges within Australia's research assessment system to foster research careers, which include the ways the system considers knowledge creation, innovation and excellence. Research assessment can enable institutional change, including improving research management and output and attractiveness to industry partnerships. However, the reliance on particular indicators and metrics can have unintended consequences and impact on researchers' career paths and research focus. Research assessment practices may also distort research-related activities, fostering competition and reducing academic autonomy. Stakeholders argued that rigid assessment can be limiting and that linking assessment with funding allocation might negatively impact the scholarly process.

The evidence in this report provides new insights into the personal challenges and perceptions of researchers across the sector, and into the ways research assessment systems are affecting Australian researchers, influencing both their research outputs and career prospects. Details about research method can be found in Appendix 2.

3.1 Strengths of Australia's research assessment system

The research conducted and data collected in the development of this report indicate that the research community in Australia values the crucial role research assessment plays in evaluating research excellence and impact and ensuring a skilled research workforce. It also reveals a general view that the research community would like Australia's research assessment metrics to be more closely aligned with global standards. However, action and cultural change towards this goal is not happening.

Various stakeholders identified positive elements of Australia's research assessment system, including fostering equitable career opportunities (Research Opportunity and Performance Evidence), enabling an understanding of overall performance and progress in all disciplinary areas (ERA), shifting assessment from research quantity to quality, and recognition of alternative measures of impact, such as considering the impact of grey literature (for example, government reports, unpublished work, think take reports)or policy-oriented publications for those who publish outside academia.

'Metrics are necessary and cannot be avoided but should not be the endpoint of the conversation. While rankings are important, they are not the only factor that universities consider when recruiting.'
Interview respondent

Researchers responding to the survey expressed a range of positive views on different research assessment practices within their organisations, based on their experiences. A summary of these is presented in Table 3.

Overall, respondents felt that Australia's research assessment and related metrics have generally facilitated the visibility and recognition of high-quality research. However, criticisms emerge at each layer, often targeting the fact that equity and opportunity interventions do not go far enough.

Table 3: Positive views on research assessment practices

Categories	Researchers' experiences
Framework for research assessment	• Aids evaluation of research quality, impact and productivity. • Considers various factors such as career stage, discipline and output types. • Promotes transparency, accountability and a level playing field for researchers.
Flexible assessment criteria	• Allows researchers to craft their own narratives and focus on their quality and impact. • Considers NTROs and discipline-specific differences. • Encourages collaboration and interdisciplinary approaches.
Supportive environments and opportunities	• Provides supportive environments, mentoring and opportunities for professional development. • Helps researchers achieve their goals and improve their performance.
Benchmarking and recognition	• Helps identify areas for improvement and provides benchmarks for performance. • Recognises excellence in research, leading to promotion and career advancement. • Fosters a strong research culture within institutions.
Focus on real-world impact	• Increases recognition of NTROs. • Emphasises research translation and engagement with stakeholders.
Fair and inclusive assessment	• Considers career breaks, discipline-specific expectations and NTROs. • Encourages collaboration and mentoring to support early career researchers. • Aims to provide a fair and transparent evaluation of research output.
Incentives for career progression	• Leads to recognition, promotion and funding opportunities. • Incentivises researchers to strive for excellence (for example, recognition of diversity, independence and/or academic rigour) and maintain a consistent research focus.
Emphasis on research impact and engagement	• Focuses on research impact, translation and engagement with industry and community. • Recognises the importance of applied research and non-commercial aspects of research translation.
Flexibility and improvement	• Values flexibility and adaptability in research assessment practices. • Makes efforts to continuously improve practices, particularly during challenging times.

3.2 Challenges in Australia's research assessment system

The project identified several challenges with current practices, and project stakeholders indicated a high level of dissatisfaction with the current state of research assessment in the university sector (Box 1). However, it should be noted that the majority of individual survey participants were academics in and, based on role descriptions, likely to be relatively more secure employment, so the results cannot be taken as a representative view of industry or public sector researchers, or those in less well-represented or secure components of the academic research workforce, such as EMCRs. Broadly, the issues identified were:

- the role of senior staff in shaping research culture, often resulting in self-preservation, reinforcing biases or fostering of antiquated expectations or quality

- indicators and metrics that do not match the reality or context of work and environments, or general awareness of better indicators and measures

- the impact of non-research responsibilities, such as carer responsibilities and supporting underrepresented research communities, can affect the relative capacity to undertake research at similar volumes or speed as other researchers

- the opacity in rewards and recognitions

- acquired and translatable skills between sectors/employers, impacting mobility and management of IP, especially related to Indigenous Knowledge

- a lack of a voice and agency in shaping research assessment practices.

Chapters 4 and 5 unpack these messages, analysing the experience and insights of organisations and individual researchers, respectively. Subsequently, Chapter 6 explores potential alternative approaches identified by the research community that could inform future directions for Australia.

Box 1: Challenges in Australia's research assessment practices revealed through the individual survey

- Assessment processes are not consistently or equitably applied across different disciplines, with particular perceived differences between HASS and STEM fields (73% respondents).

- There is a lack of opportunity to provide input into research assessment practices (67% of respondents).

- Assessment processes do not accurately capture research quality (62% of the respondents).

- Assessment processes do not adequately consider the availability of resources, for example funding, support for publication costs and infrastructure (58% of respondents).

- Assessment processes require unreasonable time and effort (70% of respondents).

- Assessment practices hinder researchers' ability to transition between different parts of the research sector (67% respondents). However, in the organisational survey equal proportions of respondents (about 30% each) indicated that assessment processes help and hinder researcher mobility.

- There is dissatisfaction with the adaptability of assessment to the changing needs of the research community (66% respondents).

Senior staff and supervisors are reinforcing the culture of 'publish or perish', even with processes by funders actively encouraging a shift in focus from volume towards quality (most roundtables).

3.3 Reflections on the system

There are compelling reasons to use research assessment systems as a means of fostering new knowledge creation and innovation. Research assessment systems should enable different sectors to identify and support the best institutions, researchers and research for their specific needs using the available resources, including people and funding. They also should foster and encourage good research culture, enabling as far as possible those with good ideas to have equal opportunity to succeed and thus have sustainable research careers.

'Metrics are essential for defining value and comparative difference, but Australia requires a modern and fair framework for assessing our current and next generation of researchers.'
Interview respondent

University rankings have long been debated. Interview respondents explained that universities with favourable positions in international rankings are receiving significant benefits in the attraction of international students (the fees from whom subsidise research activity) and are sought-after partners for companies. Students and companies value universities with robust scientific and research activity to enable their own success. This, in part, drives universities to invest in research and researchers that will increase their international rankings.

Researchers who value metrics as a way of demonstrating tangible and quantifiable impact and value, and others for whom metrics have negatively impacted their careers, have moved away from research or been 'forced' to focus on particular outputs for career advancement, to the detriment of new discoveries.

Many new and emerging approaches to assessment being explored by organisations indicate a clear shift in focus towards prioritising the assessment of outcomes and impacts over 'simple' output measures (such as research funding and publications). In many cases, we found these that impact-focused approaches are drawing on sophisticated national and international frameworks (see Chapter 6 for more information). New data-driven approaches are also being developed that enhance our understanding of research engagement and reach. These approaches are also utilised for predictive assessment, enabling the identification of individual researchers with high potential to succeed. Finally, we heard that several organisations are broadening the scope of what is being assessed to include assessment of environmental impact of research and alignment with the United Nations Sustainable Development Goals and organisational Reconciliation Action Plans.

Australia has made good progress and has pockets of excellence in research assessment; however, there are clear opportunities to improve the system. Any future changes will be an evolution rather than a revolution. All stakeholders have a role in developing and implementing a coordinated modern research assessment system. Governments, including the federal government, have limited direct policy levers to shape how workplaces undertake employee performance assessments and workforce culture in general. However, national systems that assess organisational excellence and impact can have trickle-down effects (both positive and negative) on institutional behaviours. Care must be taken when modifying Australia's system of assessment to prevent unintended consequences for Australian researchers. Due consideration will also be needed on the complexities of interactions in and across the research system, domestically and internationally.

4 Consequences at the system level

Research assessment is necessary to evaluate and monitor the performance of researchers and research teams and to gauge the effectiveness of research strategy and investments. However, where the outcomes of research assessment have material impacts on researchers' careers (for example, hiring, prestige, funding or promotion), or on the funding or standing of their employers, the act of assessment itself has significant and wide-ranging impacts on researcher and organisational decision-making and behaviour.

In many cases, these effects can be positive: for example, benchmarking, goal setting and normative effects on practice, and culture. However, research assessment has also introduced significant biases and perverse incentives into the system that distort research outputs and activities and impact negatively on researchers' wellbeing and careers. For example, research assessment can foster intense competition among researchers for standing, reduce academic autonomy and influence academic judgements about research achievement.

There has been a decades-long shift towards bibliometric assessment of research outputs in the global academic community. While there is some merit in this approach, it has also led to a complex and international pattern of dependence across universities, research publishers, research funders and global ranking agencies that has had an outsized impact on the type and nature of research that is undertaken in universities. For example, bibliometric assessment of research prioritises journal articles over other types of output, creating a bias against interdisciplinary work[19] and research in many humanities and social science fields.[20][21][22]

Research commercialisation is becoming increasingly important in the academic research sector,[23] and there is also a growing emphasis on research engagement and impact, and on research culture and inclusion.[24,25] The emphasis on publication as an endpoint of the assessment, and the impact of such assessment on university researchers and their employers creates barriers to a more integrated assessment of research translation and commercialisation, where research publication is an input to the knowledge and innovation system.

This chapter examines the impact of the current research assessment system on Australia's ability to produce quality research. It explores how the focus on quantity rather than quality has reduced the creation of new knowledge and diminished recognition of the importance and impact of fundamental research, which is often only seen later and outside of many metrics windows.[26] It also explores the challenges faced by interdisciplinary research, the difficulties of sharing knowledge across different sectors, and how research assessment systems can limit the variety of knowledge being created, and even lead to researchers trying to game the system to improve their performance. By delving into these topics, this chapter aims to provide insights into how research assessment impacts Australia's research system.

4.1 Impacts on the scope and nature of research activity

One consequence of Australia's research assessment processes reported by many of those involved in the consultations was the discrepancy of values assigned to different kinds of research activity. Examples include prioritisation of incremental, disciplinary-focused and easily publishable research over multidisciplinary and more exploratory research in universities; prioritisation of internal research with immediate commercial value in businesses over longer-term experimental or exploratory projects undertaken in partnership with academics; and prioritisation of a cycle of research grants and publications over external engagement and collaboration with stakeholder groups in universities and MRIs.

Collectively, these impacts serve to limit the scope of research undertaken within Australia's research ecosystem, in turn limiting innovation and collaboration, and presenting barriers to the translation of knowledge into new products, policies and programs.

4.1.1 Output at the expense of excellence and impact

Consultations with stakeholders suggest that Australia incentivises fast research rather than slower but potentially more impactful research. EMCRs highlighted that current metrics encourage and focus on rapid results and outputs instead of longer-term or interdisciplinary work or outputs that may require a greater amount of time.

This prioritisation of rapid and measurable research has many consequences, including reducing the capacity for careful design and analysis (a general prerequisite for excellent research) and reducing the propensity of researchers to spend time and effort engaging with stakeholder groups before and after publication for purposes of enhancing impact. A focus on research outputs can also perpetuate a problematic culture in academia.

There are mixed signals in the system due to the complexity of employers' needs and desires. In the consultation for this project, respondents often noted that assessment processes that prioritise research outputs favour research-only academics over those in teaching and research, or service roles, and over academics who do not follow traditional research pathways. The current approach to research assessment in Australia does not incentivise knowledge translation, interdisciplinary research or risky research, particularly for early career researchers.

4.1.2 Lack of recognition for 'new' or 'good' ideas

There was concern from respondents that Australia's research assessment system does not allow for adequate recognition of new ideas; just one-third (33%) of respondents believed that current assessment practices encourage innovative research.

Journal-based metrics and rankings can also be a cause of concern for researchers working on Australian-focused subject matter. This is because many smaller country-based journals of the type that are critical for the publication of much Australian and Indigenous studies research are not included in journal ranking lists and therefore carry less weight in aggregated assessment processes such as ERA or global university rankings. This particularly impacts researchers working in HASS disciplines focusing on local research. While such research is of high impact and importance for Australia (for example, research on the Murray–Darling Basin, the ecology of the Pilbara), it often has limited interest outside Australia, making it difficult for research in this area to be recognised and published in high impact journals. This impacts the career choices and opportunities for researchers in these areas.

Consultations with government agencies and PFRAs revealed that researchers generally face pressure to focus on established research areas to increase their publication count. They also indicated a need to celebrate success outside of academic publications.

This was echoed by EMCRs, who called for a change in research assessment to place more emphasis on innovative thinking and good ideas rather than solely relying on track records. Consultations indicated that journal impact assessments and grant funding play a crucial role in academic careers but often fail to foster innovation; current metrics also discourage EMCRs from exploring unconventional ideas. In addition, EMCRs raised concerns about the influence of research assessment on research culture and on funding outcomes. Both factors are contributors to mental health issues among researchers and among the key reasons reported by survey respondents for considering leaving the profession.

Besides the problems mentioned above, lack of funding also hinders Australia's potential to pursue new knowledge creation and innovative ideas. The latest release of ABS statistics on gross expenditure on research and development (GERD)[iii] shows that while GERD has increased by 8% over the past two years, it continues to decline as a proportion of GDP.[27] Additionally, a recent study has revealed that Australia is falling behind in funding fundamental research, particularly in fields like medicine, biotechnology and pharmaceuticals.[28] This has resulted in Australia's ranking on the Global Innovation Index (GII)[29] dropping consistently over the past five years – 25th place in 2022, down from 23rd in 2020, 22nd in 2019 and 20th in 2018. One inference from this is that a lack of funding, especially for fundamental research, is contributing to this decline.

While other countries are increasing their investment in R&D, Australia's R&D investment as a percentage of GDP has been decreasing for the past 15 years. The competition for funding is relevant because it skews focus towards 'safe' research over new and innovative ideas. This, in turn, has negative implications for the research community, as it affects researchers' ability to establish important knowledge, attract foreign investment, support local businesses, and ensure long-term innovation and progress in Australian research. Recognising this issue, consultation with government agencies highlighted the importance of national organisations creating supportive environments for scientists to take risks and explore new research areas.

Many respondents raised concerns about the apparent inability of Australia's research assessment system to appropriately recognise and support new and innovative ideas. Pressure to publish – particularly with high-ranking international journals, prestige book presses or influential conference proceedings – and to do so through established areas of inquiry further compounds this problem. The narrow focus of prioritised research assessment metrics and the decline in fundamental research funding negatively impact the research community's ability to generate new knowledge and foster innovation over the long term. To address these challenges, it is essential for government and research agencies to create supportive environments that encourage risk taking and the exploration of new research areas. Chapters 6–8 will delve further into potential suggestions to improve the current situation.

iii GERD represents the total expenditure devoted to R&D by the business, government, higher education and private non-profit sectors.

4.1.3 Lack of reward for interdisciplinarity

Information collected through consultations and surveys conveys concerns about the ability of assessment processes to appropriately recognise and incentivise interdisciplinary research. Measuring the contributions of multidisciplinary research poses particular difficulties for traditional metrics focused on citations or peer review from specific disciplinary silos where there may be limited understanding of the diverse literatures, approaches and outputs being sought. Some respondents noted that interdisciplinary research outputs in an academic context sometimes resulted in 'weak' impact, as the outputs were often judged at the discipline level, where, conversely, they were valued more highly in an industry context. The value placed on publication output does not support interdisciplinary efforts because researchers often face longer publishing timelines, are part of larger teams, and need to decide which disciplinary metrics they are measured by.

Further, respondents reported that internal university recruitment activities are often discipline-specific, which can negatively impact multi- and interdisciplinary candidates who do not fit the mould.

Interdisciplinary research can often have real-world impact, and indeed most of our current challenges (for example, energy, climate change) require an interdisciplinary approach. However, current academic metrics poorly measure interdisciplinarity and it can therefore be a disincentive to pursue such research in an academic context. When the payoffs for combining knowledge across disciplines are too small, and the efforts too high risk or costly, this detracts from Australia's ability to solve complex problems. It should be noted that outside of academia, interdisciplinary skills are sought after in research roles in other sectors.

Assessment metrics can influence the research career choices, including collaborative behaviour, of researchers. Survey respondents reported that while interdisciplinary research develops people with broader skills and improves mobility across sectors, it is strongly disincentivised through metrics that don't reward such researchers in promotion and funding decisions. Through consultation, both the opportunities and barriers to collaborative research outputs were raised. This experience was encountered not only by researchers within specific disciplines but also by those involved in interdisciplinary and cross-sector collaborations. On the one hand, collaboration was seen as a positive to a researcher's career outputs and, thus, career trajectory through increased publication output. On the other hand, in some disciplines, collaborative outputs were not assessed equally to other outputs, particularly first-author publications or publications from smaller groups, and could hinder a researcher's career trajectory as promotion committees would often overlook collaborative papers due to difficulties in proving individual contributions.

4.2 Limited knowledge sharing between sectors

As discussed previously, the needs of researchers in academia, industry and PFRAs vary, and different types of research organisations prioritise different skills and competencies in their staff, aligned to their different organisational needs. Universities value researchers with a strong track record of academic publication, research supervision, grant or philanthropic revenue generation, and – increasingly – external engagement and networks, whereas governments, not-for-profits and private sector organisations tend to value the ability to work effectively in teams and to deliver on organisational objectives. However, there are stark differences in how researchers are assessed in these areas.

From the desktop research undertaken for this report, there appears to be a lack of academic literature on whether and how research assessment impacts career mobility and subsequent knowledge exchange, particularly in the Australian context. While the link to research assessment has not yet been adequately examined, some countries measure intersectoral mobilities through surveys, labour force statistics and patent data.[30] There is also a growing theoretical rationale for the analysis of CVs as a part of research assessment.[31] These have been posited to be particularly helpful in appraising career trajectories, mobility and the mapping of collective ability.

In terms of publication recognition, significant research occurs outside of academia (for example, government, industry and think tank reports). However, these publications often cannot or do not recognise the contributions of researchers involved in their development, nor are they considered a publication output by academia in hiring processes. Better defining what a researcher is across organisations and sectors could help to recognise the contributions of non-academic researchers and overcome the problem that many organisations outside of academia do not consider themselves to have researchers or to undertake research. Enabling researchers involved in non-academic research work, such as reports and policy papers, to be listed as an author or contributor would provide them a mechanism to demonstrate their research and publication contributions and impact, especially to future academic employers and into potential data collection tools. A potential tool to track such outputs across institutions is the utilisation of Open Researcher and Contributor ID (ORCID), which is a free and unique persistent identifier that enables individuals to engage in research, scholarship and innovation activities.[32]

Finally, government respondents noted that academic metrics and the nature of academic CVs are not well understood or appreciated in government. Despite the need for research skills in government, work is needed for government departments to better understand how to apply academic metrics to their hiring needs, as well as to equip academics to better communicate their skills and capabilities when applying for government roles.

Anecdotal data from interviews suggests that more needs to be done to bridge the gap between research and innovation and research and policy, particularly in relation to strategies aimed at transforming research findings into practical applications. Analysis of the consultation data suggested there would be benefits in improving shared terminology and creating opportunities for granularity that can be adapted to different purposes and sector needs.

This highlights the need to better align research systems across sectors to generate a shared understanding of research, the value of research and assessment practices.

4.3 Limited diversity in knowledge creation

A third system-level flaw with Australia's research assessment system is that it is unclear if due consideration is being given to promoting the 'best' researchers – especially when metrics support the 'traditional' and legacy profile of a researcher, who is typically a white and cisgender male.

Respondents reported that reliance on traditional metrics did not adequately account for external contextual elements such as caring responsibilities, health issues and cultural integration challenges, leading to barriers for underrepresented and diverse groups. The system's historical preference for systemically privileged individuals tends to continue to perpetuate structural inequalities.

Additionally, researchers suggested that mobility as a factor for promotions and better pay creates bias and challenges for individuals who are unable to move due to caring responsibilities or safety reasons, disproportionately impacting women and marginalised groups and creating inequities in career progression. While industry actively seeks diversity, the lack of diverse talent flowing through the academic channel limits the pool of candidates for industry positions, including individuals with disabilities and from Indigenous communities.

Consultations with academia revealed a perception that assessment processes can lead to female researchers being pigeonholed into administrative functions and roles, regardless of their research attainment, due to inherent societal biases. Respondents also suggested that a lack of female role models can contribute to younger women leaving academia because they perceive the system as being disadvantageous. Conversely, consultation with industry stakeholders revealed that research culture is seen to be more welcoming towards women, particularly in larger companies, because there is greater visibility of unconscious bias and little-to-zero tolerance of bullying and harassment. Although most organisations have appropriate policies in place, consultation suggests there is variability in terms of whether the practices are perceived to match the policies.

The lack of demographic and institutional diversity in Australia's research ecosystem perpetuates equity challenges and limits Australia's ability to integrate diverse perspectives into knowledge creation, constraining the ability to comprehensively address social needs.

4.4 Gaming and optimising performance in research assessment systems

Assessment systems inherently incentivise participants to focus on what's being measured. Where those measurements have material consequences (for example, impacts on promotion, funding or reputation in competitive environments), they encourage prioritisation of activities and reporting in such a way as to optimise performance on assessment measures.

When assessment systems become multi-faceted and complex, reporting becomes a sophisticated skill, requiring significant levels of experience, time and resource investment to achieve the strongest assessment outcomes. In such circumstances, participants with greater resources are more likely to have the capacity to invest in optimisation of assessment: 'out-optimising' those with less experience, time or resources to prepare for and participate in the process.

Seventy per cent of survey respondents (mostly senior university academics) indicated that the amount of time researchers were required to spend in research assessment processes was unreasonable.

Incentives associated with complex research assessment processes can drive undesirable behaviours – 'gaming' in ways that seek to take advantage of loopholes or subvert the intention of the assessment framework, or in some cases outright misconduct such as deliberate misattribution of research outcomes or fabrication of information.

Importantly, the consultations for this review did not reveal any direct evidence of misconduct in the context of research assessment processes. However, anecdotal evidence from participants in roundtable discussions, interviews, and the individual researcher survey reported knowledge or experience of malpractice occurring to various degrees in Australian research organisations.

These results imply that optimisation and 'gaming' will always be a feature of research assessment processes with material consequences for participants. Consultation and survey findings indicate a strong desire for assessment processes to incorporate independence, transparency, open discussion, regular review, equity and accountability, to reduce the impact of negative behaviours and enhance the integrity and validity of assessments for their intended purpose.

5 Consequences at the researcher level

The success and effectiveness of individual researchers and research teams are influenced by multiple factors including talent and ability, funding, the broader research environment, workplace culture, 'luck', and support to continue research following career interruptions. In general, the effects of research assessment on individual researchers can be sustained and substantial.

There is much to suggest that research assessment exercises, especially at the institutional level, directly affect the research choices and behaviours of academics, particularly when funding is linked to assessment outcomes. McCulloch (2017) outlines some of these:

> McCulloch discovered a strong correlation between academics' career advancement and their university's performance on the UK's Research Excellence Framework (REF). During probationary periods, new lecturers are expected to publish specific numbers of papers, meeting a particular 'REF-able' quality standard. Researchers are also urged to publish in journals outside their primary disciplinary area as this can improve assessment outcomes. Citation metrics, a critical component of REF assessments, can significantly influence academic practices for early-career researchers.[33]

This chapter explores the impact of the research assessment system on the career progression and mobility of individual researchers by uncovering challenges and presenting the need for sustainable research careers. To promote equity, diversity and fairness, it is important to value a wider range of research outputs, experiences and knowledge, and provide more opportunities for underrepresented groups.

The chapter also explores the effect of research assessment practices on workforce diversity and inclusion. It highlights the obstacles researchers face when transitioning between academia, government and industry, and emphasises the significance of protecting intellectual property, particularly for Indigenous Knowledge. It also calls for acknowledging Indigenous cultural governance and authority to preserve and share their knowledge.

The chapter underscores the need for systemic changes within the research assessment system to enhance career progression, promote diversity and inclusion, facilitate workforce mobility, and protect Indigenous Knowledge.

5.1 Metrics revealed a different reality for researchers

Researchers interviewed for this report were concerned about how they were judged by metrics across different career stages and disciplines.

Interview and survey respondents acknowledged that a significant level of work is needed early in a research career to establish and build an adequate base of research outputs. Faced with limited time and resources, EMCRs felt they must choose 'which' metrics and indicators (formal and informal) should guide their efforts and priorities. In this context, EMCRs often do not have a track record to fall back on (such as grant funding or publication output) and may not have the networks to be connected into large collaborative groups or institutions. This means they tend to focus on metrics that are aligned with career promotion and job opportunities (for example, swaying their focus to quantity of publications and presentations and attendance at conferences).

Often contrary to advice from supervisors, respondents noted that securing their next research role, seeking promotion, capability building and networking may be more important for career sustainability than publications. Fifty-eight per cent of respondents acknowledged that current assessment processes did not adequately consider the availability of necessary resources, such as research funding, infrastructure and publication costs. Other specific factors uncovered by the data are outlined in Box 2.

Box 2: Concerns and consequences of research assessment practices

The main concerns highlighted through consultation on research assessment processes were as follows:

- **Accuracy issues**: HASS respondents noted that metrics in their fields are often not very accurate or reflective of effort. Instead, researchers suggested opportunities to justify small publication numbers and contextualise their choices to publish in books or book chapters instead of journal articles.

- **Grant applications and career progression:** Researchers may choose not to apply for grants from organisations like the ARC because they perceive there are more funding opportunities in the demand-driven space. Their decisions on where to apply often consider the return-on-investment in terms of time spent on applications, rather than solely considering how well the funding source aligns with their research.

- **Team size and collaborations:** These have an impact on metrics and success in various applications. Large teams with extensive networks tend to produce more papers, while small teams may have fewer despite their strengths. Institutes or organisations play a role through their varying opportunities for early career researchers to be involved in diverse projects, leading to a migration pattern where researchers join successful teams, or potentially reinforcing nepotism. Similarly, the precedent and expectation for collaboration on projects can be challenging in fields with bespoke conventions for author lists , making it hard to assess individual contributions and impacting promotion decisions.

- **Metrics complexities:** PhD students and postdocs joining new groups face increased complexity in utilising metrics to demonstrate their potential. Some groups prioritise individual contributions over team success, which can hinder the recognition of early career researchers' contributions to publications or grant outcomes. In larger groups, early postdocs are often expected to produce work that benefits the larger team, at a cost to their own capacity for advancement. Mentorship and quality supervision are crucial but not universally accessible, creating disadvantages for those without supportive mentors and guaranteed publications from their PhD. The environment and team surrounding a PhD journey significantly impacts progress, sometimes necessitating a move if the dynamics are not conducive.

- **Luck factor:** Numerous respondents noted the importance of luck in career progression, including getting a good project, good supervisor or positive results. They felt that even when researchers behaved in ways that deserved to be rewarded, they were not always seen as good researchers if, for reasons outside their direct control, their results were not able to be published in high impact journals. This factor was acknowledged particularly by underrepresented groups and those within specific disciplines.

- **Other issues:** Some respondents noted that because assessment methods are focused strictly on past success, such as number of publications, citations or grant income, there is a missed opportunity to analyse 'potential'. The current focus means that talented researchers who have not had access to the 'right' opportunities struggle to gain traction despite their capabilities.

These insights underscore the complex landscape of funding, promotion and evaluation of academic outputs within the research community. Some results may not be surprising; if an assessment system seeks to identify the 'best' research and researchers, then it is to be expected that less sophisticated research and less experienced researchers would not be as highly rewarded. However, the notable failure of this system is when the conditions for becoming established are too harsh and inequitable. Researchers should be able to achieve measures of success relative to their career stage. Sustaining employment as a researcher (and favouring paid teaching, for example) is sometimes to the detriment of other milestones that would build credibility to emerge from both the label and conditions of 'inexperience'.

Consultation revealed that in the current system access to opportunities is not always equal, which means that talented researchers can go unrecognised. Evaluation systems can be improved by being tailored to different career stages and by accommodating individuals with different needs and different access to resources and opportunities.

5.2 Effort-and-reward systems are opaque

The sustainability of research careers can be improved by increasing the reliability of effort and reward cycles, including through more consistent, transparent and equitable assessment processes. Adjusting metrics to value a wider range of research outputs, experiences and forms of knowledge can address this, especially opportunities for underrepresented groups.

5.2.1 Impact of research assessment processes on workforce diversity and inclusion

Organisational culture affects research workforce diversity. Many participants indicated that pressure to perform, competitive culture and lack of job security were significant barriers to diversity and inclusion in universities, whereas job security and a greater focus on collaborative culture and workplace behaviour were reported as significant enablers of diversity and equity in public, community and private sector research roles. Insecurity of employment is one of most significant factors impacting on EMCRs.

Sixty-one per cent of the primarily university-based sample surveyed had considered leaving the research sector due to funding pressures and a desire for greater work–life balance. This trend was higher among women (65% compared to 55% of men) and particularly among non-binary and other gender respondents (82%). While not a direct consequence of assessment, it is clear the pressures associated with academic research careers are significant, and the constant presence of assessment across activities creates a significant strain for many.

These results reinforce the well-known issues of equity and diversity in academic research fields; however, it is difficult to differentiate these impacts from research assessment per se.

For example, university-based respondents to the individual research survey said that fairness and flexibility were one of the most positive aspects of research assessment practices in their organisation; however, only 20% of these respondents (primarily university based) said that research assessment had a positive impact on their ability to conduct their research (36% neutral and 44% indicating a negative impact), and less than half (46%) felt that their employers' relative-to-opportunity policies were appropriately reflected in their research assessment practices.

When considering the assessment of researcher potential (as opposed to assessment of outputs and performance), a more systematic application of relative-to-opportunity policies, with a particular focus on performance relative to the availability of funding and resources, may help to improve diversity and inclusion within the research sector.

There is a need for more cultural change and better recognition of diverse perspectives in academia. Respondents highlighted the importance of fairness, inclusivity, comprehensive assessment, and encouraging collaboration, innovation and kindness in research evaluation and career advancement. Aboriginal and Torres Strait Islander researchers and those from underrepresented groups are often overburdened with activities such as mentorship or participation in diversity committees. These activities are not weighted highly in most research assessment frameworks, despite being time consuming due to the need for a researcher to upgrade their skills beyond those required in their research role. Individuals engaged in these additional activities can therefore face additional challenges, often impacting their chances for career progression and ability to perform well on traditional research metrics. Addressing systemic biases and promoting inclusivity are crucial for recognising the diverse contributions of researchers from underrepresented groups.

Community-specific challenges for underrepresented groups

- **Lack of role models and systemic support:**
There is a need for increased scrutiny and pressure to address issues of diversity, particularly in leadership positions. Barriers in academia exist through policies, systems and infrastructure that are not sufficiently inclusive. A lack of role models can discourage underrepresented groups from pursuing career advancement.

The lack of proper support and infrastructure places additional burdens on marginalised individuals. For example, gender minorities face emotional weight and barriers when advocating for their rights and asserting their place in research, which can impact their ability to excel in roles. The issue of bias in research assessment requires cultural and organisational changes rather than changes solely to the assessment process. LGBTQIA+ researchers can face challenges with cultural integration, struggling to fit into the traditional academic mould. The absence of representation at higher levels can create uncertainty about promotion criteria for LGBTQIA+ researchers. Respondents raised concerns about promotion processes due to a lack of representation in senior leadership positions. Additionally, reliance on recommendation letters can disadvantage underrepresented groups and those who have experienced discrimination and bias.

- **Diversity community responsibilities:**
Researchers noted that those who identify as a minority are often called upon, or feel compelled to be, an advocate for their community. This results in an added burden of community responsibilities, such as for women, people with disability, LGBTQIA+ or Indigenous representation within a research community. While researchers felt this work was noted in organisations, many respondents reported it was rarely recognised in assessment metrics or as part of recruitment approaches.

- **Extenuating external circumstances:**
Career disruptions such as family and caring responsibilities, health conditions and moving across sectors are not always considered in assessments. Part-time staff also face challenges in meeting the standard metrics, so they have limitations in advancing their careers.

Metric challenges for underrepresented groups

- **Capacity to travel:** Studies have shown that the capacity of researchers to travel and engage with domestic and international colleagues directly and positively impacts academic discovery, career development and cultural maturity, especially for early career scientists.[34] However, the link between research assessment and mobility is not clearly established, except for some work that shows the effects of mobility on different assessment measures.[35] The most internationally connected researchers benefit from a relatively high degree of international funding and networks, but this does not necessarily translate to a higher productivity in publications and patents. Greater investment is needed in establishing better proxies for understanding the effect of international mobility on research performance, and for understanding how the contexts and cultures fostered by research assessment approaches encourage or hinder mobility.

  Despite this, several respondents noted that international travel should be reweighted and considered a privilege rather than an essential requirement of research. The diversity of circumstances should be considered, such as

health vulnerabilities, carer responsibilities, access to funding, teaching load and personal safety (particularly for gender-diverse populations), which may impede researchers from pursuing travel opportunities. This also impacts environmentally conscious researchers who seek to reduce their carbon footprint.

- **Journal publication and citations:** Minority groups are often underrepresented in published literature or work in areas not recognised by top journals. As research performance metrics (for example, citations) disproportionately disadvantage certain groups, it can lead these researchers to shift or abandon their original research interests, further impacting diversity. Specifically:

  - Female academics receive fewer citations overall, due to issues such as unconscious bias of primarily male-reviewers (a particular issue in male-dominated fields), as well as unpaid caring responsibilities which can create additional pressure and unavoidable publication gaps.

  - Publication is also a challenging realm for Indigenous academics and knowledge holders. Battles to publish Indigenous research in scholarly journals are ongoing, although there have been some successes such as getting papers published with abstracts in Indigenous language.

  - Some LGBTQIA+ respondents noted academic bureaucracy made it difficult to navigate processes such as name changes for IT systems, which had negative flow-on effects to publication data.

- **Meeting cultural norms to succeed:** Some respondents felt there were unspoken rules that favour certain groups to the exclusion of others due to conscious or unconscious bias. These rules were felt to impact career progression. They also noted that underrepresented groups that fall outside cultural norms may suffer higher levels of bullying, stigma and social marginalisation, compounding opportunities to advance and achieve promotion.

5.2.2 A need for transparent criteria for career progression

A significant area of interest and concern was the desire for more transparent criteria for reward in academic careers. Myths and misunderstandings about how to be considered for promotions persist, and clearer holistic metrics could alleviate this and improve the balance of multiple factors in promotion decisions. EMCR respondents and diversity groups noted that while some universities incorporate research assessment into promotion criteria, others lack transparency.

Data collected from the consultations emphasised the need for transparency in recruitment and career progression and suggested that promoting diversity and inclusion should be a priority in promotion committees, with the creation of specific pathways and clear guidelines to cater to diverse needs. The lack of diversity within committees was identified as a potential hindrance to understanding and empathy towards researchers who are faced with different career paths.

'A diversity of modes of assessment requires a diversity of assessors to evaluate those metrics.'
Interview respondent

Researchers lack access to conversations and information about how their identities impact their career progression, and in this context, transparency emerged as a critical factor in research assessment to address biases that may influence decision-making. Participants in a roundtable discussion also highlighted the importance of 'research trust markers' as indicators of integrity, equity, openness, democracy and transparency. These markers could include acknowledging the research funder and the percentage of work made open access and should be considered alongside assessments of quality and excellence.

Explicitly stated criteria were viewed as critical and beneficial for individuals to understand how to position themselves better, and it was suggested by a stakeholder that assessing organisations should be required to report on the outcomes. The below needs were also identified:

- **Diversity group needs:** National best practice guidelines for staff assessment and promotions.

- **Research sector needs:** A uniform system that works for institutions and is structured to address the challenges faced such as funding, culture and the pressure to conduct certain types of research.

  – EMCRs: It was mentioned that decision weighting should be quantified better to reduce variability and alleviate the responsibility of reviewers and assessors.

  – Diversity groups: Increasing transparency, open communication and representation was highlighted as the biggest and easiest first step to improve the assessment processes. Bias can influence decisions when the process is not transparent and there isn't appropriate diversity in assessment processes. Transparent systems can be critiqued more effectively, allowing individuals to better understand how their identities impact their career progress.

5.3 Workforce mobility is challenging

Cross-sector mobility, referring to movement of researchers across academia, government, non-government and industry roles, poses multiple challenges. Specifically, research work and outputs tend to differ quite substantially across different parts of the sector, meaning both that the specialised professional skills developed by researchers are likely to be relatively sector-specific and that the indicators and metrics that they will accumulate over the course of working in a particular role may not transfer well to other types of research organisations.

While this is not in any way unique to the research sector, the challenges faced by researchers in moving between different jobs create constraints on Australia's capacity for knowledge-sharing.

Restricted mobility also impedes the researcher workforce by limiting career progression and movement. Misalignments and gaps in assessment metrics impede recognition of research skills, causing wasted effort by researchers having to prove themselves again in new contexts, and lost opportunities for both research jobseekers and employees as skills fail to be recognised. Consultation respondents felt there is a lack of support for secondments and mobility between different parts of the sector, making it difficult for researchers to gain diverse experience. They also felt that while academic researchers are increasingly expected to work with industry, advocate for policies and fulfil diversity obligations, current assessment frameworks continue to prioritise traditional academic outputs, meaning that these activities are not sufficiently supported or rewarded. Specifically, respondents noted that academic researchers with excellent industry skills but without traditional key performance indicators (KPIs) aligned to industry risked not receiving proper recognition and reward for their valuable contributions.

5.3.1 Mobility into universities: almost impossible

Respondents indicated that moving from a public, community or private sector research role to a university is difficult at every level, unless researchers have chosen or been required by their employer to be involved in publication processes and grant applications. Without an established academic track record, mobility from public sector or industry into a university research position generally requires a backwards career step to junior levels. For those who have taken time away from academia and are seeking to return, it requires competing for positions with a 'career interruption' that may or may not be considered valid by selection panels. Respondents noted that there were limited opportunities for industry professionals in academia, particularly related to:

- determining the appropriate level for researchers with industry experience to transition into the university sector, especially where the decision ultimately rests with the academics in the discipline

- difficulty of measuring impact and understanding that researchers outside a university setting have the necessary skills to contribute effectively

- recognising the value of diverse experiences and leadership in other sectors

- applying for and obtaining grant funding from research funders outside of industry.

The differences in culture and priorities between academia and industry not only affect career opportunities but also create barriers to collaboration due to differences in translatable communication skills across sectors. Stakeholder consultations also revealed concerns about research funding, which tends to divert to consulting firms over research centres. Balancing industry contributions in academic outputs while maintaining independent research in academia is also a challenge. Overall, these factors contribute to the complexity of bridging the gap between academia and industry.

5.3.2 Mobility out of universities: skill and translation gap

Differences in skills, organisational requirements and priorities creates a barrier between universities and other parts of the research sector. Moving from a university research position to one in the public or private sector, for example, is generally easier at junior and early career levels, where skills are relatively under-developed, or in specialist technical positions, where well-developed management and organisational working skills are not as important. However, many respondents also indicated that having moved out of academia, it became challenging or, in some cases, impossible to move back into a university role, unless there had been opportunities to continue publishing research and engaging in other academic activities. Movement from academia to the public or private sector often requires researchers to communicate how their skills can translate across into a non-academic space. The ability to translate this knowledge into simple language is a separate skill and is often not taught.

The most challenging aspects of hiring academic expertise in industry and vice versa are:

- lack of clear research assessment metrics used by industry

- limited opportunities for industry professionals to transition into academia

- mindset differences between academia and industry

- lack of relevant communication and engagement skills

- industry-focused rather than academic language in research proposals

- the need to balance industry contributions and independence in research papers.

Fifty-nine per cent of respondents reported that researchers with experience working across different sectors, such as academia and government, were disadvantaged by the current research assessment practices. The use of research metrics for recruitment and promotion of staff with academic backgrounds raised challenges for employers in public and private sectors, including a lack of clear assessment metrics used by industry to capture commercialisation potential and patent generation.

In some cases, mobility between universities and other parts of the sector becomes feasible at executive levels, where the management and organisational skills of senior academics responsible for university faculties or business units can be more transferrable to public or private sector contexts. Movement from universities to other parts of the sector at mid-career level is the most challenging, with mid-career academics less likely to have developed the necessary management skills and experience for equivalent positions in the public service or in industry. Industry consultations revealed that some in the private sector prefer to employ entry-level staff with undergraduate or master's level qualifications, as opposed to PhD graduates or EMCRs. Several industry respondents said that the skills acquired through undertaking a PhD or postdoctoral research, and the pressures from meeting university research metrics, can make candidates narrower in their thinking and in their collaboration and transferrable skills.

PhD training in universities may not adequately prepare researchers for the challenges of working outside academia. While there is a common belief that collaborating with industry can be difficult, it is important to take a more comprehensive approach by considering industry engagement and evaluating collaboration and contributions beyond the limitations of university rankings.

For researchers to be successful in industry, they need to genuinely show interest in conducting research that is relevant to industry. They must also value publications, patents and meeting organisational objectives that are applicable to industry needs, while maintaining the trust of both industry and society in the scientific method. The use of a technology readiness scale helps measure the progress of innovation, and it is essential to acknowledge the importance of early-stage ideas and fundamental scientific research. Recognising and appreciating all contributions, including groundwork, is crucial in this context.

It is becoming increasingly important to provide academics with diverse skills, such as management and communication, to support their professional growth beyond their expertise in research. Many researchers face challenges in translating their skills into non-academic roles due to a lack of necessary skills and knowledge.

Organisations often question the ability of researchers to transfer their skills between different sectors, especially when transitioning from academia to non-academic organisations. This highlights the need for a better alignment between academia and industry, which can be achieved by re-evaluating strategies for incentivisation, talent recruitment and evaluation systems. It is crucial to recognise and reward collaborative efforts and the ability to effectively translate knowledge to bridge the gap between academia and industry. Pathways forward are explored in Chapter 6.

Case study 1: Bridging the gap between academia and government policy roles

A researcher with experience in government policy recruitment has noticed a lack of applications from individuals transitioning from academia into policy positions. They believe that this transition is feasible and appropriate, but the problem lies in the limited awareness or advertising of job opportunities between these two sectors. Job information tends to be shared within their respective domains, with little visibility across sectors.

Applying for government roles often does not provide an opportunity to showcase academic skills and expertise in the application process. The focus is usually on understanding and applying data to address sector-related issues, rather than on academic achievements. Research metrics that hold value in academic settings may not be understood or appreciated in government applications. Consequently, individuals in academia may feel unsuitable for these roles, despite having the necessary qualifications.

When seeking evaluation partners from government, research metrics are not given much consideration. Evaluation primarily focuses on responding to project questions and highlighting past outcomes that demonstrate service impact, rather than outcomes that contribute to research metrics.

This bias may stem from confidentiality concerns and the fact that government outputs have historically been more focused on reports rather than publishing in peer-reviewed journals to reach wider audiences and promote learning.

However, there are emerging collaborations and partnerships, such as the Australian Prevention Partnership Centre, that have the potential to bridge the gap between academia and policy. These initiatives work across both sectors, providing an opportunity to communicate in a common language between academia and the public service.

The skills gained in academia can be relevant to other sectors and can greatly benefit the public sector, particularly in policy roles. However, there is a significant lack of transition between these sectors. To address this challenge, it would be beneficial to promote a better understanding of research metrics or adopt a more universal application of these metrics, enabling individuals to apply for roles outside academia. This shift would facilitate a smoother transition and foster the exchange of knowledge and expertise.

5.4 Intellectual property

IP concerns can be a major barrier to greater mobility and collaboration between universities and the private sector, with businesses generally oriented to protection and commercialisation of IP as a necessary return on investment, and research outputs attributed to and owned by the company rather than individual research employees. In contrast, university researchers tend to focus and are assessed on the publication and sharing of research findings. And while most universities retain ownership of IP produced by their employees, individual attribution of research outputs and incomes is a defining feature of academic career paths.

In the context of collaboration between university and private sectors, complex IP sharing or protection agreements are often required. These can have a significant impact on the nature and content of what can be assessed and present a significant and sometimes insurmountable barrier to greater or more frequent engagement.

Several frameworks and model agreements have been developed to facilitate greater collaboration and engagement between university and private sector researchers. However, these tools generally do not cover metrics and ways in which researchers, in either private sector or government, can have their contributions to research outputs formally recognised and recorded in a way that would allow for direct application in academic assessment systems. This is a major challenge to greater mobility in the sector, and one that could provide substantial improvements if resolved.

5.5 Indigenous Knowledge

First Nations peoples in Australia have rights that are recognised by international agreements such as the United Nations Declaration on the Rights of Indigenous Peoples; the Convention for the Safeguarding of Intangible Cultural Heritage; and the Convention on Biological Diversity. These agreements emphasise the importance of maintaining, protecting, rebuilding and expanding Indigenous Knowledge.[iv] However, according to the Final Report of the Scoping Study on Stand-Alone Legislation for Indigenous Knowledge,[36] Australia's current IP laws are insufficient to adequately safeguard these rights, even if they undergo reform. The existing legal framework does not adequately recognise and protect the Indigenous cultural and IP rights of First Nations people; it is not designed to address their specific needs. It should acknowledge their cultural governance and their authority to protect, use and share their Indigenous Knowledge in ways that they deem fit. This may include promoting the growth of authentic Indigenous industries and increasing demand for their products.

Through consultations, academics expressed the same concern regarding the protection of Indigenous Cultural and Intellectual Property (ICIP). First Nations researchers, including those whose research focused on Indigenous Knowledge, identified challenges which can have a negative impact on both researchers and the development of Indigenous Knowledge. Indigenous communities often lack the necessary resources and power to protect their IP or ICIP, in comparison to larger industries. Appropriate recognition and assessment of Indigenous Knowledge can become particularly problematic for researchers working in areas like plant nutrition, as conflicts arise when publishing findings related to Traditional Owners. Consequently, researchers can be reluctant to work with native plants, resulting in a loss in discovering new food and medicine crops and plant genetics that could benefit society.

---

iv Indigenous knowledges encompasses all the tangible and intangible cultural heritage of First Nations peoples in Australia and is rooted in ancient and enduring connection to Country and its landscapes, waters, flora and fauna. It includes not only traditional knowledge and traditional cultural expressions but also rights to the genetic resources of the native flora and fauna of traditional lands.

Consultations revealed there have been instances where universities claim IP rights over plants without the consent of Traditional Owners. This has led to conflicts and negative media attention, affecting both Indigenous and non-Indigenous researchers, and barriers to publishing work until legal issues are resolved. Additionally, outreach activities and events related to Indigenous Knowledge often go unrecognised.

To address these issues, Indigenous researchers suggested the establishment of clear policies that recognise and address the ownership and profit-sharing of Traditional Owners' intellectual property. This can be achieved through establishing memorandums of understanding in universities. However, a lack of funding and appropriate evaluation metrics for early career researchers in the field of ICIP hinders their ability

to contribute valuable insights and knowledge to their community. There is also a need for different metrics to assess research in ICIP that align with the values and priorities of Indigenous communities. The implementation of existing frameworks such as the Nagoya Protocol and access and benefit-sharing agreements can provide protection for Indigenous Knowledge and facilitate collaboration between researchers and Indigenous communities. Furthermore, a new method of measuring the impact of work could involve assigning a score to contributions made to the community across various fields. This approach aims to recognise and reward contributions made to Indigenous groups, even if they are not published as research outputs.

THE WAY
FORWARD

6 Alternative models and approaches to metrics

Research evaluation frameworks are evolving to become more holistic and inclusive, reflecting the increasingly complex and interconnected nature of research. There is growing recognition across the world that research assessment should be tailored to the research objectives of organisations or funders, with evaluation based on a wide range of impact metrics and outputs, and other factors like research culture, inclusivity, external engagement, and teaching.

Making changes to the culture of research and the ways in which it is assessed will help foster diverse workforces that are innovative and collaborative, while supporting dynamic and original research and disincentivising unwanted approaches such as gaming the system. No single metric can appropriately assess research or researchers. Several tools will be needed, including both quantitative indicators and metrics, and qualitative measures and peer review.

This chapter provides an overview of key pinch points emerging from consultations and points to where Australia can explore areas for improvement or alternative approaches to research assessment. It explores international initiatives, suggestions from academic literature, and feedback from stakeholders. While not all suggestions raised through consultation have been explored, the chapter includes high-level suggestions and ideas.

More than 1,000 individuals responded to the question: 'What is one specific change you would recommend to improve current research assessment processes in a way that better supports and encourages high-quality research?'. Additionally, more than 40 organisations responded to the question: 'What, if any, new or innovative approaches to research assessment are being considered, trialled or implemented within your organisation?'.

In analysing the responses, the same consistent themes around moving away from traditional metrics of assessment discussed in earlier sections of this report emerged (see Box 3). Respondents wanted to see a shift towards quality over quantity, recognition of impactful research with long-term benefits, addressing of discipline-specific challenges, promotion of interdisciplinary research, rewarding of collaboration and teamwork, transparency and fairness, biases addressed, promotion of diversity, and support of early career researchers.

> **Box 3: Suggestions from consultations on alternative approaches to research assessment practices**
>
> - Introduction of narrative and competency-based approaches supported by reflective questions
>
> - Establishment of organisational standards to guide responsibilities
>
> - Recognition and appreciation of successful project delivery
>
> - Valuing different types of publication records
>
> - Tools to better capture demographic and institutional diversity
>
> - Structures to measure broader research impacts
>
> - Formalising researcher involvement with non-traditional research outputs
>
> - Capturing informative measures of research impact, noting challenges and tailoring frameworks
>
> - Assessing engagement beyond traditional metrics, for example mainstream and social media
>
> - Predictive assessment for identifying researchers' future potential
>
> - Implementation of indicators that report on collaboration and engagement (such as network and diversity measures of co-authorship).

6.1 International 'fit for purpose'

There have been numerous attempts to reform research assessment practices globally over the last decade, with a focus on increasing understanding of quality, excellent and impactful research and researchers. However, with the exception of the recent partnership with the Research on Research Institute, the uptake of these in Australia, such as signing up to international agreements, has been limited. These international approaches provide useful insights when reviewing Australia's approach, noting that they do not focus on non-academic research workforces or explicitly cross-sector mobility beyond the recognition of NTROs in academia.

Good research assessment processes acknowledge diverse outputs, practices, and activities, and prioritises qualitative judgement, while responsibly incorporating quantitative indicators. There are several important lessons observed. The project examined how several countries assess research (see Appendices 6 and 7).

In synthesising the international approaches explored through desktop research, insights emerged that could inform a future approach to research assessment in Australia.

- Clear criteria must be set and include factors such as originality, rigour, and relevance, with a range of outputs and research activities. These criteria should be grounded in the specific research field and uphold the character of the research, with a focus on valuing various contributions.

- Journal-based metrics should not be the primary means of evaluating research and researchers, and a fully metricised system should not be adopted. Instead, multiple sources of evidence should be used to ensure a comprehensive and reliable assessment of a researcher. These could include analysing the research outputs, expertise and reputation through a combination of peer review and self-nominated article-level metrics and narratives.

- Assessments should be systematic and transparent to ensure consistency. This includes addressing bias and discrimination (for example, multiple assessors, broadening criteria for selecting reviewers), and ensuring that processes and criteria are clearly documented with continual monitoring and evaluation. In particular, the approach to assessment should be co-produced with, and the results co-interpreted by, the community being evaluated, with evaluation occurring only where necessary.

- Research context should be explicitly considered to capture the uniqueness and full scope of the research, including disciplinary norms and expectations, a range of diverse academic profiles, and available organisational resources and support.

- To achieve a more comprehensive and cost-effective evaluation, the assessment system needs to evolve to include broader and fairer metrics, as well as more representative sampling. Although resistance to its adoption exists, sampling's reliability in other contexts makes it a valuable addition for considering all aspects of university work. Piloting the approach in a smaller area could showcase its benefits and dispel concerns about catastrophic consequences.

- Finally, if possible, feedback should be offered. To make progress in their design and implementation, research assessments need to be considered in their entirety, in terms of content, processes, assessors, environment and coordination.[37]

Australian universities, and any researcher employer, can join or implement these pre-existing initiatives to help improve their practices or remove barriers to their effective use. In doing so they must consider these in the context of organisational and cultural differences between countries and sectors, which can be a barrier to establishing a united approach.

A challenge for universities in committing to these, without then creating a reputation risk, is the tension between reconciling the assessment of individual researchers with organisational objectives linked to international rankings to continue to attract international students and be globally competitive in comparable benchmarks.

While this section includes perceptions of researchers and research organisations obtained through our surveys, interviews and roundtables, these do not always correlate with public statements or activities of organisations and governments. Additionally, we acknowledge there are also likely voices we have not captured.

6.1.1 The San Francisco Declaration on Research Assessment

The San Francisco Declaration on Research Assessment (DORA) was developed in 2012 to improve the ways in which researchers and the outputs of scholarly research are evaluated. DORA is a worldwide initiative and 2,784[v] organisations globally have signed the DORA,[38] including 25 Australian organisations (and 427 individuals) including the NHMRC, Australian Academy of Science, and key independent research institutes. Only one Australian university, the University of Melbourne, has signed DORA. However, other universities are in discussion about signing DORA.

DORA emphasises the need to assess research on its own merits, rather than on the journal in which the research is published. DORA offers valuable alternatives for Australia's research assessment, such as: eliminating journal-based metrics as a primary evaluation method, being transparent about hiring and promotion criteria and decisions (shifting from quantity to quality), and the development of new indicators that more accurately measure the impact and quality. The full list is outlined in Appendix 8.

Case study 2: DORA in Australia

Australian universities generally place an emphasis on university rankings, whereas DORA seeks to transform the assessment of academic researchers by promoting the adoption of non-bibliometric metrics by funders, institutions, and publishers.

The adoption of the DORA by Australian institutions is lagging behind the rest of the world. There needs to be better understanding of the barriers to its adoption so that they can be addressed and for systematic collaboration to be encouraged for reform.

Valuable Australian local level research frequently goes unrecognised for several reasons, including international journals' aversion to publishing local research. This suggests a need for a closer examination of the gap between local research and recognition within the broader research system.

Despite Australia's significant and competitive academic output, few groups are actively engaged in international initiatives affecting meaningful changes to research assessment. Australian institutions find it difficult to participate in international initiatives such as Open Science and the DORA, due to time-zone differences. The lack of Australian involvement in meetings and low adoption of international initiatives have diminished Australia's role and influence in international discussions.

It will be important for Australia to demonstrate leadership and coordination, domestically and internationally, in promoting the application of international initiatives, rather than relying solely on external organisations. Enhanced coordination and leadership in this area, as well as a structured approach to supporting and promoting such activities, will be important for the future of research metrics in Australia and maximising Australia's global research landscape contributions.

v As of 15 March 2023

6.1.2 The Coalition for Advancing Research Assessment

The Coalition for Advancing Research Assessment (CoARA) was initiated in 2022, with over 350 organisations from more than 40 countries involved. Building on international progress made through DORA,[vi] and on the Leiden Manifesto and the Hong Kong Principles, the Agreement on Reforming Research Assessment established a common direction for research assessment reform while respecting organisations' autonomy. The agreement is based on several shared principles, 10 commitments, and a 1- and 5-year timeframe for reform. It is hoped that through the agreement, CoARA can enable systemic reform of research assessment through common principles and commitments and within an agreed timeframe.[39]

In comparison to DORA, key areas of CoARA that may provide alternatives in Australia's research assessment system include diverse outputs, practices and activities, qualitative judgements, responsible quantitative indicators, and flexibility in evaluation practices. Importantly, the agreement understands the need to be respectful of the autonomy of organisations and of their respective missions or strategies, appreciating that assessment practices can vary according to the context, type, and purpose of the evaluation.

At the time of writing this report, no Australian organisation had signed the agreement. There are over 500 European organisation signatories, and a massive international collaborative effort underway to implement it.

Although separate to CoARA, there are alignments between it and the work of the Research on Research Institute, which seeks to improve meta-research, meta-science (the science of science) through a rich blend of old and new disciplinary and methodological approaches to test, evaluate and experiment with different aspects of research systems, cultures and decision-making.

During the development of this report, on 23 August 2023, the ARC entered into a partnership with the Institute. It is hoped that this will help encourage Australia, domestically and internationally, to develop meaningful improvements to the design and operation of research culture and systems. This should have a positive impact on research assessment in Australia.

Survey respondents were more aware of DORA than CoARA, which could be more practical and actionable.

Some organisations have started to develop public statements on their implementation of DORA and/ or CoARA. One notable example is the European Molecular Biology Laboratory, which provides a statement of their research assessment practices and advice to applicants on how to develop a CV for job opportunities there. They include the following instructions:

- candidates for recruitment, promotions, and awards are asked to include a variety of research outputs in their CVs and to describe the significance of key research outputs in a narrative

- beyond publications, we recognize and encourage submission with all relevant research outputs, which can include but is not limited to open data sets, databases, code, software, preprints, patents, commercial products, instruments, clinical practice developments, educational products, and policy publications

- supply of a brief narrative (max. 300 words) summarising the impact and importance of applicant's main outputs, citing persistent identifiers where available

- avoid mention of impact factors, h-indices etc. Consider instead impact measures directly related to outputs, including qualitative indicators such as influence on policy and practice.

Further details can be found at https://www.embl.org/about/research-assessment/.

---

vi CoARA worked closely with DORA in the early stages of the CoARA project, provided feedback on early drafts of the agreement and participated in the implementation group to define modalities of operation of the coalition that supports the reform efforts by the signatories of the agreement.

6.1.3 Human Frontier Science Program

The Human Frontier Science Program (HFSP) Research Grant Program is funded by 15 leading life sciences research countries. The program supports innovative fundamental research on fundamental biological problems. There is an emphasis on novel and interdisciplinary approaches that involve scientific exchanges across national and disciplinary boundaries.[40]

HFSP is a signatory to DORA. An important feature of the HFSP Research Grant Program is that research proposals are evaluated based on their content and not solely by the criterion of JIF. At all stages of the HFSP grant application process, reviewers are advised that they should consider the quality of the research published and/or of the research proposed in the grant application. While publication output/productivity may be an important factor, the reviewers are asked to assess based on the content of articles, not the JIF. They are also asked to consider the influence of a candidates' publications in advancing knowledge in the field.

Despite the process to assess researcher excellence not considering publication quantity or JIFs and instead focusing on potential impact and influence, 28 HFSP grantees have gone on to win a Nobel Prize over the past three decades.

6.1.4 The Netherlands and a new system for recognition and reward

While focused only on the academic sector, unlike this project, the work of the Netherlands in developing a modern assessment system for recognition and rewards provides valuable insights for Australia, especially on common language and shaping culture. Commencing in 2019 with the publication of the 'Room for everyone's talent' position paper[41], a significant change is underway in the way public knowledge institutes (universities and research bodies) are reshaping their assessment models and practices under a common framework. In 2023, this work entered a new phase of implementation under an agreed roadmap.[42]

This work encompasses a shared vision, common language and organisational-specific implementation approaches, including committees, career planning and documentation.

The roadmap, based on the five priorities outlined in 'Room for everyone's talent', emphasises balancing individual and collective contributions, diversifying and revitalising career paths, promoting open science, focusing on quality, and encouraging academic leadership. To enable this, Dutch institutions will develop personnel plans, create career paths aligned with recognition and rewards principles, incorporate open science activities in evaluations, define quality features in different areas, and foster good leadership at all levels.

6.1.5 The Hong Kong Principles for Assessing Researchers – fostering research integrity

In the context of career advancement, it is crucial to understand the distinction between research quality, integrity, excellence, and impact. While all these aspects are essential for a robust and trusted research ecosystem, they are assessed in different ways and their impact should be given proper attention.

In simple terms, quality and integrity pertain to the nature and activities of the researcher themselves. They focus on whether their research is reliable and trustworthy. On the other hand, excellence and impact refer to how the results of the research are perceived and valued. They measure the level of success the research has achieved both within academia and society as a whole.

While there has been much emphasis on assessing excellence and impact, often through methods like h-indexes, there is a growing recognition of the importance of research quality and integrity. This shift is driven by concerns over the prevalence of misinformation and the need to ensure that researchers' conduct and research practices are actively considered in career advancement.

The Hong Kong Principles for Assessing Researchers, also known as the Hong Kong Principles[43], are valuable guidelines for building trust and promoting career advancement. These principles were developed during the 6th World Conference on Research Integrity and are designed to recognise and reward behaviours that strengthen research quality and integrity.

The principles encompass several aspects, including prioritising the assessment of responsible research practices and the value of thorough reporting (see Figure 4). This means researchers need to be accurate and transparent in sharing their research methods and findings. The principles also encourage the adoption of open science practices, including sharing work and data, and recognise the importance of diverse research activities such as replication, innovation, synthesis, and meta-research.

Australia's approach to modernising research assessment should consider incorporation of these principles. By doing so, trust in science and research can be ensured or restored in the face of misinformation. Ultimately, the approach will foster a strong and responsible research community that follows rigorous and standardised approaches to assessing researchers' contributions, and promote research integrity.

Stage	Importance	Example indicators
Study formulation	• Exploratory or confirmatory, useful and relevant research that builds on previous findings	✓ Knowledge synthesis ✓ Priority-setting exercise ✓ Stakeholder(s) engagement
Study design	• Reduces publication bias and other reporting biases • Enhances reproducibility • Specifies exploratory and confirmatory parts	✓ Open protocols ✓ (Pre)registration 📊 Reuse of protocol by others
Study conduct	• Allows data aggregation, data reuse, and transparency	✓ Quality assurance of data ✓ Data sharing ✓ Sharing materials 📊 Reuse of data/materials by others
Analysis	• Enhances reproducibility • Separates data-driven analyses and hypothesis testing	✓ Analytical code sharing
Reporting and publication	• Enhances openness and accessibility • Specifies exploratory and confirmatory findings	✓ Transparency ✓ Open access ✓ Use of reporting guidelines
Dissemination	• Focuses on outcomes, essential subsequent studies, knowledge transfer and impact of research	📊 Altmetrics 📊 Citation 📊 Specific markers for impact on research, practice and society

Impact

✓ yes/no indicators   📊 numerical indicators

Figure 4: Indicators of responsible research practices in the Hong Kong Principles

6.1.6 Elsevier Draft Academic Performance Evaluation Framework

Commercial entities are seeking to support and enable improved research assessment practices. For example, Elsevier has developed a draft Academic Performance Evaluation Framework in collaboration with the global community. Focused on universities and research institutes, the framework aims to provide a comprehensive assessment of various aspects of academic performance. Given universities also focus on education, the draft framework includes teaching indicators (for example, number of students, bachelors, doctorates), reputation (qualitative indicators related to the quality of teaching and student experience), learning environment and student outcomes.

In the draft framework, inputs focus on resources (human capital, funding and equipment), while throughputs focus on research and education processes such as growing emphasis on research culture, reproducibility, sustainability, interdisciplinarity, and knowledge exchange. Outputs, which remain the focus of research organisations, focus on knowledge created, including volume and quality of publications, traditional research output augmentation and non-publication research output augmentation. The outcomes and impact consider societal impact, economic impact and impact on students, education system and priorities and alumni.

A notable example of measuring societal impact is Elsevier's collaboration with the University of Tasmania. Together they developed the Tasmanian Societal Impact Model to help research and teaching organisations identify local areas with societal risks and opportunities.[44] The model evaluates the organisation's strengths in these areas and promotes collaboration with external stakeholders and the community, with the key steps shown in Figure 5.[45]
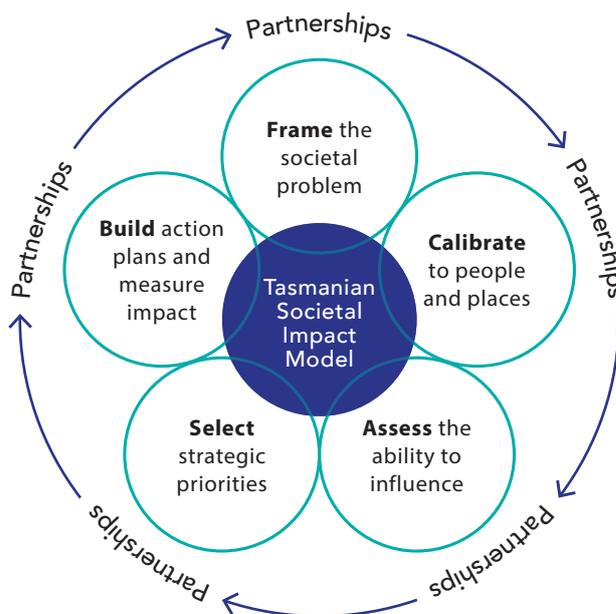
Figure 5: The Tasmanian Societal Impact Model

In another example of measuring economic impact, Elsevier collaborated with Advanced Oxford to create an updated understanding of the knowledge economy and show how it contributes to the overall economy.[46] To achieve this, they developed an 'innovation dashboard,' allowing the research team to track changes in regions over time (an example being Oxfordshire). This dashboard brings together different indicators to paint a picture of the knowledge economy in the area with the goal to continually improve the dashboard as new data becomes available. The ultimate objective of this collaboration is to promote innovation by highlighting existing collaborative efforts and identifying potential collaborations at the intersections of different sectors. The aim is to encourage further innovation and economic growth in the region.[47]

Elsevier's framework provides one alternative way for assessing research that broadens the focus from traditional research output indicators to a much wider set of indicators related to the research process, reflective of a more holistic approach to research evaluation.

A high-level representation of the draft Framework is presented in Figure 6.

Input	Teaching	Research and education		Outcomes and impact
Resources	**Education**	**Research and education processes (throughput)**	**Knowledge created (output)**	**Outcomes and impact**
Human capital: staff (researchers, Pis, teachers, support staff, etc.)	**Teaching basic indicators:** number of students, doctorates, bachelors	**Research culture:** is the research produced in an inclusive and diverse environment: ECR nurturing, collaboration, gender, race and ethnicity	**Volume of publications** as well as quality of publications	**Societal impact:** impact on local/national/global society
Funding: Block funds, grants, industry funds, donations, IP income, etc.	**Reputation:** qualatative indicators related to the quality of teaching (courses, student experience)	**Reproducibility:** is the research reproducible: shared, availability of datasets, SW, methods and protocols, review citations	**Traditional research output augmentation** (local big data platform)	**Economic impact:** impact on local/national/globa economy
Equipment	**Learning environment**	**Sustainability of research practices:** carbon neutrality, team based effort	**Other traditional research output augmentation** (preprint, datasets …)	**Impact on students:** education system and priorities, alumni
	Student outcomes and learning gains	**Interdisciplinarity:** MI (Multidisciplinary Index), II (Interdisciplinarity Index)	**Non publication research output augmentation** (creative work, events, live performances, etc.)	
		Knowledge exchange: research in collaboration with industry, mobility to and from industry, etc.		
Quantive and qualitative				

Figure 6: Elsevier's draft academic performance evaluation framework

6.2 Measuring impact

A major policy shift over the past decade has been an increasing focus on research impact, as well as on the responsible assessment of research; approaches that 'incentivise, reflect and reward the plural characteristics of high-quality research, in support of diverse and inclusive research cultures.'[48] International best-practice continues to underline the importance of using case studies and narratives to demonstrate the richness and complexities of 'impact', even when supported by appropriate metrics. Impact can change throughout a research career, highlighting that frameworks that support people as they progress are an important consideration.

CSIRO's definition of impact is 'an effect on, change or benefit to the economy, society and environment, beyond contributions to academic knowledge'[49] – impact is the effect of CSIRO work that is generated from the work's adoption. This echoes the ARC's definition as 'the contribution that research makes to the economy, society, environment or culture, beyond the contribution to academic research.'[50]

Case study 3: Impact frameworks – the CSIRO experience and approach

In 2010, CSIRO adopted a systematic approach to planning, monitoring, and evaluating impact, enabling CSIRO to improve engagement and ensure that research remains relevant, realistic, and addresses potential risks.[51] This organisational impact framework (see Figure 7) provides a standardised approach for evaluating impact across various research areas and simplifies 'the journey' from input to impact by highlighting five stages: inputs, research activities, outputs, short- to medium-term outcomes, and long-term impacts. It seeks to provide a roadmap for understanding how research can lead to meaningful societal, economic, and environmental benefits that can be attributed to the program.

To support and cultivate a culture of impact, CSIRO designed an enterprise-wide program to shift towards an outcome-focused approach resulted in improved resource allocation, streamlined communication and increased transparency within the organisation.[52] Researchers have gained a better understanding of how their work can make real impact and have been presented opportunities to develop impact-related skills. Externally, stakeholders have gained a deeper understanding of CSIRO's impact and the value of their contributions.

Engagement

Inputs	Activities	Outputs	Outcomes	Impact
e.g. resources, staff	e.g. methodology, work	e.g. publications, reports	e.g. change in working practices, technology licences	e.g. social, environmental, economic

Feedback

Planned work

Intended results

Can be controlled | Direct influence | Indirect influence

Impact activity

Planning

Monitoring

Evaluating
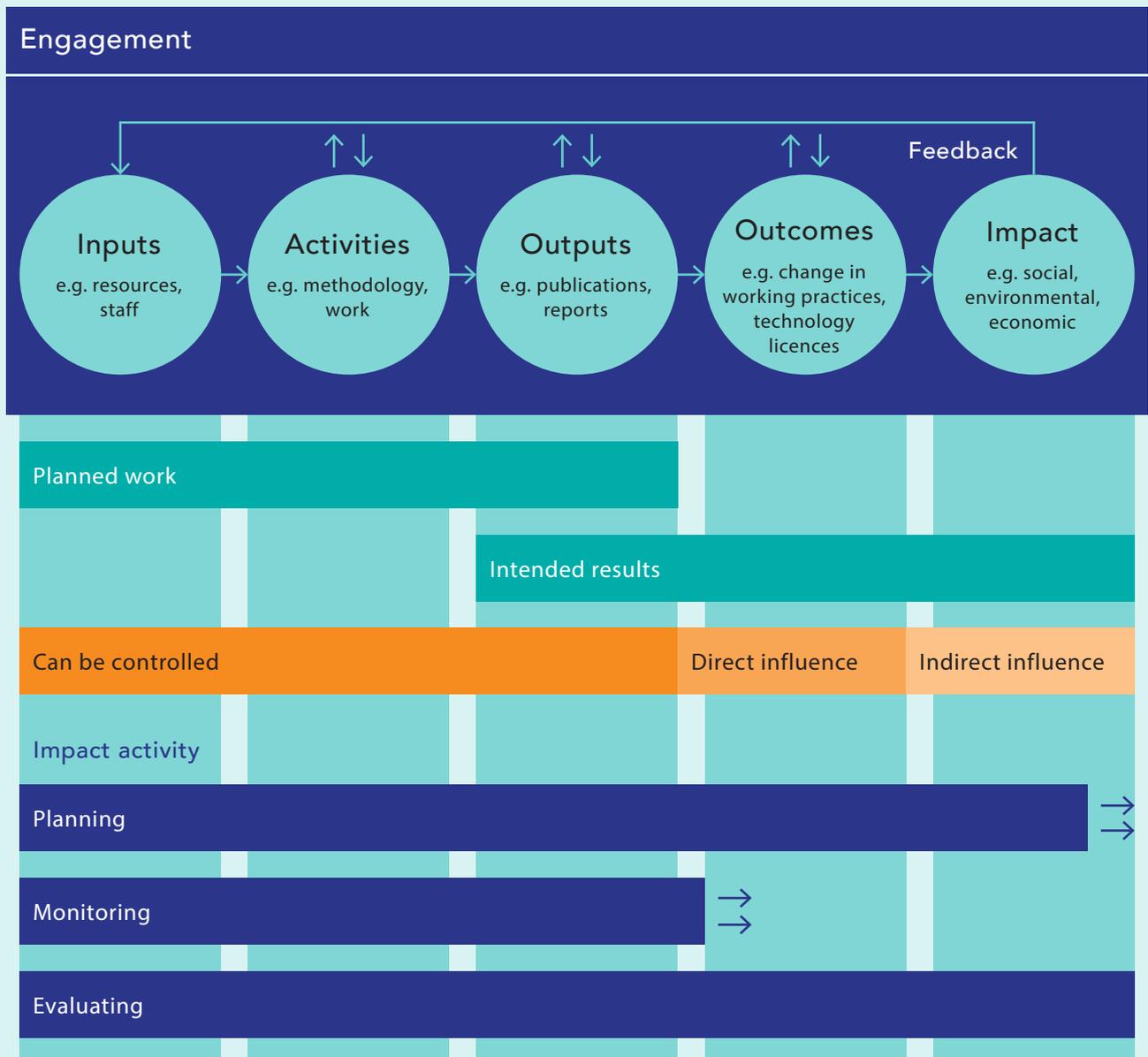
Impact Framework derived from the work of the W.K. Kellogg Foundation

Figure 7: CSIRO's impact framework

The NHMRC is also actively considering research assessment practices that better account for research impact and quality rather than quantity. Assessment of impact by the NHMRC is an important element of its flagship scheme, Investigator Grants, in which an individual's impact is assessed.

In 2022, the NHMRC published a Research Impact Position Statement[53] that defines impact as 'the verifiable outcomes that research makes to knowledge, health, the economy and/or society, and not the prospective or anticipated effects of the research.' Impact is the effect of the research after it has been adopted, adapted for use, or used to inform further research. Research impact also includes 'new knowledge demonstrating the benefits emerging from adoption, adaption or use of new knowledge to inform further research, and/or understanding of what is effective.' The NHMRC's definition is noteworthy because, by including 'knowledge' as a potential impact domain, it recognises research can be impactful within as well as beyond academia.

Additionally, the NHMRC has made grant application process changes to prioritise quality over quantity. Instead of providing a complete publication history, applicants are requested to provide their top 10 publications only, with an explanation for why they have selected these publications. The NHMRC no longer considers the number of successful grant applications received as an assessment of track record, with the focus instead on evidence of leadership, collaboration, and mentoring. These changes aim to encourage positive behaviours in collaboration and mentoring and minimise gaming associated with filling grant applications with 'trivial' publications to appear more productive.

Anderson (2023) takes this one step further, suggesting that a more radical approach is needed for using publications in assessment, with applicants asked to nominate their best (in their opinion) paper.[54] The approach would have applicants assessed on the best that they are capable of, rather than publication output, emphasising research quality rather than quantity.

The NHMRC's statement and the ARC's EI evaluation only provide for retrospective assessments, whereas some Australian research funding[vii] requires prospective analysis of impact. Australian's research assessment frameworks, including the ERA and the EI assessments, are outlined in Appendix 9.

The ARC recently released a report prepared by ACIL Allen on *Impact assessment of ARC-funded research*.[55] The report examined the ARC's support for research impact and identified four opportunities for improving research impact, including:

- Developing an impact evaluation framework for the National Competitive Grants Program to provide greater clarity on impact reporting for the research sector (taking into account the upcoming policy review of ARC programs and seeking to align with Australia's national research evaluations)

- Strengthening National Competitive Grants Program impact data collection and reporting, starting with a pilot of post-project reporting for the Industry Fellowships Program

- explore data-driven approaches to the National Competitive Grants Program impact assessment that could leverage the redesign of Australia's national evaluations of research quality and impact, and

- enhance communication of research impact.

In addition to organisational-specific frameworks, some agencies are developing monitoring and evaluation impact assessments to assist organisations. These often have a level of self-interest, coming from a potential vendor for the data for organisations or to support potential customers or organisations (for example, university ranking tools).

Suggestions from respondents (individual survey) on alternative assessment approaches to measuring impact are presented in Table 4.

---

vii See, for example, requirements of key research funding initiatives under the Medical Research Future Fund.

Table 4: Suggestions for alternative impact assessments

Categories	Details
Research assessment criteria	• Focus on academic quality, excellence and impact over quantity/volume • Tailor criteria to the nature of the research • Consider non-academic impact and real-world solutions to challenges • Use diverse metrics and case studies • Recognise teamwork, collaboration, and interdisciplinary research
Research impact measurement	• Include societal impact and engagement indicators • Move away from citation-based metrics • Assess long-term impact and success of knowledge and research outputs • Involve end-users, stakeholders and sponsors in assessments of impact
Research governance and culture	• Improve internal governance to prevent favouritism • Foster an enabling and celebratory research culture, moving away from an audit culture and rankings obsession. • Shift away from funding-driven culture • Support researchers with better pay and job security
Research evaluation processes	• Implement DORA principles and increase the use of impact statements • Extend assessment time periods for long-term impact • Establish evaluation panels for consistent appraisal • Tailor assessment criteria to specific disciplines
Research support and resources	• Prioritise freedom and security in blue sky research • Enhance peer-review processes and recognise overlooked research tasks • Provide resources for translating research to non-academics • Encourage community-controlled First Nations research
Addressing diversity and inclusivity	• Recognise the value of humanities and social sciences research • Assess research quality based on inclusivity and diversity among authors • Consider the needs of early career researchers and diverse career pathways • Conduct ethical, culturally responsive research with Aboriginal and Torres Strait Islander communities

6.3 Disciplinary and interdisciplinary considerations

Many pressing problems facing society, such as climate change, advances in technology, and pandemics, require interdisciplinary research, yet research assessment metrics can make it difficult for researchers to undertake this type of work. Blanket approaches involving citation-based measures of research quality do not support the significant proportion of research, researchers and disciplines that communicate knowledge and insights outside peer-reviewed journals. Some of these measures rely on peer review assessment within ERA, but many do very different things within their own disciplinary or community areas, including community assessment of outcomes such as viewership and gallery invitations.

Multi- and inter-disciplinary research often takes more time to conduct and produce impact, especially where community engagement is involved.

This can lead to some researchers prioritising discipline-specific outputs to maintain KPIs, instead of focusing on larger and more complex, and possibly more impactful, research. As a result, impactful interdisciplinary research and innovation become difficult in the current system of short-term competitive funding and assessment practices.

While interdisciplinarity and collaboration is a common stated performance measure and is embedded in most Category 1 funding assessment criteria, research performance and assessment of grants in academia are almost exclusively measured along disciplinary lines. A strong theme from consultation was a need for mechanisms and processes that better recognise and reward interdisciplinary research excellence.

Other suggestions from stakeholders are outlined in Box 4 and Box 5.

6.4 Improving transparency and objectivity in hiring and promotion of researchers

Consultations with EMCR and diverse research groups suggested there is a need to improve transparency in hiring and promotion practices (see section 5.2.2).

Gärtner et. al., propose a two-phase process for considering promotion of researchers.[56] This relates to the field of psychology and may have limited application in other fields. However, it provides an overview of different ways to improve objectivity and transparency in hiring and promotion. The two stages include a mix of quantitative and qualitative metrics. The quantitative metrics in phase 1 include a researcher undertaking a self-assessment of research quality, identifying specific features of their publication outputs. Phase 2 involves discussions on how innovative, creative, and meaningful the research is, whether and how the work contributes value to the knowledge base in the respective field, and how it fits with the hiring institution's strategic vision and resources.

Industry professionals consulted emphasised the significance of transparency in employee evaluations to attract top talent and drive innovation. A talented and adaptable pool of people trained in research and capable of working with stakeholders and switching between different areas was identified as crucial for achieving innovative advancements. By promoting accountability in research assessment and supporting achievements across various industries, organisations can attract top talent and foster innovation.

Respondents to the individual project survey expressed a strong desire for significant improvements in the transparency and accountability of research assessment processes. They suggested that the current system is flawed and needs urgent attention. To address these concerns, respondents presented several suggestions to make the assessment process fairer and more objective. See Box 6.

Box 6: Suggestions from survey respondents on alternative assessment approaches to improve transparency and objectivity in hiring and promotion of researchers

Suggestions to improve transparency and objectivity

- consideration of the percentage of research time allocated in academic positions and the productivity of researchers, relative to the available resources, to avoid political biases or favouritism towards larger universities

- assess research on an individual basis rather than solely relying on institutional affiliations

- publicly-available rankings and scores of assessed projects

- provide mentoring opportunities for emerging academics, especially those in health services research, to support their growth and development

- the system should be adaptable and reasonable, accommodating different methodologies and non-traditional outputs with standardised metrics and communication

- enhance transparency in decision-making processes by senior university officials, so mediocrity can be reduced, and excellence encouraged

- for university researchers, establishing collaboration among deans to promote consistency in the assessment processes

- acknowledge efforts to promote responsible practices in research supervision, data management, dissemination, and open science

- use more transparent practices for evaluating women and non-white-male researchers

- providing clearer descriptors of metrics

- incorporate research ethics, integrity, mentoring, and sponsorship in research assessment

- apply two-way research assessment processes, enabling subordinates to assess their supervisors

6.5 New directions and responses to digital systems

Governments have long sought efficient technical solutions to decrease the administrative burden of research assessment. This has included attempts to use bibliometrics in place of peer review (for example, in the UK's Research Assessment Exercise), in which flaws were quickly identified. Notably, systems have been developed to gain more efficient visibility into the data on research to support research assessment, especially for NTROs, such as products by IRIS-UMETRICS[viii] and Overton.

The rapid leaps in technology, most notably through increased accessibility and power of big data and analytics (including generative AI and more sophisticated modelling), present opportunities, as well as challenges, for automating and enhancing insights to support research assessment, especially in qualitative ways. Traditional publication peer review processes typically require considerable time from subject-matter experts to filter publications for quality and originality. AI has already been used to supplement peer review, such as in plagiarism detection, formatting tests and scope verification and identification of domain experts (Adams *et al.*, 2022). However, given the current limits of the technology, AI is unable to solely conduct peer review and, crucially, in these applications, the assessment of quality and excellence is still largely performed by human evaluators.

Despite the interest in using data-driven technologies for leaner forms of assessment, AI systems are trained on existing datasets and are created by system designers, so great care is needed to ensure that past prejudice and bias are not perpetuated, or new ones introduced. Without dramatic improvements in transparency and repeatability, AI cannot replace peer review due to challenges in explaining decisions, as well as potential bias towards high-scoring institutions over emerging and infrequently publishing ones. Some authors note other problems, including that these digital solutions can assess only shallow attributes of articles and cannot meaningfully assess aspects of quality (for example, originality, robustness and significance).

viii Institute for Research on Innovation and Science – Universities: Measuring the Effects of Research on Innovation, Competitiveness and Science.

Accuracy is also a problem, as it is not sufficient to replace expert scores, and there is potential for less accurate measures to encourage conservative behaviour (for example, targeting high-impact journals, gaming). Thus, strong caution is required, and AI-based approaches should not replace human peer evaluation, or otherwise diminish the role or number of peer reviewers in assessment processes.[57]

Another area of interest and concern for those capturing, incentivising, and rewarding research performance is the use of AI in research practices. AI and in particular machine learning, is being used across all fields and sectors from the creative arts through to cybersecurity and health diagnostics,[58] creating new opportunities, risks and challenges. Recent research has shown that AI is being used by researchers to increase personal productivity and to support collective endeavours such as citizen science, impact activities, and interdisciplinary working.[59] It can also be applied to research, such as through analysing large data sets enhancing imaging techniques or identifying patterns in results to predict outcomes. Generative AI platforms are also emerging, designed to help researchers analyse literature to extract key takeaways from papers related to a research question or extracting information from papers to help with literature reviews and publication development.[ix]

This raises questions about how metrics and peer review approaches designed to capture productivity and performance will respond to new AI-assisted ways of working. Without proper care, AI use could make research processes faster simply to facilitate meeting the demands of performance metrics, rankings and assessments, particularly for science, while having possible negative effects on research excellence and the welfare of researchers.

6.6 Narrative CVs

Emerging approaches aim to more readily identify researcher potential by understanding the context of past research achievements (in particular, relative-to-opportunity assessment) as well as allowing researchers to present their own 'best evidence' of potential by identifying their top-five or top-ten publications, or by providing a narrative CV.

AI-based tools, such as generative AI, allow researchers to more efficiently explain their skills and impact through developing narrative or traditional CVs, reducing the burden and stress of recreating CVs for new employment opportunities, including for people with low skills or confidence in English.[x]

Research funders have considered the value and potential benefits of narrative achievements over quantitative metrics and are making or considering changes to their funding schemes to encompass this. This sentiment is reflected by the NHMRC, which also examines evidence of leadership, collaboration and mentoring to encourage positive behaviours in collaboration and mentoring. As noted previously in section 6.1.2, some research employers, such as the European Molecular Biology Laboratory, have started providing guidance on how to develop a narrative CV for their advertised positions.

However, there were some conflicting views on whether researcher identified top-ten publications or narrative CVs provide a more complete picture of a researcher for funders or employers (see Box 7). The research opportunity and performance evidence statement of ARC applications have some similarities to the goals of narrative CVs. Some researchers have suggested that this is not popular with some, even with the guidance provided by universities and the emergence of AI tools.

> **Box 7: Suggestions from respondents (organisational survey) on alternative assessment approaches to use narrative CVs**
>
> Stakeholder suggestions to consider
>
> - implement the use of qualitative/narrative CVs to allow researchers to compare their performance with their peers in aspects including research output, service and citizenship, research integrity and quality, mentoring, and other contributions
>
> - support development of a strategic career plan with guidance from mentors and, in some cases, provide internal grants to help progress. This would encourage researchers to focus on their scientific pursuits, finding a unique niche, and exploring uncharted territory.

ix   See for example, https://elicit.org/ ,https://www.perplexity.ai/
x   See for example, https://www.linkedin.com/pulse/10-ai-powered-tools-create-effective-resume-speed-up-your-srivastava/

6.7 Open access: unlocking scholarly literature and the benefits of visibility

Even beyond complexities of journal impact factors and citations-based metrics, the academic publishing system creates barriers to research assessment practices, affecting individual's indicators of research impact and mobility. Most notably, non-academic potential employers often cannot access paywalled journals, and publishing costs may be prohibitive for researchers.

To address these challenges, the research community has developed initiatives to support open access (OA), which aims to make research articles and data freely accessible online without any restrictions. OA has the potential to accelerate the recognition, innovation and dissemination of research findings across the wider research community, especially outside academia. There are benefits, such as in the medical and health sector, where better availability of evidence-based research can improve treatments and information sharing. However, the Australian Chief Scientist, Dr Cathy Foley, has shown that a model of OA that requires researchers to pay high fees to publish creates a divide between those who can afford it and those who cannot, putting a financial burden on academic budgets.[60]

Implementing OA is further complicated by the large volume of published research, the affordability of access, and researchers' preferences for publishing in high-impact factor journals that are often behind paywalls. Nonetheless, OA articles are downloaded more frequently and attract more attention from the media and policymakers.[61] Researchers recognise the advantages and disadvantages of OA journals and are still determining how to increase citations in these journals while considering drawbacks, such as lower impact factors and unclear copyright policies.[62]

OA would require investment in policies and infrastructure, such as funding university repositories, agreements with publishers and local OA journals. Models adopted in other countries show that OA can be achieved without increasing costs, while respecting the rights of publishers and benefiting researchers and society as a whole.

Addressing OA is important to keep Australia on par with other countries in improving research transparency, and in facilitating better and fairer research assessment by non-academic employers, which is especially important in enabling sector mobility.

6.8 Randomised grant allocation

A problem for researchers is the low success rate for grant applications, coupled with burdensome application processes. Researchers who have been successful in previous grant rounds may win new grants on this basis, disadvantaging others. To overcome some of the impediments to accessing research grants, some funders have adopted lottery-style approaches to grant rounds, typically applied for small research grants at this stage. This presents a challenge for research assessment, which regularly uses grant success as a measure of career performance. In addition to changes to the consideration and weighting of grant funding, alternative approaches to grant allocation would benefit research assessment and research culture.

The Health Research Council of New Zealand, the British Academy, the Swiss National Science Fund, the Austrian Science Fund, and the Volkswagen Foundation have adopted, or are trialling, lottery-based approaches. Further details are outlined in Appendix 10. Locally, the Statistical Society of Australia uses lottery-based approaches to award scholarships.

Barnett (2016) states that randomised schemes would benefit from additional studies over time, given their recent introduction. Lottery-based schemes lack political and organisational support in some countries but have the potential to minimise bias from assessment panels relating to sexism, racism, or ageism.[63] They can reduce administrative burdens in shortlisting applicants. In evaluating the Health Research Council of New Zealand approach, Liu et. al. identify that a randomised process still requires a shortlisting of selected applicants.[64] Most lottery systems are staged, with the first stage involving a quality assessment like peer review, followed by a random process applied to the qualifying applications.

While many respondents had general feedback on research funding and the nature of how funding should be allocated, many of these views were out of scope. However, these suggestions provide useful information and will be shared with the Australian Government.

6.9 Strengthening and recognising collaboration

Collaborative approaches to research leads to improved quality and outcomes.[65] While exchanges between industry, government and academia can develop informally over time, increased collaborations, both formal and organic, would help encourage mobility of researchers outside academia and vice-versa through increased understanding and appreciation of the expertise associated with each sector.

Collaboration between sectors requires communication and coordination, understanding of the cultures of other entities, and assessing success not only from publications and citations, but on other metrics like project management and stakeholder and communication skills. Strong relationships between researchers across different sectors is critical to Australia's research and innovation ecosystem, and a stronger emphasis on collaboration in research assessment frameworks could help support greater collaboration, innovation, and career outcomes for researchers.

While there are already mechanisms to support collaboration, such as industry sponsoring PhD projects, efforts to promote scalability are required to enhance collaboration. New approaches to support, encourage and recognise impact and collaborative efforts would help support career trajectories and drive innovative solutions.

The approach could consider interdisciplinary work, industry needs, and sector specific metrics. In doing so, it will be important to incorporate research assessment mechanisms that encompass broader timeframes to recognise that research impact takes time, and recognises the value of all contributions, from initiation through to completion. Box 8 explores suggestions from survey respondents.

Box 8: Suggestions from survey respondents on strengthening and recognising collaboration

Stakeholder suggestions to consider

- encourage interdisciplinary and multisectoral collaborations at the national and international level as indicators of success. This can include measuring the number of co-authorships between academia and industry, as well as assessing the contributions of academia to industry or community of practice.

- foster collaborative work with Indigenous peoples, with a focus on power sharing and cultivating valuable relationships. Encouraging the use of Indigenous methodologies and ensuring the translation of research findings back to the community in their language is also important.

- promote collaborations among colleagues by encouraging joint authorship of books, book chapters, and other publications. This collaborative approach enhances knowledge sharing and the dissemination of research findings.

6.10 Supporting enhanced mobility

Consultations and survey findings reveal that mobility of researchers across different parts of the sector, such as between industry, government and academia, is constrained largely by the differing skills required:

- for universities, the research skills and experiences sought by employers relate primarily to ability and track record in securing grants, publishing in high-impact journals, and forming productive collaborations with external parties

- for businesses, desired attributes are industry experience, ability to work well in teams, and specific technical or methodological knowledge and skills

- think tanks, PFRAs and government departments are often more diverse in their employment of researchers, valuing research skills, but leaning towards policy inputs, impacts and outcomes.

Research assessment processes and metrics affect mobility. However, some initiatives support and facilitate researcher mobility between sectors, including internships, secondments, and fellowships (for example, Science Policy Fellowships).

Mobility of researchers could be enhanced if there was more harmonised understanding of researchers, and the different experiences they can bring to an organisation. The research sector could improve mobility by better recognising and enabling researchers in non-academic careers, for example allowing recognition of citations beyond traditional academic outputs, acknowledgement in grey literature (and other publication) citations, dual roles/appointments, and support for trisector employees. Alternative research assessment practices are emerging in some universities to facilitate the mobility of researchers and industry professionals back into academia.

Additionally, including a variety of transferable skills in PhD training would improve the readiness and mobility of researchers into non-academic research roles, especially in projects, communication, and stakeholder management.

7 How to modernise Australia's research assessment

To drive Australia's knowledge economy and solve complex problems, we need a highly-skilled research workforce. The way research is measured, incentivised and rewarded has a profound impact on this workforce, influencing the culture in which researchers work, their collaborations and ultimately their careers. While the assessment system has had some positive outcomes, it has created challenges. Australia's assessment approach should reflect the nation's values, ambitions and aspirations for research.

Research assessment, for this project, is the judgement we make about a researcher's activities and their research outcomes, for the purposes of appointment, promotion, and resource allocations. Broadly, there are two categories of errors that occur in making judgements, related to *accuracy* and *bias*.

'Accuracy' errors include relying on quantitative metrics when qualitative exploration is needed, or on metrics with little relationship to the real world. 'Bias' comes from conscious or unconscious preferences and values toward certain characteristics including gender, nationality, knowledge-system and career stage.

Data analysed for this report, including the assessment of international models, yields principles and enablers that will support Australia's research assessment system over the coming years. The more effective the assessment system, the better the people, organisations, and ideas.

This project reveals that

Australia's current research assessment system does not sufficiently:

- emphasise qualitative assessment by peers via responsible use of quantitative indicators

- incorporate contextual understandings of researchers, acknowledging the stage of career and different personal characteristic and backgrounds (such as socioeconomic, Indigeneity, sexuality, geography and career disruptions)

- leverage new technologies and processes to enable and validate fair assessment and create deeper insights, as well as minimising the financial and administrative burden on institutions

- hold organisations to account on transparency and decision-making in funding and resource allocations, access to opportunities, recruitment and career advancement.

Assessment of researcher performance must value and reward:

- the diversity of contributions and skills that make a researcher excellent

- the quality of research undertaken, even if the 'experiment' did not 'discover' anything

- the different roles researchers undertake, including non-research and non-traditional career pathways

- research leadership, including the contributions of research leaders to building the capability of their teams, such as through supervision and mentoring EMCRs

- multi-, inter- and trans-disciplinary research

- the roles researchers can play in supporting a diverse and inclusive research community, noting that this can create additional burdens on their own research output.

There are organisational gaps in enabling, supporting and promoting a positive and fair research assessment culture, as it affects researcher careers:

- leaders, managers and supervisors should ensure and foster a healthy and productive research workforce through their support, adherence to organisational processes and initiating arrangements that can better understand, manage and avoid potential biases in assessment and selection

- researcher mobility between academic and non-academic roles could be better enabled through improved consideration of the breadth of skills and indicators of actual and potential success, as well as supporting opportunities that offer mobility and flexibility, such as dual appointments

- work is needed to better enable and support research at the interface of Indigenous Knowledge, particularly by helping Indigenous researchers navigate careers and achieve impact, and understand, protect and commercialise their IP/ICIP rights.

Modernising research assessment in Australia will pave the way for a more effective and strategic research system. By embracing the above evidence-based insights, we can enable a research sector that:

- improves research excellence and integrity

- has clearer career pathways

- reduces administrative burdens on researchers and institutions

- focuses on research excellence, quality and impact

- enhances researcher mobility

- enhances alignment with international assessment processes.

The progress and impact will lay the foundation for a research ecosystem that is dynamic, strategic, and globally connected. It will empower researchers, institutions, and the community to realise the full potential of research, fostering innovation and driving societal impact. Embracing this transformation will unlock the transformative power of research assessment.
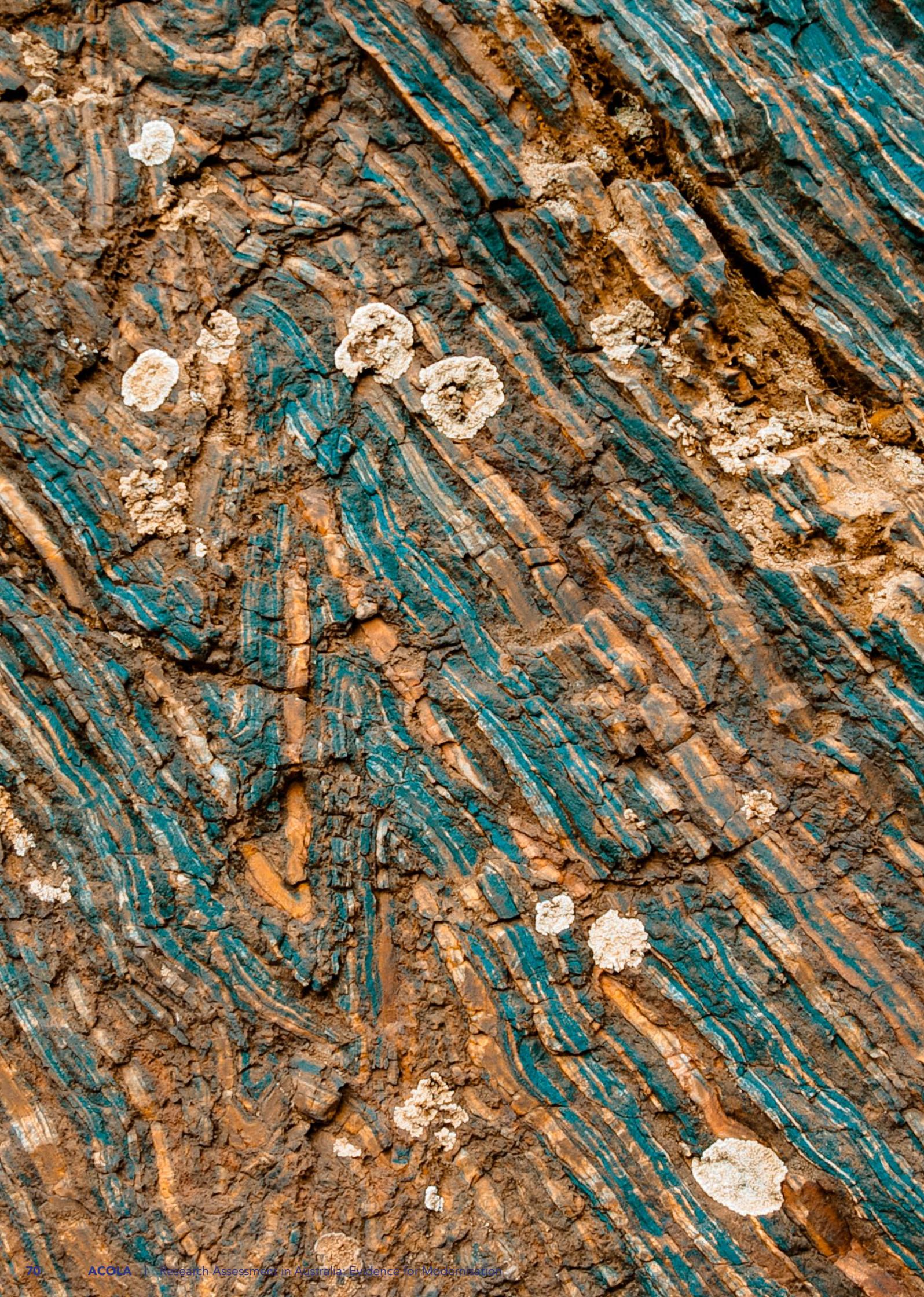
8 Potential actions to achieve a modern research assessment system

Improving Australia's research assessment system will be an iterative and non-linear process that takes time to build on existing strengths and activities. Work will be required to ensure a positive research culture and enabling environment for research and researchers to flourish. This section presents guiding elements to inform modernisation efforts, then outlines priority actions towards modernisation of the research assessment system.

The foundations of modern research assessment

In synthesising the evidence and analysis associated with this review, six pillars for a modern and effective research assessment system were identified (Figure 1). These pillars support valid, accurate information and reliable and consistent assessments. Care will be needed in considering organisational and system-level assessments, such as the future approaches by the ARC, to limit unintended consequences and perverse incentives, given the interactions between these forms of assessment.

Leadership
In responsible assessment, metrics innovation, and open research.

Transparency
Framework of standardises competencies, metrics and expectations.

Integrity
Fair, open and accountable assessment or research and researchers.

Equity and diversity
Reduce bias; promote cultural understanding; enhance Indigenous Knowledges ownership and assessment.

Collegiality
Promote and recognise supervision and service roles.

Collaboration
Recognise and reward collaboration, dual-sector roles and non-traditional research outputs.

Valid, accurate information

Reliable consistent assessments

Figure 1: The pillars of modern research assessment

Activities that could be considered by employers, funders and governments to build upon these pillars are outlined below, drawing on successful overseas activities, project analysis and suggestions from the sector.

Transparency

Australia needs sector-wide common language (consistent with international norms) and standards to underpin accurate judgements of fair, reasonable and comparative assessment across disciplines, career stages and sectors. This would guide funders, employers and the community, and clarify what is meant by quality research and researchers.

- A common transparent framework for 'standardised' researcher competencies, indicators and metrics across sector, career stage and disciplinary considerations will help researchers and employers, informing organisation employment and performance frameworks
- Increase alignment with international good practice and focus on quality and impact and balance current and past performance.

Integrity

As the saying goes, 'culture eats strategy for lunch', so employers need to foster and implement a positive and fair research culture that is accountable to the policies in place. Many researchers lack trust that they are being assessed fairly and transparently.

- Employers make publicly accessible their assessment approaches, including role descriptions and metrics, and their alignment with the organisational strategy
- Employers regularly review and be held accountable for how their policies and frameworks are applied in recruitment, advancement, and opportunities.

Equity and diversity

Biases exist in all aspects of society, sometimes unconsciously. It is important to understand, identify and avoid biases. Research assessment is no exception. Some researchers, particularly those from diverse backgrounds, can face barriers in being assessed fairly. Australia needs systems to ensure that the best researchers and research can flourish.

- Ensure assessment panels and processes involve multi-stage assessment that reflects diversity and helps panel members recognise their biases
- Better recognise the potential of researchers against burdens they can face, especially being carers, Indigenous, LGBTQIA+, , low socioeconomic status, researchers with disability, and intersectional identities
- Sector recognition and value of additional roles researchers play in the community, as leaders and voice for fellow researchers
- Investment in tools to understand, identify and ameliorate bias in assessment
- Enhance assessment approaches for understanding and measuring Indigenous impact
- Enhance approaches to Indigenous Knowledge ownership and support for researchers in managing IP/ICIP to support Indigenous Knowledge research outputs and outcomes.

Collegiality

Collegiality underpins the development of a positive research culture and support for the next generation of researchers . This occurs at multiple levels, with research and training supervisors and mentors playing critical roles. The quality of these interactions affects the success of research careers and the quality of research, but is not being fully valued and rewarded.

- Enhance metrics that better recognise the impact of good research leaders in the research community, for example readiness of PhDs for industry jobs
- Enhance understanding and approaches to the assessment of team-based metrics to inform individual researcher's career assessments.

Collaboration

d competition in support of quality. With real-world solutions increasingly at the nexus between 'the lab' and the 'real world', work is needed to better value multi-, inter- and transdisciplinary research and the movement of researchers between sectors.

- Enhance the recognition and valuing of collaboration in assessment processes. This could include valuing time spent in research roles in other sectors, dual roles, referencing of research in government documents and recognition of NTROs.
- Develop frameworks and supports for dual sector roles.
- Develop improved and robust approaches to assessing team research, especially in multi- and inter-disciplinary research.

Leadership

While employers of researchers have a substantive role in the development and application of research assessment, collective effort and leadership is needed, especially by governments, to set the tone and national parameters. Government leadership is needed to ensure Australia's approach to research assessment is aligned with, complements, or leads international approaches. Research sector leaders and policy makers need to ensure that research assessment systems and processes become as efficient as possible to reduce administrative burden and maximise efforts on knowledge creation and innovation.

- Government and organisational leadership will be critical to challenging unfair and perverse focuses on 'university league' processes (including working with the international companies specialising in the analysis and ranking of higher education institutions), driving open research, and championing engagement and implementation of processes such as DORA and CoARA to shape assessment.
- Employers and other organisations can improve the way indicators are considered and metrics are collected.
- New technologies and open science present opportunities to develop more efficient and new tools and metrics, especially regarding leadership capabilities, for research and researcher assessment, and to minimise burden on employees, assessors and organisations.
- Building on ERA, by leveraging new technologies where possible and appropriate.
- All employers of researchers to remove internal barriers and negative and inhibitive cultures for modern research assessment.

Glossary

Term	Definition
Engagement	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.
Gaming	Deliberate and unscrupulous manipulation of data or reporting to improve assessment outcomes.
Indicator	Quantitative measures of the degree to which a result is occurring over time. In identifying and developing indicators, it should be considered that they are: quantitative, internationally recognised, relevant, repeatable, verifiable and time bound.
Learned Academies	The five academies recognised by the Australian Government as Learned Academies. These comprise: the Academy of the Social Sciences in Australia, the Australian Academy of Health and Medical Sciences, the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering, and the Australian Academy of the Humanities.
LGBTQIA+	A term referring to people who are lesbian, gay, bisexual, transgender, queer, intersex and asexual. The + holds space for the expanding and new understandings of diverse gender and sexual identities.
Metrics	A system of related measures used to assess performance of research and quantify characteristic outputs or outcomes of that research.
Peer review	The impartial and independent assessment of research by others working in the same or a related field.
Research	The creation of new knowledge and/or the use of existing knowledge in a new and creative way 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.
Research assessment	The processes and metrics used to evaluate the performance of researchers and research institutions, including the quality, excellence and impact of various outputs. It can include standardised forms of both qualitative and quantitative measurement and reporting.
Research assessment indicators	Proxy measures of research performance or outcomes.
Research excellence	The *contribution* the *specific research makes* to (new) knowledge and complexity of thinking, such as breakthroughs in understanding difficult concepts and transcendence of boundaries.
Research impact	The *benefits* realised *as a result of specific research*. Specifically, the benefits outside of academia, such as economic, social and other benefits.
Research integrity	The *behaviours* through which research is undertaken *by a researcher*, to ensure adherence to the ethical principles and professional standards essential for the responsible conduct of research.
Research quality	The *process* through which research is undertaken *by a researcher*, to ensure it is rigorous, transparent and in-principle reproducible. It focuses on: research design, (the right) method(s), measurements, data analysis approach, reporting and supervision standards.
Researcher	Person (or persons) who conducts, or assists with the conduct of, research.
Scientist	See 'researcher'.

Abbreviations

Term	Definition
ACOLA	Australian Council of Learned Academies
AI	artificial intelligence
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
ANTSO	Australian Nuclear Science and Technology Organisation
ARC	Australian Research Council
ASSA	Academy of the Social Sciences
CoARA	Coalition for Advancing Research Assessment
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CV	curriculum vitae
DORA	Declaration on Research Assessment
EI	Engagement and Impact Assessments
EMCR	Early- and mid-career researchers
ERA	Excellence in Research for Australia (program run by the ARC)
GDP	gross domestic product
GII	Global Innovation Index
GLAM	galleries, libraries, archives and museums
HASS	humanities, arts and social sciences
HFSP	Human Frontier Science Program
ICIP	Indigenous cultural and intellectual property
IP	intellectual property
JIF	journal impact factor
KPIs	key performance indicators
MRI	medical research institute
NHMRC	National Health and Medical Research Council
NTRO	non-traditional research outputs
OA	open access
PFRAs	publicly funded research agencies
R&D	research and development
SMEs	small to medium enterprises
STEM	science, technology, engineering and mathematics

Appendix 1
Project aims and scope

At the request of the Australian Government, Australia's Chief Scientist commissioned ACOLA to undertake a review of how research assessment affects research culture and the behaviours and choices of Australian researchers across the research and innovation system. The review seeks to understand how research metrics influence the diversity of Australia's research workforce, and shape research quality, outputs and impact. The review will inform the Chief Scientist's advice to government to ensure that assessment of researchers in Australia:

- recognises the valuable and essential contribution of the range of research activities, including mentorship, outreach, team science, innovation and commercialisation

- supports a diverse research workforce[xi]

- facilitates researcher mobility between research, industry and government, adequately recognising time spent working in industry or with industry partners

- accurately recognises research quality and research excellence, while supporting research integrity

- provides the right incentives for researchers and institutions to engage in high quality research, development and innovation.

Scope

The report will include:

1. An overview of metrics currently being used in the Australian system to assess individual researchers, research projects, research institutes or organisations and universities.

    a. This includes metrics used for government research funding, private research funding, international funding opportunities and by institutions themselves for the recruitment and advancement of their research workforce.

    b. Research is in scope as it relates to research in universities, research institutes, government and publicly funded research agencies, and research conducted in industry.

    c. The focus should be on metrics that are in use, noting that sophisticated metrics may be available in principle, but not used in practice.

11 Gender diversity is necessarily a key focus of this work, as there is a significant gender imbalance in STEM that is contributing to skills shortages and a lack of team diversity. For the purposes of this project, questions of diversity should address both personal characteristics (including gender, age, language, culture, disability, sexual orientation, sex and gender, and religion) and diversity of opportunity (including urban/rural/remote location, size of research institution and research group, and access to international collaborations).

2. A system-wide analysis of the impact of research assessment on Australia's research workforce, such as

    a. How assessment currently in use for recruitment, advancement and funding impact workforce diversity and inclusion

    b. How assessment drives researcher publishing behaviour and career choices

    c. The impact of pressure to publish on individual and institutional ability to apply for intellectual property protections

    d. How international rankings drive university behaviour that impacts individual researchers and their careers, with particular reference to workforce diversity

The research workforce is in scope as it relates to researchers in universities, research institutes, government and publicly funded research agencies, and research conducted in industry.

3. Highlights of international activity in research assessment in countries with comparable science and research systems, such as

    a. Comparative advantages of qualitative and quantitative research assessment

    b. Achieving best practice in research workplace culture, including supporting a diverse research workforce.

    c. Best practice means of assessing quality and content qualitatively, without excessive administrative burden

    d. Best practice in funding and grant applications from both Australia and overseas.

4. Details of emerging ways of assessing research in Australia.

5. Possibly through short case-studies, examine the intersection between Australia's research metrics and other research themes, such as:

    a. open access

    b. gender imbalance in STEM particularly in senior research roles, and

    c. differences in assessing research output and impact according to the research discipline.

Appendix 2
Research method and approach

This project used a mixed methods approach to gather evidence, combining desktop research with consultation processes including surveys, roundtable discussions and interviews. This involved several stages, as follows:

- desktop reviews of research assessment frameworks and metrics in Australia and internationally

- a survey on research assessment for individual researchers, distributed widely through networks, research organisations and social media networks

- a survey for research organisations, distributed to a targeted list of organisations

- a series of roundtable discussions with different stakeholder groups

- a series of interviews with key stakeholders.

Drawing on the strength, expertise and networks of Australia's five Learned Academies, ACOLA collected and synthesised current and new evidence through literature reviews and engagement to investigate experiences with and approaches to research assessment.

Stakeholders involved in the consultations included universities, research funders, research sectors, government agencies, PFRAs, EMCRs, diversity groups, and industry; each contributed their unique perspectives. Engagement extended from the Academies to wider Fellowships, researchers from across Australia, Australian universities, other research institutes and researchers, government agencies, PFRAs, industry, and international universities and organisations.

Data from these consultation processes were processed and analysed, and further inquiries with stakeholders undertaken as required. Information was synthesised into key findings and implications for this report. The project was overseen by an Expert Working Group, with membership drawn from the Fellowships of Australia's Learned Academies, industry experts and the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS). Policy, research and project management were provided by a project team comprising ACOLA and Academy of the Social Sciences in Australia staff.

Data collection

To understand perspectives and experiences within the research sector on research assessment, two surveys were conducted.

The first survey focused on individual researchers; this was open for approximately six weeks and consisted of 61 closed-ended and 14 open-ended questions (75 questions). Questions included demographics, perceived legitimacy of research assessment practices, practical applications of metrics, consequences of current approaches, and how assessment practices affected the researcher's decision-making. The survey received 1,864 responses, of which 1,428 were complete or mostly complete, and included in the analysis. Further details about the survey, including the characteristics of the sample and the survey results can be found in Appendix 11.

A second survey was directed to research organisations. This was open for approximately four weeks and consisted of 25 closed-ended and open-ended questions (29 questions un total). The questions asked explored the types of research metrics currently being used to assess staff and research progress, how staff were being supported, measures being taken to promote diversity, and the relationship between organisations and industry, as well as other topics. This received a total of 125 responses, of which 70 were partial responses, and 54 full responses were included in the analysis. Further details about the survey, including the characteristics of the sample and the survey results can be found in Appendix 12.

In addition to the surveys, 25 interviews with key stakeholders and experts and 11 roundtables involving various segments of the Australia's research sector were undertaken to gather insights into research assessment practices in Australia and overseas.

Details of interviews and roundtables are presented in Tables 5 and 6, respectively.

Table 5: Details of interviews

Interviewees	Date
Interviewee 1	26 May 2023
Interviewee 2	30 May 2023
Interviewee 3	31 May 2023
Interviewee 4	31 May 2023
Interviewee 5	2 June 2023
Interviewee 6	5 June 2023
Interviewee 7	6 June 2023
Interviewee 8	6 June 2023
Interviewee 9	6 June 2023
Interviewee 10	7 June 2023
Interviewee 11	7 June 2023
Interviewee 12	7 June 2023
Interviewee 13	8 June 2023
Interviewee 14	12 June 2023
Interviewee 15	13 June 2023
Interviewee 16	14 June 2023
Interviewee 17	16 June 2023
Interviewee 18	16 June 2023
Interviewee 19	23 June 2023
Interviewee 20	26 June 2023
Interviewee 21	30 June 2023
Interviewee 22	4 July 2023
Interviewee 23	6 July 2023
Interviewee 24	6 July 2023
Interviewee 25	18 July 2023

Details of roundtables conducted for this project can be found in Table 6.

The data collection for this report fills a crucial knowledge gap in the Australian context of research assessment, directly addressing the scarcity of survey and consultation data to date. As mentioned earlier, numerous articles highlight the potential limitations on researchers through rigid and generic assessment, and concerns have been raised about researchers tailoring their work to fit the system. There is a limited understanding of how research assessment systems are affecting Australian researchers and influencing both their research outputs and career prospects, and underrepresented groups especially remain largely unheard. This research also aims to explore the complex relationship between universities, organisations and industry, to generate understanding for improvement of the current systems.

Because this data is largely based on individual perceptions, it provides a rich tapestry of insight into barriers on a personal level. It also points to systemic challenges that individuals are finding with the processes they have engaged with. It is worth noting that because research work itself is often a fragmented assemblage of diverse activities across the span of a career, those within the system should be granted a high degree of authority in articulating the shape of their careers and assessment pressures; their insights provide a valuable insight into an otherwise opaque landscape.

Regardless, we accept that there are likely voices we have not captured – likely those hardest to reach and least powerful in the system. Ongoing work by the sector is needed to ensure future work continues to be as comprehensive and as inclusive as possible.

The deidentified data from the two surveys is available for non-commercial research on request.

Table 6: Details of roundtable discussions

Number	Group	Date
1	FACS Meeting	18 May 2023
2	GSG Meeting	23 May 2023
3	QueersinScience	26 May 2023
4	EMCR groups/networks	1 June 2023
5	AIATSIS	9 June 2023
6	Research sector/Universities	13 June 2023
7	Diversity group	14 June 2023
8	Research funders	15 June 2023
9	Industry	19 June 2023
10	CRA members (industry)	28 June 2023
11	Science Policy Fellowship alumni	3 July 2023

Appendix 3
Citation impact analysis

The importance of measuring and understanding the influence and significance of scientific works within specific fields is vital for researchers, institutions and funders. One essential tool for this analysis is citation impact analysis, which provides profound insights into the impact and use of scientific literature through citation counts. Researchers can gain knowledge about the reach and recognition of their published work, identify emerging trends and find potential avenues for future investigations. This allows them to align their work with evolving research directions, facilitating ongoing relevance and impact.

Understanding the return on investment for research efforts is crucial for resource allocation. Citation impact analysis not only benefits individual researchers but also helps institutions and funders in making informed decisions. Using citation impact analysis, institutions and funders can assess the influence and impact of the scientific literature produced, allowing them to allocate resources to areas that have demonstrated significant impact and returns. Moreover, insight into knowledge flow patterns enables institutions and funders to identify research directions that align with their strategic goals, ensuring meaningful outcomes from their investments.

There are three common citation indicators used in citation impact analysis: the JIF, altmetrics score and field-weighted citation impact. The JIF assesses the reputation of a journal by measuring the average number of citations its articles receive. The altmetrics score measures the online attention and engagement of a research publication, providing dynamic feedback on its relevance and public interest. Lastly, the field-weighted citation impact compares the citation impact of a research publication to the global average of similar publications, accounting for differences across diverse fields and disciplines.

In a study by Wheeler et al. (2022), the citation impact of various types of open access repositories was examined. The effectiveness and influence of different repository types in increasing visibility and citation impact were assessed. While citations are just one measure of impact and may not fully capture the value of institutional repositories, they do support economic development, local policymaking, and the publication and preservation of unique collections. In addition to citations, altmetrics and analysis of citations within grey literature are warranted to fully understand the impact and value of institutional repositories. The availability of electronic theses and dissertations through institutional repositories also contributes significantly to open scholarship.[66]

Appendix 4
Global university rankings shape student choices

University rankings have a significant impact on the behaviour of students when selecting an institution for higher education. Rankings act as a crucial reference point for students to evaluate the quality and prestige of universities with an objective assessment based on factors such as academic reputation, research output, faculty quality and student satisfaction. Recognising this, students often choose to enrol in institutions with higher rankings in search of a better education with greater career prospects.

As the demand for higher-ranked universities increases, the level of competition among institutions also rises. To attract more students, many institutions focus on improving the areas that contribute to their ranking position, such as research output, faculty quality, infrastructure and student services. By doing so, they aim to enhance their reputation and visibility and attract a larger number of students.

However, it is essential to consider other factors beyond the rankings when making this important decision. Ultimately, the choice of a university should also be based on factors such as program offerings, location, financial considerations and personal preferences. Therefore, students should take a holistic approach to choosing an institution. While international university rankings may serve as a valuable guide, it is essential for students to gather a comprehensive range of information to make an informed decision about the education provider best suited to their needs.

Several organisations produce annual rankings of global universities. The three largest are:

- **Times Higher Education (THE) World University Rankings**, which collects indices of research influence (as indicated by Web of Science citations), research volume, teaching indicators and international diversity. Among the 1,800 universities included, Australia had seven institutions in the top 100 in 2023, with the University of Melbourne ranked highest at 34. THE also produces rankings based on subject area and university reputation.

- **Quacquarelli Symonds (QS) Rankings**, which draws on SCOPUS records and a large survey of academics and employers to rate around 1,500 universities on measures of academic reputation, citations per faculty member, employer reputation, and international staff and student ratios. Three Australian universities ranked in the top 20 in 2024, with the University of Melbourne highest ranked at 14. QS also provides subject area and governance rankings, among others.

- **Academic Ranking of World Universities (Shanghai Ranking)**, which is weighted heavily towards leading scientists as staff and alumni, with 50% of the ranking based on Nobel Laureates or Fields Medallists (staff or alumni; 30%) and *Nature* or *Science* publications (20%). Of the more than 3,000 universities included, seven Australian institutions made the top 100 of the most recent 2022 list, with the University of Melbourne first at number 32.

Despite different indicators and methodologies, each of these university ranking schemes favour research output, with a bias towards STEM disciplines included in citation indices.

Consultation participants indicated that global university rankings are a high priority for research-intensive universities, with significant resources dedicated to optimising organisational performance in the rankings, and much made of strong results in promotion and marketing.

Participants also noted that global university rankings can be 'self-fulfilling', with higher ranked universities attracting more students (and hence revenue), allowing them to attract, develop and retain more high-quality researchers and to invest more in research activities and infrastructure, thus boosting their output and, consequently, rankings.

Finally, participants noted that global university ranking providers are in the process of diversifying their indicators and that this may encourage a change in assessment processes within research intensive universities. QS was the first of the ranking providers to introduce such changes for the 2024 rankings, including measures of student employment outcomes, international engagement and sustainability focus. Overall, this change benefited the standing of most Australian universities, with the top-ranked University of Melbourne moving from 30 in 2023 to an all-time high of 14.

Appendix 5
External factors and research assessment

External factors affect employers' decisions about the composition and assessment of their workforce, and ultimately the careers of current and prospective researchers. The nature of and priority placed on specific workforce capabilities and metrics reflects the diversity of the organisation and their strategic objectives. However, several externalities influence the approaches and metrics that organisations use in engaging and promoting their researcher staff.

The need for universities to cover the full cost of research

As is well documented, Australia's national research funding system does not cover the full cost of research or the breadth of research endeavours. To address this, universities seek other income to cross-subsidise research, most notably international and postgraduate student fees, as government rules prevent domestic student fees covering research.

In a competitive global student marketplace, universities rely on marketing to improve their attractiveness against other universities. While rankings are publicly debated and vary in their methodology (see Appendix 4), it is clear students take account of rankings in their decision-making processes. As such, to a greater or lesser extent, most universities consider the metrics used in ranking systems, such as bibliometrics, to shape their workforce decisions. In interviews, some universities stated explicitly institutional priorities linked to students and rankings, such as staying in the top 'X' of universities globally.

The degree these ranking systems influence hiring decisions varies by institution, and often by school and faculty. There are numerous strategic hires within universities of highly cited researchers to improve rankings, student attraction and research outputs.

Government measurement of excellence and impact

Appropriately, governments are increasingly responding to public pressure to identify and demonstrate value from public funds, including in research. As a result, they have sought to develop sophisticated systems to measure quality and impact of research and research organisations. As opposed to commercial or not-for-profit university rankings/league tables, which are mostly oriented towards informing student consumers, these systems are intended to inform government decision-making.

Notably, ERA is intended to support quality assurance, demonstrate the effective use of resources, assist in the analysis of research, aid in the advocacy within government for the allocation of resources to meet national research objectives, and provide an objective basis for the distribution of resources. However, like all metric-based systems, it has been argued that organisations can easily optimise/shape outcomes in their ERA ranks, leading to distortion (for example, by staff movements or targeted categorisation of research outputs).

For example, it encourages researchers to 'teach to the test', encouraging a metric-based research program targeting high impact journals and high citation topics. There is a disincentive to publish in specialised journals, even where those journals provide better access to relevant peer audiences.

Government research priorities

A significant amount of research activity is shaped by price signals from the market. As the largest single funder of R&D in Australia, the Australian Government, across its various programs and tax incentives, strongly influences the focus and nature of research activity at institutions and ultimately by researchers. While none will debate the importance of national priorities, a quick change in priorities can 'strand' specialised researchers and limit their future career prospects.

Notably, this can also impact disciplines significantly and differently, as responding to research priorities can shift the balance away from the best quality research at an institution, for example shifting funding from the social sciences, towards commercially focused research.

Competitive leadership and building new relationships

While government agencies and businesses are unlikely to rely on rankings of institutions alone in shaping commercial or relationship decisions, we have heard during consultations that rankings can shape board and shareholder perspectives of organisations.

Appendix 6

Comparison of international research assessment approaches

	Australia	United Kingdom
Name	Excellence in Research for Australia (ERA)	Research Excellence Framework (REF)
Description	Peer review or citation analysis of prior research	National peer review of prior research
Purpose	1. Benchmarking 2. Creating incentives to improve quality 3. Accountability	1. Allocating funding 2. Accountability 3. Benchmarking
Criteria	1. Quality 2. Activity 3. Application	1. Quality 2. Impact 3. Environment
Submissions	1. Explanatory statements 2. Eligible researchers 3. Research outputs 4. Research income 5. Applied measures	1. Outputs 2. Impact case studies 3. Environment statements (plus data on research income and doctoral degrees)
Procedures	Assessments of data are undertaken across eight Research Evaluation Committees	Assessment of the submissions by panels of experts, who assign a score to each submission based on the three criteria
Key reviews		67, 68

	Norway	Germany
Name	Norwegian Model	Excellence Strategy
Description	National peer review of prior research in subject areas	National two-stage peer review of research proposals
Purpose	1. Informing institutional improvements 2. Informing national funding strategies and priorities	1. Promoting research 2. Funding research 3. Enhancing competitiveness 4. Promoting collaboration
Criteria	1. Quality 2. Impact 3. Organisational performance	1. Quality 2. Significance 3. Feasibility
Submissions	1. Bibliographic records 2. Free text descriptions 3. Impact case studies	1. Proposals for research clusters 2. Proposals to enhance research capabilities
Procedures	Assessment of the submissions by panels of experts, informed by a national bibliometric database	Assessment by international panel of experts of proposed research projects and the overall research strategies of the institutions
Key reviews		

Netherlands	Sweden	New Zealand
Standard Evaluation Protocol (SEP)	N/A	Performance-Based Research Fund (PBRF)
Institutional peer review of prior research	Peer review of research outputs and environment	National peer review of prior research
1. Informing development of research policies 2. Enhancing competitiveness	1. Providing feedback 2. Identifying areas where research can be strengthened 3. Allocating a small portion of research resources	1. Allocating funding 2. Incentivising excellence 3. Encouraging research culture
1. Quality 2. Social relevance 3. Viability of group	1. Quality 2. Impact	1. Quality 2. Research degrees 3. External Income
1. Self-assessment report 2. Open science 3. Academic culture 4. HR policy 5. PhD policy	Indicators of external funding, productivity and citation impact within Web of Science	Portfolio of evidence of research activity and performance
Assessment via site visit to the university to meet with the researchers, evaluate research outputs and review infrastructure and support.	Individual universities develop their own research assessments, with the assistance of international expert panels	Assessment of portfolios by expert panels made up of researchers and research users
69		70

China	Hong Kong	Canada
Evaluation of Representative Outcomes (ERO)	Research Assessment Exercise (RAE)	N/A
National peer review of prior research	National peer review of prior research	Province-level assessments
1. Promoting diversity of evaluation criteria in research 2. Focusing on national journals	1. Informing funding 2. Accountability 3. Benchmarking	1. Accountability 2. Assessing policies 3. Enhancing practices 4. Allocating funding (2 provinces)
1. Quality 2. Contribution 3. Impact	1. Quality 2. Impact 3. Environment	1. Outputs 2. Environment 3. Impact
Landmark achievements (for example, new discoveries, new ideas, new principles, new mechanisms, new technologies, new processes, new products, new materials, new equipment)	1. Outputs 2. Impact case studies 3. Environment statements 4. Data on research income	Varies by province
Assessment of submissions of representative works, instead of the sheer number of publications, with a focus on national publications	Assessment of the submissions by panels, who assign a score to each submission based on the three criteria	Assessments designed and implemented independently by the provinces
	71	

Appendix 7
Overview of guidelines on best practice in research assessment

Guideline	Year	Summary of key lessons
San Francisco Declaration on Research Assessment (DORA)	2013	1. Eliminate journal-based metrics as a primary means of evaluating research and researchers. 2. Develop new indicators that more accurately measure the impact and quality of research.
Leiden Manifesto	2015	1. Use a diverse range of metrics based on the research field and the nature of the research. 2. Reduce potential misuse of metrics. 3. Ensure greater transparency in the use of metrics.
Metric Tide	2015	1. Reduce emphasis on JIFs and provide a range of article-level metrics. 2. Develop clear principles for research assessment. 3. Be explicit about the criteria used for academic appointments. 4. Ensure transparency and interoperability, and enable more open and transparent data infrastructure.
Hong Kong principles	2020	1. Foster responsible research practices. 2. Enable transparent reporting. 3. Promote open science. 4. Value various types of research and recognise all contributions to research and scholarly activity.
Position Statement and Recommendations on Research Assessment Processes	2020	1. Develop clear and transparent assessment processes. 2. Monitor and evaluate assessment processes. 3. Address bias and discrimination in assessments. 4. Standardise assessment processes. 5. Focus on the substance and content of applications. 6. Consider novel assessment techniques.
SCOPE framework	2021	1. Evaluate only where necessary. 2. Evaluate with the evaluated (co-produce). 3. Critically analyse evaluation approaches (and data) when designing evaluation approaches. 4. Test the need for evaluation.
Institute for Science in Europe	2022	1. Involve researchers in decision-making. 2. Discontinue the use of unsuitable metrics. 3. Agree on appropriate evaluation methods. 4. Provide sufficient funding for Open Science practices.
Agreement on Reforming Research Assessment	2022	1. Acknowledge diverse outputs, practices and activities. 2. Prioritise qualitative judgements. 3. Responsibly incorporate quantitative indicators.
UK Future Research Assessment Programme	2023	1. Avoid adopting a fully metricised system. 2. Only utilise metrics, AI, or machine learning to support or inform less risky areas of the assessment. 3. Peer review and verify any automation in post-assessment data analysis.

Appendix 8
San Francisco Declaration on Research Assessment[72]

The below is a direct copy of the San Francisco Declaration on Research assessment.[xii]

There is a pressing need to improve the ways in which the output of scientific research is evaluated by funding agencies, academic institutions, and other parties. To address this issue, a group of editors and publishers of scholarly journals met during the Annual Meeting of The American Society for Cell Biology (ASCB) in San Francisco, CA, on December 16, 2012. The group developed a set of recommendations, referred to as the San Francisco Declaration on Research Assessment. We invite interested parties across all scientific disciplines to indicate their support by adding their names to this Declaration.

The outputs from scientific research are many and varied, including: research articles reporting new knowledge, data, reagents, and software; intellectual property; and highly trained young scientists. Funding agencies, institutions that employ scientists, and scientists themselves, all have a desire, and need, to assess the quality and impact of scientific outputs. It is thus imperative that scientific output is measured accurately and evaluated wisely.

The Journal Impact Factor is frequently used as the primary parameter with which to compare the scientific output of individuals and institutions.

The Journal Impact Factor, as calculated by Thomson Reuters*, was originally created as a tool to help librarians identify journals to purchase, not as a measure of the scientific quality of research in an article. With that in mind, it is critical to understand that the Journal Impact Factor has a number of well-documented deficiencies as a tool for research assessment. These limitations include: A) citation distributions within journals are highly skewed; B) the properties of the Journal Impact Factor are field-specific: it is a composite of multiple, highly diverse article types, including primary research papers and reviews; C) Journal Impact Factors can be manipulated (or 'gamed') by editorial policy [5]; and D) data used to calculate the Journal Impact Factors are neither transparent nor openly available to the public. Below we make a number of recommendations for improving the way in which the quality of research output is evaluated. Outputs other than research articles will grow in importance in assessing research effectiveness in the future, but the peer-reviewed research paper will remain a central research output that informs research assessment. Our recommendations therefore focus primarily on practices relating to research articles published in peer-reviewed journals but can and should be extended by recognizing additional products, such as datasets, as important research outputs. These recommendations are aimed at funding agencies, academic institutions, journals, organizations that supply metrics, and individual researchers.

A number of themes run through these recommendations:

- the need to eliminate the use of journal-based metrics, such as Journal Impact Factors, in funding, appointment, and promotion considerations;

- the need to assess research on its own merits rather than on the basis of the journal in which the research is published; and

- the need to capitalize on the opportunities provided by online publication (such as relaxing unnecessary limits on the number of words, figures, and references in articles, and exploring new indicators of significance and impact).

We recognize that many funding agencies, institutions, publishers, and researchers are already encouraging improved practices in research assessment. Such steps are beginning to increase the momentum toward more sophisticated and meaningful approaches to research evaluation that can now be built upon and adopted by all of the key constituencies involved.

The signatories of the San Francisco Declaration on Research Assessment support the adoption of the following practices in research assessment.

General recommendation

1. Do not use journal-based metrics, such as Journal Impact Factors, as a surrogate measure of the quality of individual research articles, to assess an individual scientist's contributions, or in hiring, promotion, or funding decisions.

For funding agencies

2. Be explicit about the criteria used in evaluating the scientific productivity of grant applicants and clearly highlight, especially for early-stage investigators, that the scientific content of a paper is much more important than publication metrics or the identity of the journal in which it was published.

3. For the purposes of research assessment, consider the value and impact of all research outputs (including datasets and software) in addition to research publications, and consider a broad range of impact measures including qualitative indicators of research impact, such as influence on policy and practice.

For institutions

4. Be explicit about the criteria used to reach hiring, tenure, and promotion decisions, clearly highlighting, especially for early-stage investigators, that the scientific content of a paper is much more important than publication metrics or the identity of the journal in which it was published.

5. For the purposes of research assessment, consider the value and impact of all research outputs (including datasets and software) in addition to research publications, and consider a broad range of impact measures including qualitative indicators of research impact, such as influence on policy and practice.

For publishers

6. Greatly reduce emphasis on the journal impact factor as a promotional tool, ideally by ceasing to promote the impact factor or by presenting the metric in the context of a variety of journal-based metrics (e.g., 5-year impact factor, EigenFactor, SCImago, h-index, editorial and publication times, etc.) that provide a richer view of journal performance.

7. Make available a range of article-level metrics to encourage a shift toward assessment based on the scientific content of an article rather than publication metrics of the journal in which it was published.

8. Encourage responsible authorship practices and the provision of information about the specific contributions of each author.

9. Whether a journal is open-access or subscription-based, remove all reuse limitations on reference lists in research articles and make them available under the Creative Commons Public Domain Dedication.

10. Remove or reduce the constraints on the number of references in research articles, and, where appropriate, mandate the citation of primary literature in favour of reviews in order to give credit to the group(s) who first reported a finding.

For organizations that supply metrics

11. Be open and transparent by providing data and methods used to calculate all metrics.

12. Provide the data under a licence that allows unrestricted reuse, and provide computational access to data, where possible.

13. Be clear that inappropriate manipulation of metrics will not be tolerated; be explicit about what constitutes inappropriate manipulation and what measures will be taken to combat this.

14. Account for the variation in article types (e.g., reviews versus research articles), and in different subject areas when metrics are used, aggregated, or compared.

For researchers

15. When involved in committees making decisions about funding, hiring, tenure, or promotion, make assessments based on scientific content rather than publication metrics.

16. Wherever appropriate, cite primary literature in which observations are first reported rather than reviews in order to give credit where credit is due.

17. Use a range of article metrics and indicators on personal/supporting statements, as evidence of the impact of individual published articles and other research outputs.

18. Challenge research assessment practices that rely inappropriately on Journal Impact Factors and promote and teach best practice that focuses on the value and influence of specific research outputs.

Appendix 9
ERA and EI: fostering excellence and translating impact

In Australia, research assessment practices are used in various organisations to identify and promote excellence in research. They play a crucial role in recognising and promoting excellence in research. Two key initiatives in this regard are the Excellence in Research for Australia (ERA) and the Engagement and Impact (EI) assessments. While ERA focuses on research quality and international benchmarks, EI aims to evaluate research engagement and impact beyond academia.

Excellence in Research for Australia

ERA, administered by the ARC, compares research conducted at Australian universities with international standards. Its primary objective is to incentivise the improvement of research quality. The data generated through ERA is valuable to government entities, universities, industry partners, and prospective students. It informs government policies and decision-making, aids universities in strategic planning and research promotion, and provides discipline-specific information for various stakeholders.

The assessment framework of ERA assures the government, industry and the wider community of the excellence of research. It identifies research strengths, facilitates comparison between universities and international benchmarks, and supports the growth of research capabilities at a national level. The benefits of ERA include identifying areas for development and investment, enabling strategic planning, promoting research strengths globally and instilling confidence in research investments.

The ERA assessment evaluates research performance within each discipline at each university, offering a comprehensive view of Australian research across various fields. Through the National Report, it highlights research strengths and provides contextual information about applications, knowledge exchange and collaboration.

The program's evaluation process is based on the principle of expert review informed by indicators. It uses three broad categories: indicators of research quality, indicators of research activity and indicators of research application. Each of the ERA indicators is based on comparable, quantitative, internationally recognised indicators used for other disciplines. The ERA indicator suite was designed to align with the research behaviours of each discipline, resulting in differences in the selection of indicators.

Research engagement is the interaction between researchers and research end-users outside of academia, for the mutually beneficial transfer of knowledge, technologies and methods or resources.

Research impact is the contribution that research makes to the economy, society, environment or culture, beyond the contribution to academic research.

(Source: https://dataportal.arc.gov.au)

It is essential to note that while ERA is a reliable source of information on research quality, the Australian Government introduced another assessment process called the EI in 2017. EI focuses on measuring universities' engagement with industry and communities, as well as the impact of their research beyond academia. Each assessment has its own set of criteria and indicators, tailored to the needs of specific disciplines.

Engagement and Impact

The EI assessment is conducted alongside the ERA assessment. Both assessments aim to emphasise the significance of Australia's research sector in different ways. EI focuses on evaluating researchers' engagement with end-users of research and the translation of research into tangible impacts beyond academia, which can be economic, social, environmental or cultural in nature.

The objectives of EI are multifaceted. Firstly, it aims to promote better practices in research engagement and impact, fostering benefits for end-users and the broader Australian community. Secondly, it intends to provide a comprehensive and reliable source of information on university research engagement and impact strategies, practices and outcomes. This information supports the needs of university stakeholders, industry partners, the community and government entities. Additionally, EI serves to demonstrate the success of Australian universities in engaging with research end-users and producing research with various societal benefits. Lastly, it enables comparisons between Australian universities in terms of research engagement and impact performance at the discipline level.

The EI assessment provides valuable insights into university performance in research engagement and impact, and the results are compiled in the National Report. The report showcases how Australian universities fare in terms of engagement and impact across various disciplines. Narrative case studies are published on the ARC data portal, highlighting diverse approaches to engagement and impact and serving as best practice examples for universities, research end-users and government entities, to inform future planning.

The assessments of EI comprise two parts: engagement and impact studies. The engagement narrative provides an explanation of the interaction between researchers and research end-users outside of academia, while the qualitative impact studies detail the endpoint, contributing research and the approach to impact. Each unit of assessment receives two ratings: one for impact and one for approach to impact. Participating universities benefit from this valuable data, allowing them to identify and reward high-performing areas, facilitate strategic planning and receive insights into research impact best-practice examples in the industry and the community. Universities can use the assessment results to highlight their strengths in engagement and impact to various stakeholders.

Appendix 10
Summary features of select randomised grant rounds

Funding entity	Features of randomised funding approach
Health Research Council of New Zealand – Explorer Grant An annual grant round to the maximum value of NZ$150,000 for up to 2 years.	Scope: Provide seed support for researchers with transformative, innovative, exploratory or unconventional research ideas. Step 1: Anonymised 6-page applications reviewed by assessment committee comprising three members. Panel members rate each application for (1) its potential for transformative change and (2) the viability of the research methodology. Step 2: Applications deemed suitable for consideration are allocated a number and randomly selected by computer.
The British Academy/Leverhulme Small Research Grants Annual grant to the maximum value of £10,000 for up to 2 years.	Scope: Open to post-doctoral researchers to cover operational costs in the humanities and social science disciplines. Step 1: Assessors review applications on quality thresholds based on research objectives, methodology and likelihood of success. Step 2: All applications that pass step 1 enter into a random selection process.
Swiss National Science Fund*	Scope: Funding to support research abroad for early career post doctorates. Step 1: Two referee evaluations shortlist applications into one of three categories: (1) rejection, (2) plausible and (3) suitable for funding categories. Step 2: 'Plausible' applications assessed for 'rejection' or 'suitable for funding'. Step 3: Computer-based randomised selection process for category 3 applications.
The Austrian Science Fund* 1000 ideas programme 50,000–150,000 Euros	Scope: To promote innovation and ingenious ideas to explore new fields in scientific research. Applications received from any stage of research experience. Step 1: Applications are anonymised at the application stage (otherwise rejected straight away). Step 2: Applications are ranked, and an expert selection panel selects the 12 best applications. Step 3: Of the remaining applications, another 12 are selected at random.
The Volkswagen Foundation* Awards up to 120,000 Euros	Scope: Intended to foster unconventional creative research ideas (exploratory topics or unconventional research methodologies). Step 1: Foundation staff assess for eligibility and anonymise applications. Step2: A jury panel shortlists applicants. Step 3: A lottery drum is used to select successful applicants.

*Information sourced from Woods and Wilsdon (2021)[73]

Appendix 11
Individual researcher survey

Overview

The researcher survey was designed to capture understanding of and views on research metrics and assessment processes from individual researchers. The intention was to capture individuals undertaking research on a paid or voluntary basis in universities, in PFRAs, in hospitals and MRIs, industry, and in not-for-profit and community organisations.

The survey opened on 9 May 2023 and closed on 23 June 2023.

Characteristics of the survey

The survey consisted of 75 questions in total: 61 closed-ended and 14 open-ended questions. It included:

- demographic questions, including respondent background and employment context (21 questions)
- questions relating to perceived legitimacy of research assessment practices (23 questions)

- questions regarding how research metrics are used in practice
- questions regarding the consequences of current approaches to research assessment and how current assessment practices affect researchers' decision-making processes.

Survey responses

In total, 1,864 responses to the survey were received. Of these respondents, 308 respondents did not progress past the demographic questions and were excluded from further analysis. Of the remaining respondents, 128 indicated that they were not currently employed in a research role. These participants were asked why they had left their research career, with responses including insecure employment, lack of research funding, work–life balance, retirement and redundancy, among others (see Figure 8). As the remainder of the survey focused on current research assessment practices, these participants were excluded from further analysis.

Number of respondents
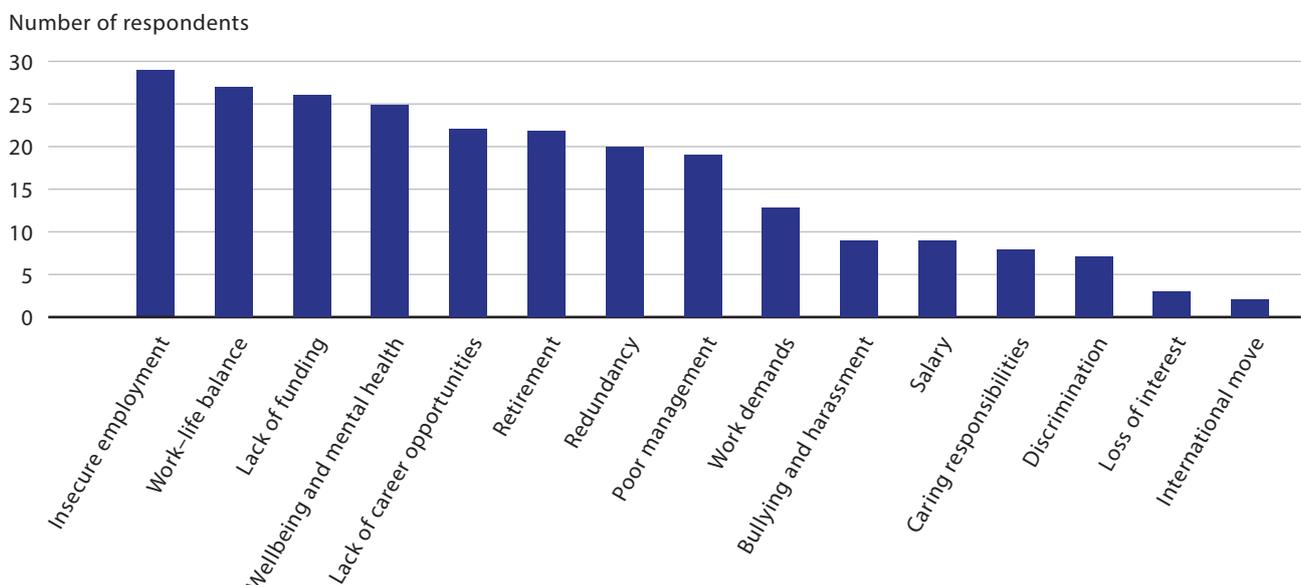
Figure 8: Reasons researchers left their research career

This left a sample of 1,428 respondents, of which 1,137 (80%) responded to the entire survey. The remaining 291 responded to some of the substantive components beyond the demographic questions but did not complete the entire survey. Among the 1,137 respondents who completed the entire survey, the median response time was 20 minutes.

Characteristics of the sample

- **Gender:** More women than men completed the survey (54% and 45%, respectively), with 1% identifying as non-binary or another gender identity.

- **Nationality:** The majority of respondents (55%) were born in Australia, followed by the UK, the USA and numerous other countries.

- **Language proficiency:** All respondents were proficient in English; the majority (81%) were native or bilingual speakers.

- **Equity group:** 42% of the sample (605 respondents) identified with one or more equity groups, including first in family to attend university; non-English-speaking background; LGBTQIA+; person from a remote or regional area; or Aboriginal or Torres Strait Islander. Results are shown in Figure 9.

- **Sector:** The largest proportion of respondents (1,250, or 88%) were university academics, followed by government researchers (87 respondents, or 6%). The remaining respondents (78, or 6%) worked in other sectors, including industry and think tanks.

- **Position:** The majority of respondents (1,061, or 74%) were in academic roles.

- **Employment:** A majority of respondents (897, or 63%) held continuing positions, which may reflect that researchers in insecure employment do not have the ability to dedicate time to responding to surveys that do not directly relate to their work. Given the prevalence of fixed-term contracts and casual employment in the academic sector, our sample may over-represent the subset of the academic population in secure employment. The 'Other' category (122 respondents, or 9%) included casuals, contractors and other employment arrangements. This is a limitation of the study. ACOLA held a roundtable with EMCRs, a component of the sector often on fixed-term contracts, to further hear their views and insights.

Number of respondents identifying with each equity group
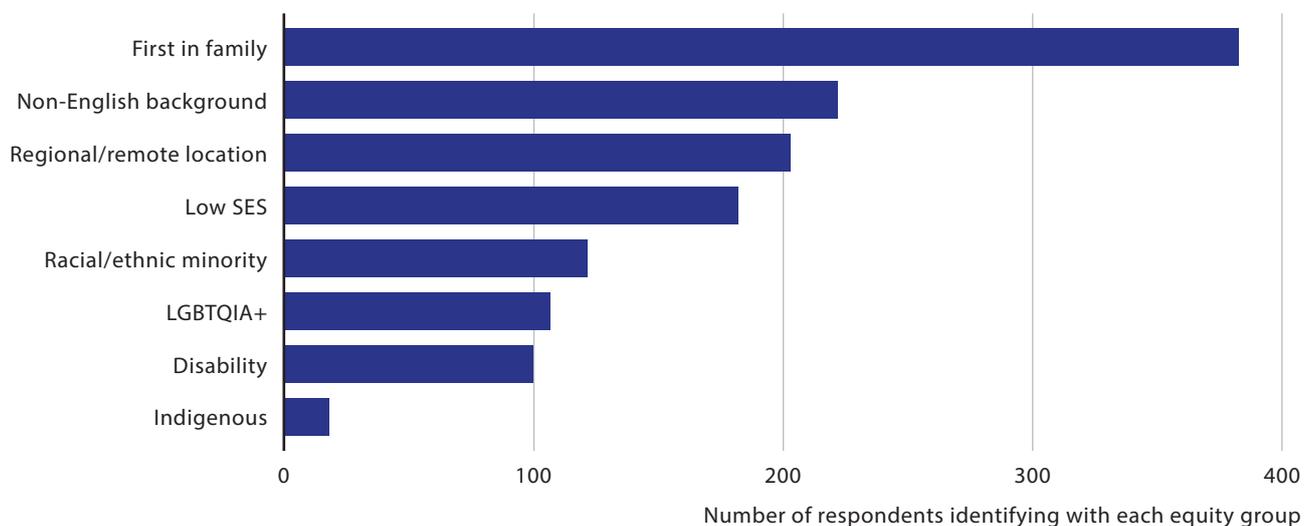
Figure 9: Equity group representation in researcher sample

- **Career stage:** The majority of respondents (624, or 44%) were established or 'Late Career' researchers, with 15+ years of experience since completing a PhD or equivalent research experience (as classified by the Australian Research Council). 'Mid Career' (456 respondents, or 32%) represents those with 5–15 years of experience, while 'Early Career' (288 respondents, or 20%) captures those with 5 or fewer years of experience.

- **Research type:** A significant number of respondents (979, or 69%) were involved in applied or pure basic research. A small fraction of the sample, comprising 64 respondents (4%), primarily conducted 'Experimental development' research. Interestingly, despite the academic inclination of the sample, 'Applied' research emerged as the most common research type, possibly suggesting a shift in academia towards more applied work.

- **Research role:** The majority of respondents (748, or 52%) were involved in both conducting research and overseeing it (for example 'Research/ admin'). A large subset of respondents (557, or 39%) were mainly engaged in direct research roles, while a smaller group (113 respondents, or 8%) were primarily tasked with research administration, including management and oversight.

- **Research fields:** The majority of respondents were from the health and medical sciences (280 respondents, or 20%), followed by the social sciences (198 respondents, or 14%) (see Figure 10). Only 1% (20) of respondents were working primarily in Indigenous studies (8 of these identifying as Aboriginal or Torres Strait Islander). These percentages largely reflect the breakdown of researchers by discipline group in Australian universities (35% STEM; 31% health and medical science; 27% social sciences; 7% humanities according to data from ERA 2018).
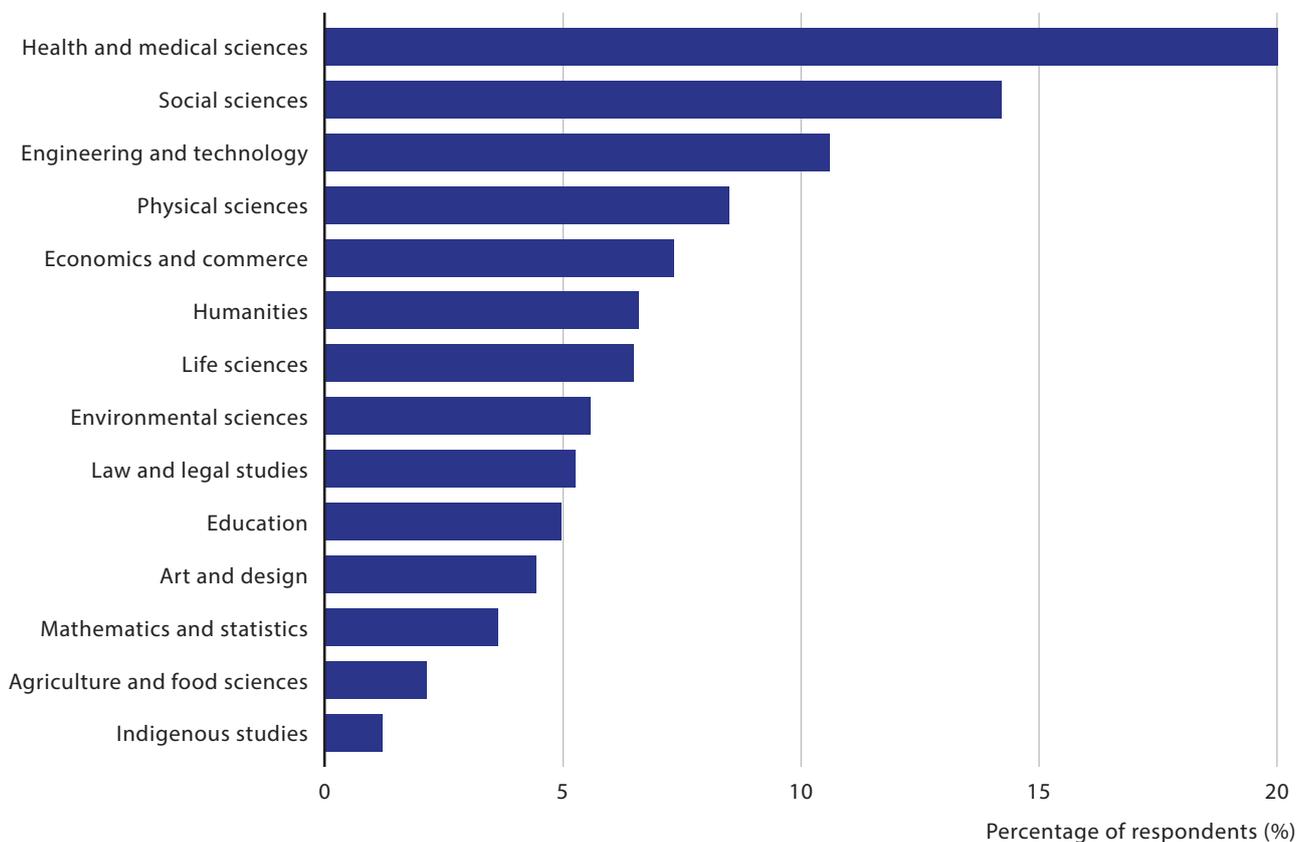
Figure 10: Composition of the researcher sample by research field

Familiarity with and impact of research assessment

The majority of respondents (85%) indicated at least a moderate level of familiarity with the research assessment practices used to evaluate them (26% moderately familiar, 36% very familiar and 23% extremely familiar, with only 15% only slightly familiar or not familiar at all). Most respondents (75%) indicated their research performance was evaluated at least once per year.

When considering the impact of research assessment, only 20% reported that current practices had a positive impact on their ability to conduct their research, with 37% neutral and the remaining 43% indicating assessment practices hindered their ability to conduct effective research.

Perceived legitimacy of research assessment practices

Respondents were asked 23 questions about their views on the fairness of research assessment processes, alignment with broader norms and values, inclusiveness of assessment processes across disciplines and diversity groups, and their effectiveness and accuracy in measuring research quality, impact and excellence. Each question used a 5-point scale ranging from 'Strongly Disagree' to 'Strongly Agree', and responses were grouped using statistical techniques into four composite legitimacy indices as well as an overall perceived legitimacy score.

A majority of respondents (67%) indicated they did not have adequate opportunities to provide input about research assessment practices, and 73% reported that processes were not applied consistently across disciplines. Similarly, 66% of respondents reported that current practices did not adapt to changing needs and priorities within the research community, with 62% indicating that assessment processes fail to accurately capture the quality of their research. Notably, 70% of respondents indicated that the amount of time and effort required from researchers for participation was not reasonable, and only one in three (33%) felt that current practices encouraged innovative research.

These findings collectively underscore a significant deficit in the perceived legitimacy of current assessment practices within researchers' organisations, indicating substantial scope for improvement. Given that the composition of the sample is dominated by academics in secure employment, these high levels of dissatisfaction reflect poorly on the current state of research assessment within the university sector.

Relative to opportunity assessment

Approximately 63% of respondents reported that their organisation had an official policy to conduct relative to opportunity assessment. Most reported that current assessment practices took account of career stage (63%) and career disruptions (54%). However, less than half (46%) reported that their organisation's application of research performance measures was aligned with its official policies.

Of particular concern, three in four respondents (76%) indicated a belief that current assessment processes in their organisation did not consider the availability of necessary resources (for example research funding and infrastructure) when evaluating research productivity. Similarly, 59% reported that researchers with experience working across different sectors (for example, academia and government) were disadvantaged by current research assessment practices.

In summary, these findings suggest that despite most researchers acknowledging the existence of official relative to opportunity assessment policies, there is scope for enhancing how these policies are implemented in practice. This is especially true for resource availability and sectoral mobility, two key areas that appear to be poorly covered under existing relative to opportunity frameworks.

Impact of research assessment on research culture and decision-making

The survey measured eight distinct dimensions of research culture and decision-making, including hiring, promotion, funding allocation, training opportunities, intersectoral and international mobility, as well as the influence of research assessment practices on choices of research projects and the prioritisation of specific research targets or KPIs.

Respondents were largely split (approximately equal numbers reporting positive or negative impact) on the impact of assessment practices on promotion, hiring and training opportunities. They were slightly skewed towards 'negative impact' with respect to internal funding allocations, with 42% reporting a negative impact, 29% reporting a neutral impact, and the remaining 29% reporting a positive impact. Most respondents (67%) reported that current research assessment practices were an impediment to their ability to move between different research sectors. Similarly, (91%) indicated that assessment practices at their organisation incentivised the prioritisation of specific research targets or KPIs, with 53% reporting more than a moderate level of influence.

Importantly, while roughly 25% of respondents reported that research assessment practices had 'no influence' on their choice of research topic, the remaining 75% reported some level of influence, with 27% reporting a 'strong' or 'very strong' influence. This influence on researcher decision-making is particularly concerning given that the sample is largely composed of senior academics in secure employment, where such influence is widely perceived to be minimal.

Indicators of career satisfaction

A final set of questions focused on researcher career satisfaction as measured by questions about whether people had considered leaving their sector of employment. Overall, most respondents (61%) reported they had considered leaving the research community entirely. Lack of funding and the desire for a better work–life balance were the most cited reasons, with each one cited by 55% of individuals that had considered leaving. Close behind, 53% cited a negative impact on their wellbeing and mental health. Other considerable factors included insecure employment (47%) and poor management (40%). A notable 25% of the respondents flagged bullying, harassment or discrimination as reasons pushing them to contemplate leaving their research careers.

Of the 717 female respondents, 468 (65%) reported they had considered leaving, with most citing work–life balance (59%), wellbeing impact (59%) and lack of funding (53%) as reasons. Similarly, a majority of male respondents (55%) reported they had considered leaving, with lack of funding being the most cited reason (59%). Finally, 82% of respondents identifying as non-binary or with another gender had considered moving on, with lack of funding and insecure employment each cited by 73%.

Relatively more respondents from government (66%) and industry (81%) sectors had considered leaving when compared to academics (60%). Work–life balance, impact on wellbeing and mental health, and lack of funding were among the top cited reasons across all sectors. Across research fields, those working in health and medical sciences were most likely to have considered leaving (68%), followed by those in STEM (62%) and the humanities and social sciences (57%). Work–life balance, impact on wellbeing and mental health, and lack of funding were among the top cited reasons across all these fields.

EMCRs were more likely to indicate they had considered leaving the research community than more-established researchers: 70% of EMCRs compared to 52% of established researchers. The most common reasons, cited by a majority of EMCRs and established researchers, were job insecurity, lack of funding, poor work–life balance, and the negative impact on their mental health and wellbeing. When compared to established researchers, EMCRs also reported significantly lower levels of satisfaction with current research assessment practices across multiple indicators, including effectiveness and accuracy, fairness, and inclusiveness.

Options to improve researcher mobility through assessment metrics

Respondents were asked to indicate one change to research assessment processes they thought would improve research quality and another they felt would improve researcher mobility.

On the research quality question, the most common responses related to:

1. moving away from citation and publication metrics (113 responses)

2. focusing on research impact rather than outputs (publications) or inputs (grant funding) (112 responses)

3. tailoring research assessment to specific research fields (91 responses).

Some of the informative observations and recommendations arising from these questions are given below.

Encouraging researchers to aim for larger outcomes, knowing that it will take longer, will be better for science, and better for them.

The assessment criteria appear to create enormous pressure on some academics and school management to demonstrate relevance within the wider university faculties resulting in poor behaviours.

Publishing is an important step but knowing the impact is far more important than volume or ranking of journals.

Research assessment processes should acknowledge that valuable and meaningful research can sometimes require more time, particularly when it involves working with communities and establishing relationships.

Different disciplines (and different researchers within a discipline) require different assessment approaches, which may or may not be metrics-driven.

Current metrics conditions researchers to pump out Q1s and Q2s as representative of quality – but this system of measurement pays little attention to societal impact.

It would be preferable for assessment processes to focus on fewer but higher quality research projects and publications as targets for performance.

One single indicator or set of indicators cannot apply to all fields across all disciplines.

It's time to think about universities in ways that are relevant to people and communities and that means valuing research (and research assessment) differently: impact and engagement.

Broaden the definition of what constitutes high quality research. Research that is published in high impact peer reviewed journals may not have been produced in ways that are inclusive.

Precarious employment should be recognised as a disadvantage when research is being assessed.

On the mobility question the most common responses related to:

1. valuing and measuring different kinds of experience, knowledge and skills (100 responses)

2. broadening assessment metrics beyond citation and publication measures (82 responses)

3. prioritising assessment of research assessment and engagement (69 responses).

Some of the informative observations and recommendations arising from these questions included:

Industry to academia needs indicators of project development that can be given the same level of weight as research papers, presentations etc.

Encouraging and facilitating collaboration with government and industry should be an explicit goal of the Australian research community.

There is almost no way that an academic could be rehired if they have spent more than a year or two in industry where they have not produced publications.

If there was more recognition of research with applied relevance and less focus on journal lists, we would likely be encouraging scholars to do work which would be more consistent with mobility between sectors.

Research that is siloed and builds the 'research profile' of an individual should not be more valuable than research conducted in teams that improves collective understanding and develops knowledge for action.

Academic researchers build track records and reputations year-on-year. As many women have found, even stepping away for a year can dramatically impact career success and progression.

Responses to remaining open-ended questions

The survey included four open-ended questions that allowed for individuals to provide free-text responses regarding the positive and negative aspects of current research assessment practices, as well as their views about the assessment criteria used to evaluate their research performance. Here we report on a preliminary analysis of the 1,020 free-text responses that were received by 2 June 2023.

This analysis is based on a three-stage process applied to each question. First, we used natural language processing tools in combination with human review to filter out invalid and off-topic responses. Next, we applied large language models to identify the sentiment of the responses ('positive', 'negative', or 'neutral'), and classify them into a subset of concise and coherent themes for further analyses. Finally, we used structural topic models on the processed text to discover five distinct topics represented in the responses to each question. Below we summarise the findings for each of the four questions.

Question: Based on your experiences, what are the **most positive aspects** of research assessment practices in your organisation?

We identified 659 valid responses that were either positive or neutral in sentiment from the 1,020 responses that were received, with the remainder identified as either negative aspects or off-topic responses. Five key themes were identified, as follows (and outlined in Figure 11):

1. **Recognition and support for diversity in research outputs.** Comments focused on the recognition and support of various aspects of research work, including the encouragement of diversity in research outputs and career advancement. Key concepts included metrics, transparency, benchmarking and recognition of non-traditional contributions.

2. **Fairness and flexibility in assessment practices.** This theme related to the fairness and flexibility of assessment practices in the research environment. It involved the clear setting of standards and expectations, alignment of goals, and value-based assessments.

3. **Grant funding criteria and collaborative development.** This theme highlighted the importance of clear criteria in grant funding, as well as the focus on development in a collaborative setting. It also brought attention to the output, autonomy and centralised approach to funding allocation.

4. **Quality evaluation and performance review.** This theme concerned the evaluation of research quality and performance, with an emphasis on peer review and publication-based evaluation. There seemed to be a concern for both quantitative measures and supportive methods in this topic.

5. **Research impact and accountability.** The final theme emphasised research impact, accountability and freedom in research practice. Comments highlighted the value placed on outcomes, time allocation and the progress towards creating positive impact in the community.
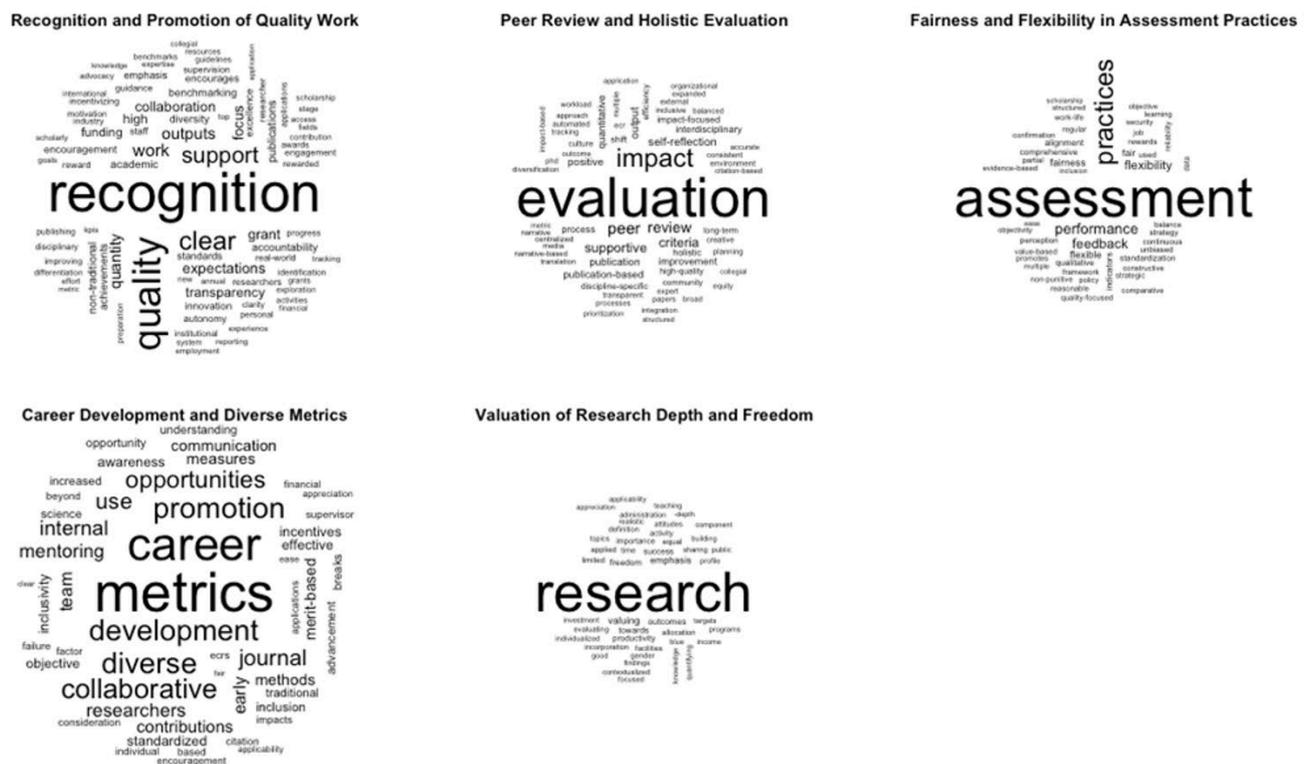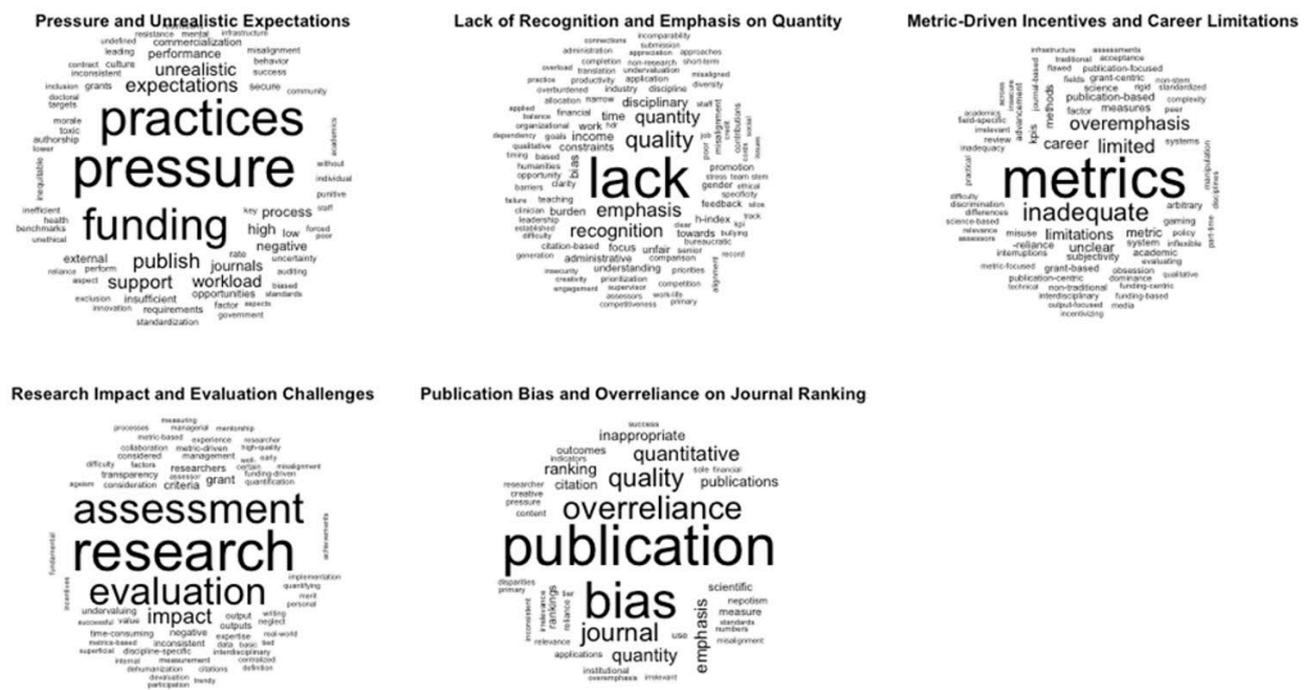

Figure 11: Survey word mapping of responses highlighting the most positive aspects of research assessment practices

Question: Based on your experiences, what are the **most negative aspects** of research assessment practices in your organisation?

There were 902 valid responses to this question. Relative to the question about positive aspects, researchers were significantly more likely to provide valid responses, which were grouped into five key themes as follows (and outlined in Figure 12):

1. **Understanding and misalignment in research assessment practices.** This theme concerned research assessment practices with particular attention to income, undervaluation and understanding. The responses generally referenced a misalignment in how research is assessed, particularly with consideration to funding-driven approaches and the humanities.

2. **Bias and pressure in evaluation criteria.** The second theme revolved around research assessment criteria, specifically referencing issues of bias, pressure and limitations. There seemed to be common concern about metric-driven, publication-centric and funding-based approaches leading to inadequate evaluation.

3. **Lack of transparency and recognition in funding and impact.** This theme reflected concerns about the lack of transparency in funding decisions and how this impacts researchers. Responses drew attention to a need for recognition of expertise, feedback and industry collaborations, implying possible gaps or failures in the current system.

4. **Overreliance on metrics and administrative burdens.** This theme focused on issues related to overreliance on metrics and the associated administrative burdens. Responses suggest issues with workload balance, time constraints and disciplinary disparities in the application of metrics.

5. **Unrealistic expectations and emphasis on quantity over quality.** The final theme concerned the tension between quantity and quality in research assessment practices. Respondents mentioned unrealistic expectations, lack of support and a skewed emphasis on quantity over quality. Responses also seemed to highlight concerns about the scientific focus and content of research.

Figure 12: Survey word mapping of responses highlighting the most negative aspects of research assessment practices

Question: What are the primary assessment criteria used to evaluate your research performance?

In total, 893 valid responses were grouped into five themes, as follows (and outlined in Figure 13):

1. **Publication quantity in top journals.** This theme concerned the importance of both the quantity and quality of research output, particularly focused on publications. The significance of publication in top-tier journals and citation-based measures was emphasised.

2. **Income and success metrics in research performance.** The second theme highlighted the use of income (such as grant funding) and other success metrics (such as KPIs) as key quantitative indicators to assess research performance.

3. **Evaluation based on funding and volume of publications and grants.** This grouping involved the evaluation of research performance based on the amount of funding acquired, as well as the volume of grants and peer-reviewed publications. Responses suggested that a financial framework and financial measures might be significant criteria in this context.

4. **Journal impact factor and project completion as performance measures.** These responses emphasised the role of JIFs and project completion rates as primary assessment criteria. The h-index was most commonly identified as a key metric in these responses.

5. **Peer review and external evaluation criteria.** The final grouping of responses emphasised peer review and external evaluations as key criteria for assessing research performance. Responses reflected a focus on these criteria alongside uncertainties in the assessment process.

Figure 13: Survey word mapping of responses highlighting the primary assessment criteria used to evaluate respondents research performance

Question: What are the primary assessment criteria that you would like organisations to use when evaluating your research performance?

In total, 781 valid responses were grouped into five topics as follows (and outlined in Figure 14):

1. **Real-world impact and community engagement.** This topic concerned the desire for research performance to be assessed by its real-world impact, community engagement, and relevance to policy and industry. It suggests that researchers would like their work to be evaluated on its societal benefits and broader contributions beyond what is measured by current assessment practices.

2. **Holistic and balanced evaluation criteria.** The second topic reflects a preference for holistic and balanced evaluation criteria. Responses reflect a desire for multiple metrics that go beyond traditional citation-based and publication count measures.

3. **Quality over quantity and grant application success.** This topic highlights the respondent preferences for assessments based on quality rather than the quantity of outputs. Additionally, there are references to mentoring opportunities alongside grants and other success measures, suggesting that researchers also see these as a reflection of their efforts and goals.

4. **Recognition of diverse research outputs and contributions.** This seems to reflect a desire for recognition of diverse research outputs and contributions. Performance, leadership, achievements and potential contributions to the scholarly environment are all referenced alongside quantitative metrics.

5. **Peer-reviewed publications.** The final topic concerns the importance of peer-reviewed publications as an assessment criterion. Responses reference capacity building, peer review, building a strong publication portfolio and the value of publishing in reputable journals.

Figure 14: Survey word mapping of responses highlighting the primary assessment criteria respondents would like organisations to use when evaluation research performance

Appendix 12
Organisational survey

The organisational survey comprised 29 questions covering organisational characteristics, questions about the type, rationale for and relative importance of internal and external assessment metrics used; questions relating to transparency and integrity of processes; and questions about challenges related to research assessment, new and innovative approaches in use, and impact of metrics on researcher mobility. It was sent to a list of 257 universities, research centres, MRIs, PFRAs, government departments and SMEs, with a request that organisations submit a single response per institution.

Fifty-four completed and valid responses were received: 28 (52%) from universities or university-based research institutes and centres, 10 (19%) from MRIs, 7 (13%) from businesses and industry groups, 5 (9%) from PFRAs, and the remainder from government departments (2) and think tanks (2). Given the small number of respondents from business and government, the analyses presented here are primarily a comparison between universities/MRIs and other research organisations.

Each of the organisational respondents varied in the size of their research workforce: 22 (40%) had fewer than 250 research employees, 14 (26%) had 250–1,000 research employees and the remaining 17 (31%) had more than 1,000 research employees.

In terms of type of research undertaken, a majority of respondents engaged in applied research (85% of total; 100% of universities) and strategic basic research (76% of total; 100% of universities), whereas fewer engaged in experimental development (65% of total; 86% of universities) and pure basic research (60% of total; 90% of universities).

All of the **university respondents** indicated their participation in ERA and EI assessment processes, as well as grant funding and bibliometric assessments. Twenty of the 21 universities participated in global university rankings (the exception being a smaller regional university).

Each of the **MRIs** participated in grant and bibliometric assessment processes, with 8 of the 10 also participating in altmetric and diversity assessment processes.

Industry, PFRA and government departmental participation in external assessment processes was mixed: several organisations engaged in funding assessment processes as grant applicants or grant providers, and several also participated in diversity assessment but not other identified processes.

Notably, both think tanks and three of the seven industry bodies indicated that they do not participate in external research assessment processes at all.

Of the 54 organisations that engaged in internal or external research assessment processes, the majority did so for reporting (81%), reputational (72%) and external benchmarking (70%) purposes. Funder requirements (68%) and internal benchmarking (62%) were also common reasons, while internal policy (52%) and legislative requirements (50%) were cited by only around half of respondents as a reason for assessing research.

Importantly, only 6 in 10 organisations utilised research assessment for workforce planning, resource allocation or staff promotion purposes.

Research metrics in use by organisations

Organisations were asked to indicate the types of research metrics used within their institutions. The results indicated that publication and grant funding metrics were used by the majority of organisations (including all of the 21 university respondents and all 10 MRIs), while fewer than 50% of organisations collected researcher-articulated metrics more common in the humanities and arts disciplines, as illustrated in Figure 15.

With respect to the relative importance of these metrics, academic publications were most important to almost half of organisations (primarily universities and MRIs), followed by research impact, grant funding, research commercialisation and external engagement. Metrics related to research collaboration, training, leadership, awards and research service were very much secondary considerations for all organisational respondents (Figure 16).
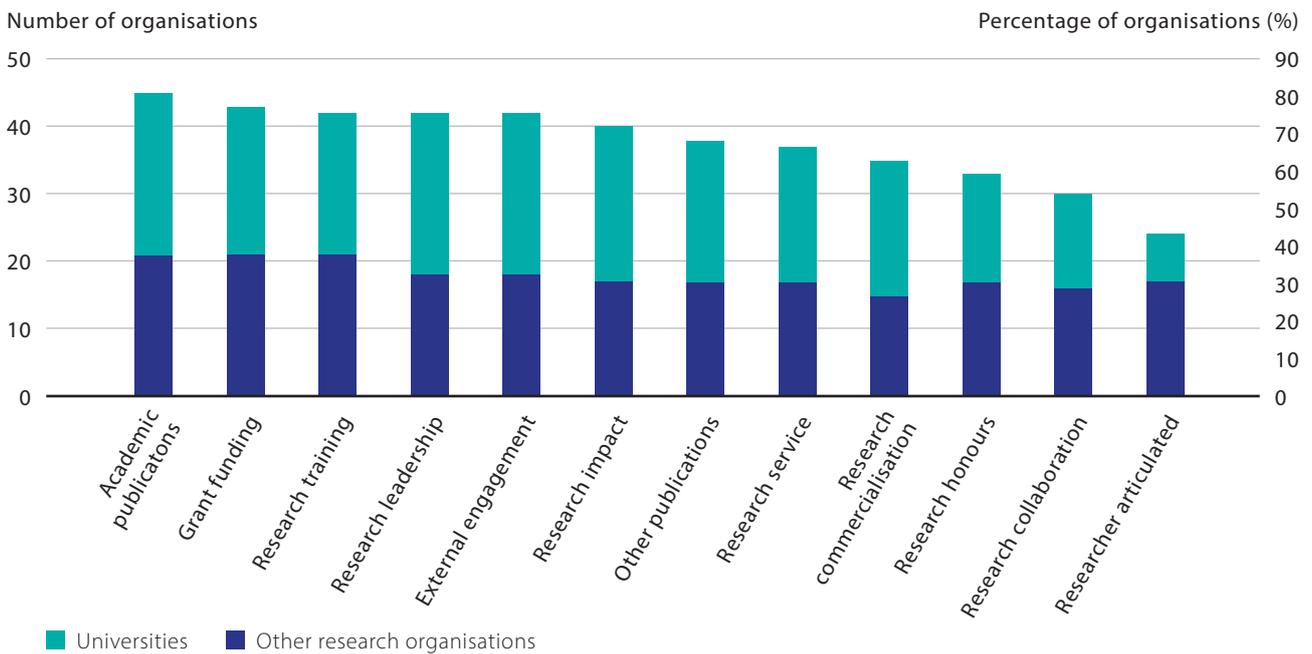
Figure 15: Metrics used by universities and other research organisations in Australia
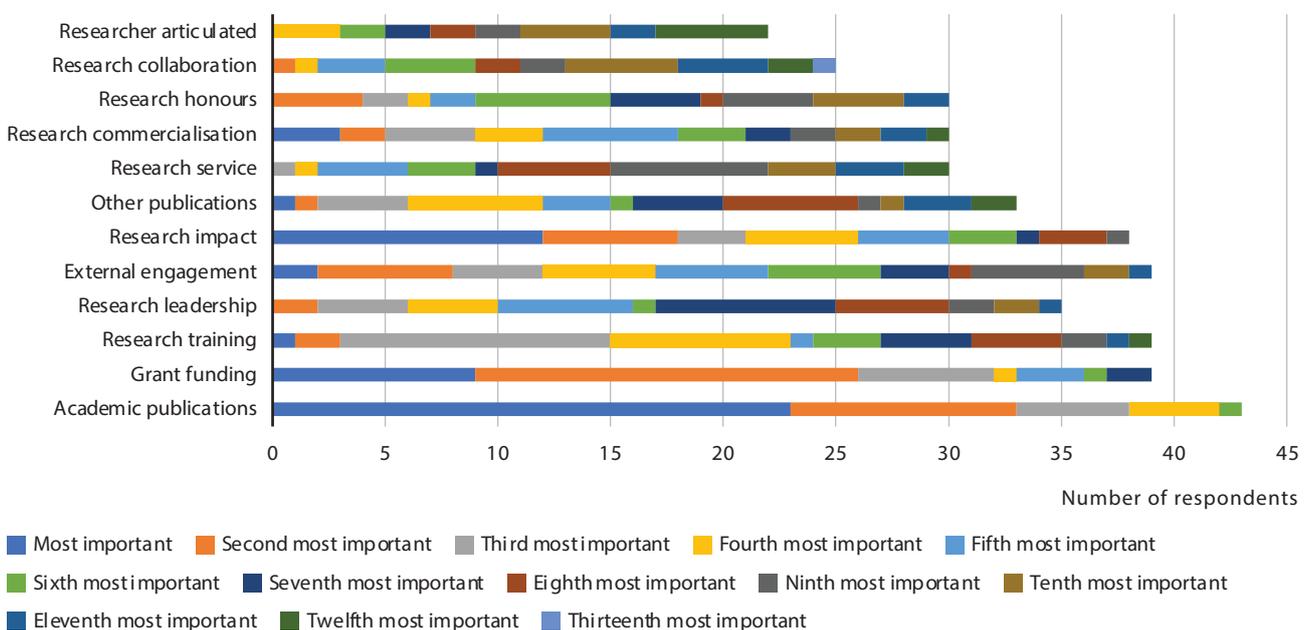
Figure 16: Relative importance of metrics used by research organisations in Australia

Researcher mobility

Organisations were asked to indicate the extent to which their employees moved to or from other parts of the sector. Somewhat surprisingly, more than 60% of respondents indicated that at least 10% of their workforce had moved between sectors within the past 5 years (and 27% with more than 20% sector turnover).

Interestingly, while fewer university respondents were able to answer this question with confidence (40% responded unsure), reported rates of researcher mobility were equivalent among university and non-university respondents.

Furthermore, fewer than one in three respondents (29%) indicated that differences in metrics between sectors hindered mobility, with 31% reporting that current metrics were useful to mobility and 40% indicating they neither helped nor hindered researchers' moves between different parts of the sector.

Challenges in research assessment

Organisations were asked to identify the three most challenging aspects of research assessment. Almost half of respondents identified disciplinary differences as a key challenge, with 31% identifying the difficulty of assessing and attributing impact, given long timeframes and multiple determinants

(Figure 17). Other challenges identified included the quality of metrics available (12%), the difficulty of making accurate relative-to-opportunity judgements (8%), and the challenge of assessing leadership potential (6%).

Particularly insightful comments from respondents included:

Qualitative indicators are not easily stored in systems and cannot be aggregated or benchmarked without being metricised.

A major challenge is the lack of a fit-for-purpose assessment framework in the context of alignment of achievements/performance with organisational priorities. A traditional academic approach to assessment is not suitable for a government-funded national lab as importance is placed not on the output itself, but on the value to the end-user/stakeholder and alignment with organisational priorities.

Our biggest challenge is the lack of linked systems to draw individual-level data together. We don't have an internal system which captures the relevant metrics. MRI held grants and pubs are invisible to affiliated university systems. Systems are expensive to procure for smaller MRIs.

Metrics do not accommodate gender or cultural differences in citation and impact rates.

There is no silver bullet, multiple assessment approaches are necessary.
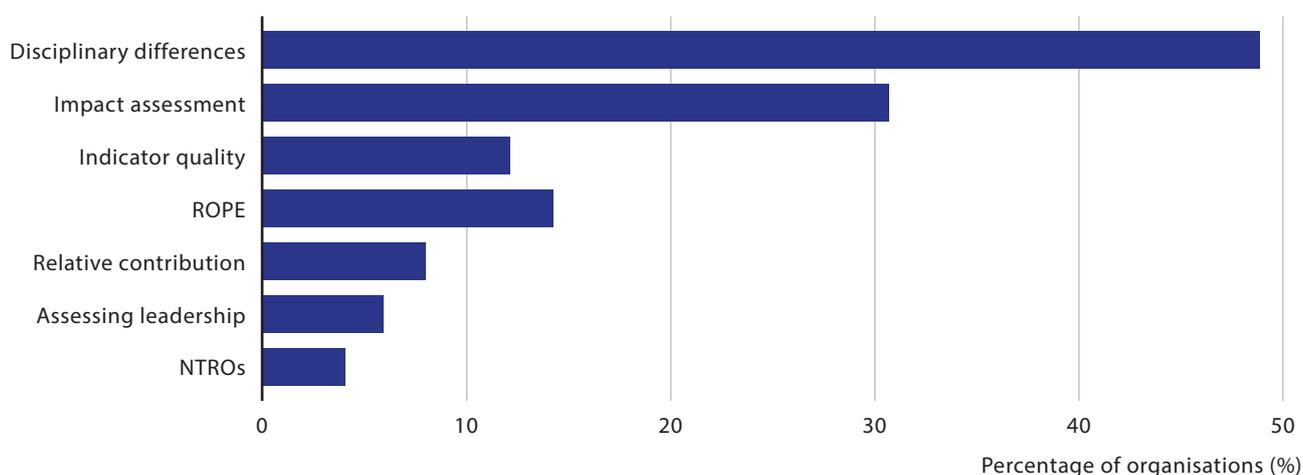
Figure 17: Organisational challenges with respect to research assessment (percentage of organisations identifying each challenge)

Impact and application of research assessment within organisations

Respondents were asked to indicate their level of agreement or disagreement with a range of statements relating to the impact and application of research assessment within their organisations. Most participants agreed or strongly agreed with the notion that research assessment measured what matters to their organisation (80%), captured diverse outputs (76%), was sensitive to Research Opportunity and Performance Evidence (76%), influenced promotion (75%), and promoted internal (69%) and external (71%) collaboration. Relatively fewer respondents felt that research assessment practices were applied transparently (59%), promoted transparency (63%) or were applied consistently (63%) (see Figure 18).
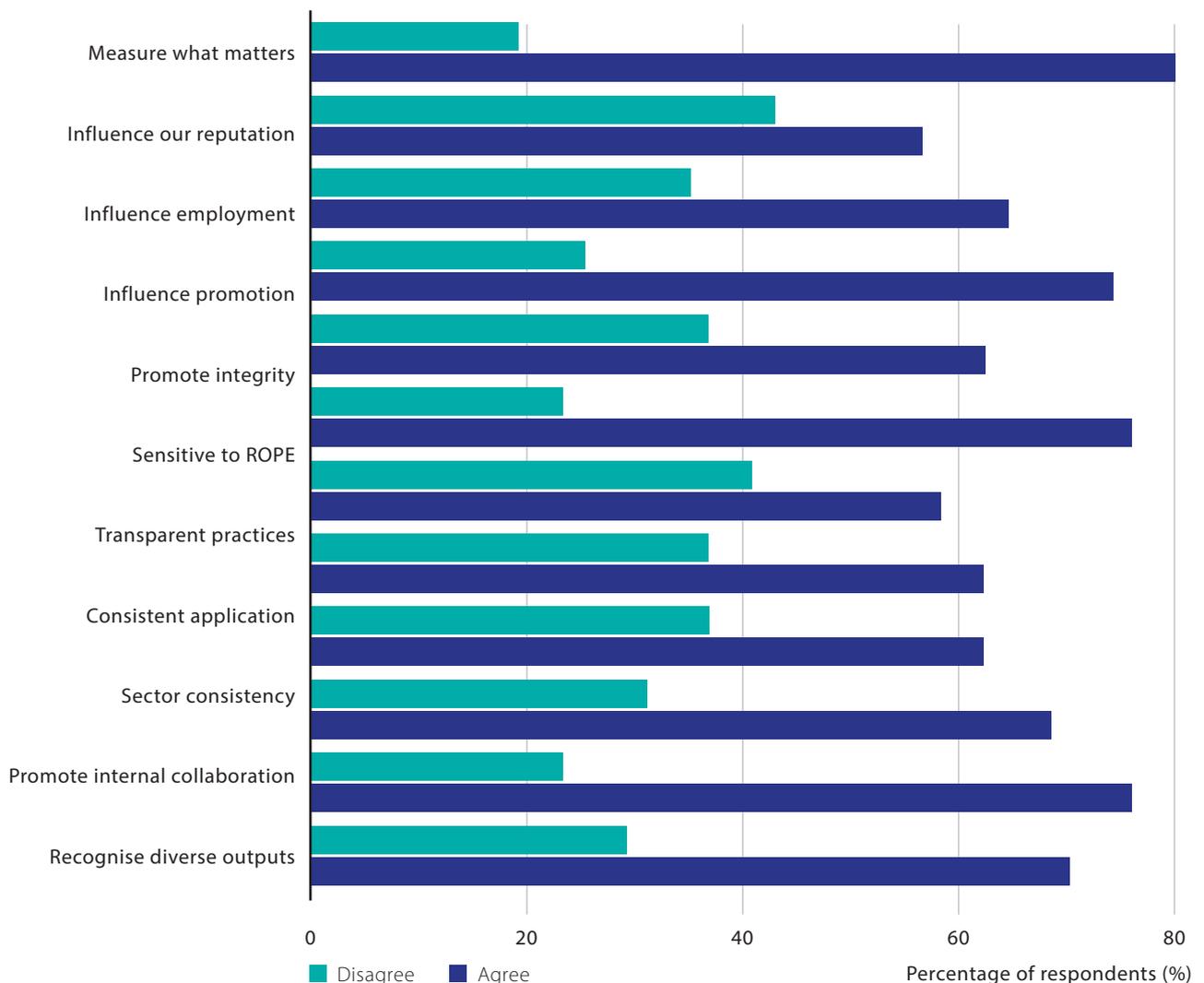
Figure 18: Level of agreement/disagreement from respondents on statements relating to the impact and application of research assessment

New and innovative approaches to research assessment

Around 40 of the organisational surveys responded to a question on what, if any, new or innovative approaches to research assessment were being adopted in their organisation (see Figure 19). Only a small number of the organisations (13%) reported that they weren't exploring or implementing new ways of assessing research, with the remainder reporting a broad range of approaches, including:

- informative measures of research impact (noting the challenge of long timeframes and multiple determinants), utilising a variety of existing and bespoke research impact frameworks

- assessment of engagement beyond researcher collaboration and external funding (that is, measures of engagement through mainstream and social media)

- predictive assessment aimed explicitly at identifying researchers' future potential

- metric-driven network analysis aimed at quantifying organisational and team-based collaboration and engagement

- incorporation of measures of impact against the Sustainable Development Goals, or of environmental impact of research generally, into assessment frameworks

- specific measures of research engagement with Aboriginal and Torres Strait Islander people and communities linked to organisational Reconciliation Action Plans.
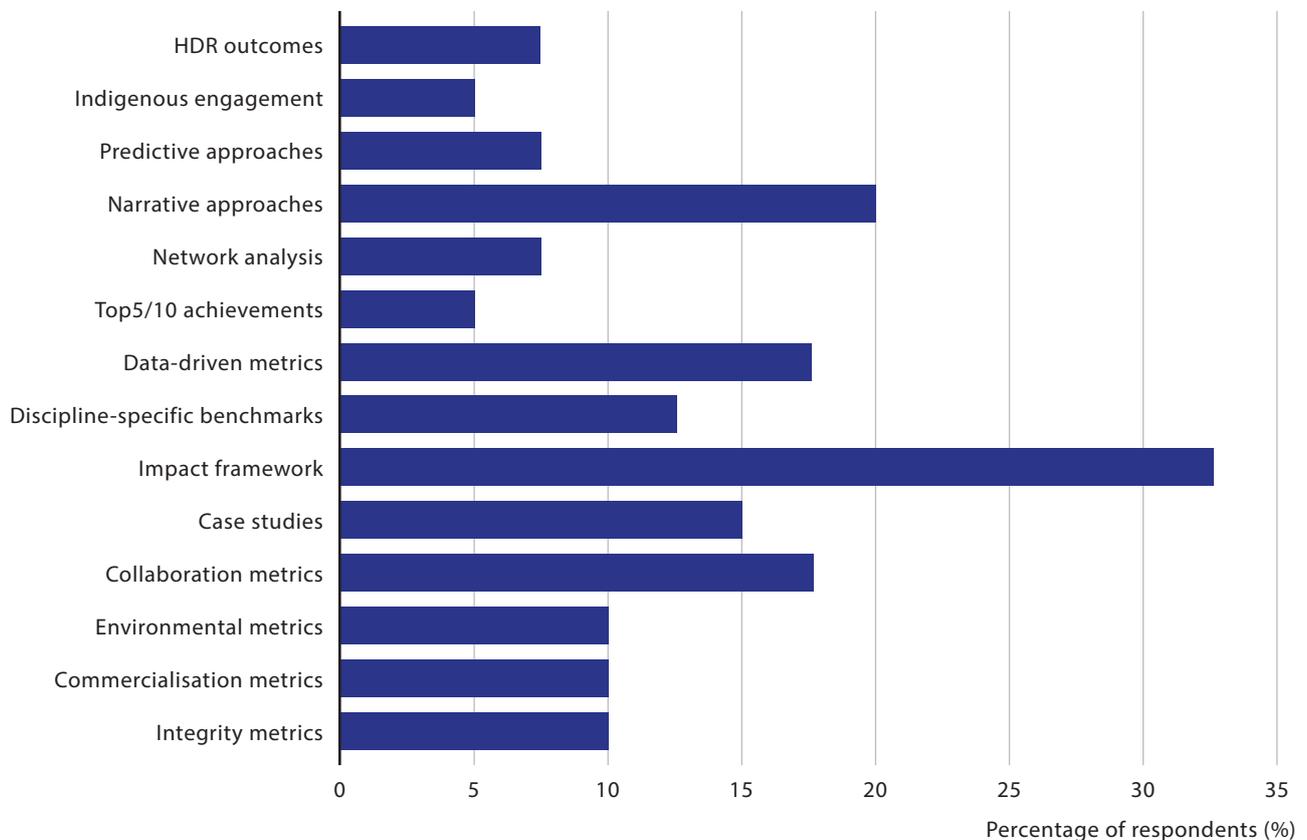
Figure 19: New and innovative approaches being adopted by respondents' research organisations

Some of the illuminating comments from survey respondents included:

We provide opportunities for defence and national security researchers to articulate their achievements in protected ways.

When a researcher moves to a commercially focused company the metrics of success are very different and focused on deliverables against KPIs. This creates a friction for researchers in Australia to move between the two as there aren't recognition of the skills developed in a commercial context in most publicly funded research organisations.

Increasing importance is being placed on data-driven, verifiable metrics complemented by structured narrative statements.

We also are exploring metrics-based network analysis to examine the activity of our research collectives such as research centres. This approach maps actual and potential areas of research concentration and collaboration by making visible the areas of overlap between individual researchers, between individuals and collectives, and between collectives within and beyond the university. In considering groups of researchers as the unit of analysis, rather than just individual researchers, we aim to inform our strategic decision-making in a more nuanced way.

One suggestion for change

Finally, the organisational survey asked respondents to suggest one specific change they believe would improve research assessment processes within their organisations, in a way that would better support and encourage researcher mobility between sectors.

Few respondents were able to provide much insight on this question: some suggested that mobility was already high and not the issue; others noted the need for transparent and consistent systems across sectors and disciplines but without any clear suggestions on how this might be achieved.

Some of the specific suggestions included:

We need a long-term strategic plan for the manufacturing sector. The inability to get discoveries from the lab to the consumer stops a lot of innovation and movement from universities into private sector.

We would love for the rankings to recognise industry NITROS and commercialisation (not patent citation, which is a traditional research measure).

Researcher mobility could be incentivised directly by awarding research workload 'points' or time, or funding, for research staff who undertake industry placements, contracts or internships; or for supervisors whose students undertake these either during candidature or who take industry jobs after completion. Direct incentives may only be required until the benefits of researcher mobility are recognised and normalised.

Access to data across health service settings to enable tracking of outcomes of research into practice or health service change (to accompany narratives that try to demonstrate this).

Expert Working Group biographies

Professor Kevin McConkey AM FASSA (Chair)

Kevin McConkey is an Emeritus Professor of Psychology at the University of New South Wales, Sydney. He holds a BA (Hons), 1976, and a PhD in Psychology, 1980, from the University of Queensland. He is also a graduate of the Advanced Management Program, Harvard Business School, 2004. He is an Honorary Fellow (since 2005) and former President of the Australian Psychological Society (1993–1994), a Fellow of the Academy of the Social Sciences in Australia (since 1996), and a Fellow of the Australian Institute of Company Directors (since 2002).

Kevin has long-standing experience in corporate governance and senior management roles across tertiary education organisations, including the University of New South Wales (Head, School of Psychology (1993–1999) and President, Academic Board (1999–2004)) and the University of Newcastle (Deputy Vice-Chancellor, Academic (2006–2008) and Deputy Vice-Chancellor, Academic and Global Relations (2009–2012)). Since 2013, he has been engaged in numerous consultancies for public and private tertiary education organisations in Australia and overseas on governance and management, strategic planning, financial management, employee relations, administrative effectiveness and efficiency, research development, complaints investigation and international education.

Professor Adrian Barnett FASSA

Adrian Barnett is a Professor of Statistics who has worked for over 27 years in health and medical research. He was the President of the Statistical Society of Australia from 2018 to 2020. His current research concerns improving statistical practice to reduce research waste. He is the current President of the Association for Interdisciplinary Meta-Research and Open Science, whose mission is to improve the quality of scientific research.

Professor Jill Blackmore AM FASSA

Jill Blackmore is Alfred Deakin Professor and Professor of Education at Deakin University, where she was inaugural Director of the Centre for Educational Future and Innovation and currently convenes the Education Governance and Policy strand of the Research Educational Impact Strategic Research Centre. She holds a BA(Hons) and Dip Ed from the University of Melbourne, a Master of Education from Monash University, and an MA and PhD from Stanford University. She is currently the President of the Australian Association of University Professors.

Her research expertise lies in areas of feminist theory in educational administration, policy studies, international and intercultural education, leadership and organisational change, and academics' and teachers' work. Her work over the past decade has focused on the structural challenges to innovation and diversity in higher education, with books including *Disrupting leadership in entrepreneurial universities: Disengagement and diversity in Higher Education* (Bloomsbury, 2022), *Globalised re/gendering of the academy and leadership* (Routledge, 2019) and *Performing and reforming leaders: Gender, educational restructuring and organizational change* (SUNY Press, 2007). She has drawn on theories of social justice in her book *Educational leadership and Nancy Fraser* (Routledge 2016) to inform her work on epistemic, cultural and structural injustices and equity policy in education.

She has been President of the Australian Association of Research in Education, was Managing Editor of the *Australian Educational Researcher* for 13 years, has served on numerous editorial boards and has held visiting appointments at the University of Alberta, the University of Nottingham, the University of Manchester and University of Sussex. She was awarded a Medal of the Order of Australia in 2017 and elected to the Academy of the Social Sciences in Australia in 2013.

Dr Guy Boggs

Guy Boggs has extensive experience providing leadership in innovation and actively working at the interface of industry and research. Guy has led the delivery of large Australian Government–funded programs driving knowledge development and industry practice change. An experienced research leader, Guy holds a PhD, completed on post mine landform design, and has an extensive publication record, authoring over 50 books, book chapters and journal articles on spatial science and natural resource management.

Guy is committed to enabling a new vision for mine closure and positive post-mine transitions through effective stakeholder engagement, research planning and innovative solutions.

Professor Ana Deletic FTSE

Professor Ana Deletic joined the Queensland University of Technology in early 2021 from the University of New South Wales where she was Pro Vice-Chancellor (Research) and Professor in the Water Research Centre, School of Civil and Environmental Engineering from 2017. Prior to that, Ana was Associate Dean of Research in the Engineering Faculty and the Founding Director of the Monash Infrastructure Research Institute at Monash University. An internationally engaged and respected researcher, Ana has been researching in the field of urban water engineering for almost 30 years and is the most published researcher in the world on the topic of storm water management. Ana has a PhD from the University of Aberdeen and is an Honorary Fellow of Engineers Australia, a Fellow of the Australian Academy of Technological Sciences and Engineering, and editor of *Water Research*.

Ana also has significant experience in leading change, most recently at UNSW she was involved in a major reorganisation of all faculties in response to the impact of COVID-19. She also developed and implemented university-wide initiatives that have underpinned the steep rise of the University of New South Wales in major international rankings.

Associate Professor Raffaella Demichelis

Associate Professor Raffaella Demichelis leads an emerging team doing research in computational materials chemistry and geochemistry at Curtin University. Her group's research spans from the study of material structure to crystal growth and mineral surface reactivity via developing classical, quantum mechanical and semi-empirical models.

Originally from Italy, Raffaella has made Western Australia her home for more than 10 years. Aside from her research, she spreads her enthusiasm for science through engaging with outreach and community building activities and is an active advocate for change in our national research system through leading local and national groups and initiatives (for example, Australian Academy of Science's EMCR Forum, chair 2022; Western Australian Software Carpentry network, co-founder; Western Australian Women in Chemistry Group, Royal Australian Chemical Society, co-founder and committee member). She also volunteers much of her time to visit schools and mentor kids to possible STEM career paths, with the double purpose of also showcasing gender diversity in STEM.

Raffaella has received national and international recognition for her research and community engagement through being a 2020 Western Australian Young Tall Poppy awardee, the recipient of the 2015 Caglioti Prize (Italian Academy of Science), the 2022 F.G. Houtermans Award (European Association of Geochemistry), and the 2023 Dorothy Hill Medal (Australian Academy of Science).

Dr Caroline Hughes AM (June–September 2023)

Dr Caroline Hughes AM is a proud Ngunnawal woman and the Executive Director, Research Education Group at AIATSIS. In 2022, she was awarded an honorary doctorate from the University of Canberra for her significant contributions to the field of education throughout her career, which spans over 30 years. She came to AIATSIS from the Canberra Institute of Technology where she was the Director of the Yurauna Centre of Educational Excellence for Aboriginal and Torres Strait Islander Peoples.

Aunty Caroline empowers others to achieve their dreams through the power of education and employment. As practitioner, manager and leader of vocational education and training programs in community development and client support services, she ensured that cultural heritage has been the essence of all. Aunty Caroline has led the design and delivery of cultural programs that have strengthened the cultural capability of individuals and teams across organisations – within government and private sectors. She grew partnerships and improved engagement with governments, private sector and community to improve business outcomes, as well as increased the commercial income to support profitable operations and outcomes. Her leadership has contributed to policies, strategies, compliance and business acumen.

Aunty Caroline was shortlisted as a nominee for 2021 ACT Australian of the Year and was a recipient of the ACT Women's Honour Roll in 2018.

In recognition of her significant service to the Indigenous community of Canberra, Aunty Caroline was made a Member of the Order of Australia in the 2023 King's Birthday Honours.

Professor Duncan Ivison FAHA FRSN

Duncan Ivison is Professor of Political Philosophy at the University of Sydney. He was previously Deputy Vice Chancellor (Research) (2015–2022); Dean of the Faculty of Arts and Social Sciences (2010–15); and Head of the School of Humanities (2007–2009). He has been a member of the ARC Advisory Council, a member of the Council of the Australian Academy of Humanities, and chair of the Group of Eight and NSW Deputy Vice-Chancellor (Research) committees, among others.

Professor Louisa Jorm FAHMS

Professor Louisa Jorm is a leader in advanced analytics in health and medical big data. She is a high-profile advocate for more and better use of routinely collected health data for research. She is a member of the ARC Medical Research Advisory group and was previously a member of the NHMRC Australian Health Ethics Committee, NHMRC Research Committee and NHMRC Prevention and Community Health Committee. In 2014, Professor Jorm commenced as the Foundation Director of the Centre for Big Data Research in Health at the University of New South Wales. Prior to this, she was Foundation Professor of Population Health and Director of the Centre for Health Research at the University of Western Sydney, and Principal Scientist and Senior Advisor at the Sax Institute. These built upon over 15 years in various senior government and service roles.

Professor Jorm has demonstrated a career commitment to putting evidence to work in policy and practice, and her work has had numerous translational impacts, for example driving changes to reporting of national health performance indicators; supporting the planning of community-based early childhood and aged care services; informing national guidelines for the management of acute coronary syndrome in Indigenous people; and shaping national policy regarding access to publicly funded health data for research.

Professor Jorm has played a leading role in the establishment of major infrastructure and capacity for health big data research in Australia, including the NSW/ACT Centre for Health Record Linkage, the 45 and Up Study and the NSW Biostatistical Officer Training Program. She oversaw the development of the Secure Unified Research Environment and E-Research Institutional Cloud Architecture secure remote access data analysis laboratories.

Professor Andrew Peele FTSE

Andrew Peele was appointed Group Executive for ANSTO Nuclear Science and Technology in July 2021 and was Director of the Australian Synchrotron for 10 years until 2023. He is an adjunct Professor of Physics at La Trobe University. In his current role, Andrew leads ANSTO's research and development capability in support of national research priorities. This includes the delivery of real-life benefits to Australia in health and environment and through nuclear materials and access to ANSTO's unique research infrastructure capabilities, such as the Australian Centre for Neutron Scattering, the Australian Synchrotron, the Australian Centre for Accelerator Science and the National Deuteration Facility.

Andrew's previous appointments include leading the X-ray Science group in La Trobe University's Department of Physics, a Queen Elizabeth II Research Fellowship held at the University of Melbourne and La Trobe University, and post-doctoral research at NASA's Goddard Space Flight Centre. Prior to undertaking his PhD studies at the University of Melbourne, Andrew was a qualified lawyer and practiced as a solicitor.

Andrew's research improves the versatility and quality of x-ray imaging, including new methods in phase imaging and coherent diffractive imaging, with applications such as tomographic imaging of cells and materials. He has published over 100 refereed articles and has been involved as a node leader, principal investigator and advisory board member in the Australian Research Council Centres of Excellence for Coherent X-ray Science, Advanced Molecular Imaging and Future Low-Energy Electronics Technologies, respectively.

He has served as President of the Australian Institute of Physics and the Asia-Oceania Forum for Synchrotron Radiation Research, and board member of the Australian Institute of Nuclear Science and Engineering and the Stawell Underground Physics Laboratory Company and previously of the Australian Mathematical Sciences Institute. He is a Fellow of the Australian Academy of Technology and Engineering.

Professor Robyn Owens AM FAA FTSE

Robyn is an Emeritus Professor in the Australian university sector and the former Deputy Vice-Chancellor (Research) of the University of Western Australia. She has over 30 years' experience working as a teacher, researcher and university leader, focusing on strategy and national policy.

Robyn was trained in mathematics at the University of Western Australia, Oxford University and the University of Paris. Her research was primarily in computer vision, where she contributed to both theoretical and applied aspects of feature recognition in images and image understanding. She has been acknowledged with several national and international awards, including the 2010 UK Rank Prize.

Robyn is an elected Fellow of the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering, and the Australian Computer Society. She is a graduate of the Australian Institute of Company Directors and of the Vincent Fairfax Ethical Leadership Program. She currently sits on the senate of Murdoch University, chairs the governing board for ACCESS-NRI national research infrastructure and is on the board of the Australian Maths Trust.

Kate Thomann (March–June 2023)

Kate Thomann is a proud Wiradjuri woman with over 29 years' experience working in Indigenous affairs in the Australian public service. Kate has extensive experience in policy development and program delivery across a wide range of portfolio areas, including: Prime Minister and Cabinet, Health; Environment; Communications; Education; Arts and Culture and Aboriginal Hostels. Kate was also the Chief Executive Officer at the Australian Indigenous Doctor's Association for 2 years. She is currently the Executive Director for Research and Education at AIATSIS.

Acknowledgements

Peer review

This report has been reviewed by an independent panel of experts. Members of this review panel were not asked to endorse the report's conclusions and findings. The review panel members acted in a personal, not organisational, capacity. ACOLA gratefully acknowledges their contribution.

The report was also reviewed by ACOLA's members, Australia's five Learned Academies.

Professor Warwick Anderson AO FAHMS(Hon)

Professor Cameron Neylon

Professor Joy Damousi AM FASSA FAHA

Emeritus Professor Peta Tait FAHA

Kate Harriden

Emeritus Professor Joanne Tompkins FAHA

Dr Mari Kondo

Professor Mark Western FASSA

References

1 Australian Government, Department of Industry, Innovation and Science, and Australian Academy of Technology and Engineering (2022) *Improving innovation indicators: Better data to track innovation in Australia*. Retrieved June 2023: https://www.industry.gov.au/publications/innovation-metrics-review

2 CSIRO (2021) *Quantifying Australia's returns to innovation: Working Paper*. Retrieved June 2023: https://www.csiro.au/en/work-with-us/services/consultancy-strategic-advice-services/CSIRO-futures/Innovation-Business-Growth/Quantifying-Australias-returns-to-innovation

3 ACIL Allen (2023) *Impact assessment of ARC-funded research. Final report*. Retrieved August 2023: https://www.arc.gov.au/news-publications/media/feature-articles/research-excellence-delivering-exceptional-outcomes-australia

4 Australian Government Department of Industry, Science and Resources (2023) Science, research and innovation (SRI) budget tables 2022–23. Retrieved August 2023: https://www.industry.gov.au/publications/science-research-and-innovation-sri-budget-tables-2022-23

5 Australian Bureau of Statistics (2023) Research and experimental development, businesses, Australia. Retrieved August 2023: https://www.abs.gov.au/statistics/industry/technology-and-innovation/research-and-experimental-development-businesses-australia/2021-22

6 Our World in Data (2023) Research and development spending as a share of GDP. Retrieved July 2023: https://ourworldindata.org/grapher/research-spending-gdp?tab=chart&country=ISR~KOR~CHN~IND~USA~JPN~GBR~FRA~DEU~ITA~CAN~AUS.

7 O'Dwyer, M., Filieri, R. and O'Malley, L. (2023) Establishing successful university–industry collaborations: Barriers and enablers deconstructed. *Journal of Technology Transfer 48*, 900–931. https://doi.org/10.1007/s10961-022-09932-2

8 Wilsdon, J. (2015) *The metric tide: Independent review of the role of metrics in research assessment and management*. SAGE Publications Ltd. https://doi.org/10.4135/9781473978782

9 Foley, C. (2023) *Trust in Science*. Australian Government Office of the Chief Scientist. Retrieved August 2023: https://www.chiefscientist.gov.au/sites/default/files/2023-08/Trust%20in%20Science.pdf

10 Moore, S., Neylon, C., Eve, M. P., O'Donnell, D. P. and Pattinson, D. (2017) "Excellence R Us": university research and the fetishisation of excellence. Palgrave Communications 3, 16105. https://doi.org/10.1057/palcomms.2016.105

11 Hatch, A. and Curry, S. (2020) Changing how we evaluate research is difficult, but not impossible. eLife 9, e58654. https://elifesciences.org/articles/58654. UNESCO (2021) UNESCO Recommendation on Open Science. https://en.unesco.org/science-sustainable-future/open-science/recommendation.

12 CSIRO (2020) Impact evaluation guide. https://www.csiro.au/en/about/corporate-governance/ensuring-our-impact/evaluating-our-impact

13 Mahfoudh, D., Boujelbene, Y. and Mathieu, J.-P. (2019) "University-enterprise cooperation: Determinants and impacts," in Social innovation and social technology: Enterprise-new technology synergy (Eds K. Boussafi, J.-P. Mathieu and M. Hatti) MSENTS2019, LNNS Vol. 162, pp. 91–121.

14 Mahfoudh, D., Boujelbene, Y. and Mathieu, J.-P. (2019) University-enterprise cooperation: Determinants and impacts. In: Boussafi, K., Mathieu, J.-P., and Hatti, M. (eds), Social innovation and social technology: Enterprise-new technology synergy. MSENTS2019, LNNS Vol. 162, pp. 91–121.

15 World Economic Forum (2021) How can universities capture more value from their research? Retrieved 31 August 2023: https://www.weforum.org/agenda/2021/01/university-research-academic-innovation-commercial-value-higher-education/

16 Atta-Owusu, K., Fitjar D. R., and Rodriguez-Pose A. (2021) What drives university-industry collaboration? Research excellence or firm collaboration strategy? Technological Forecasting and Social Change 173, 121084. https://doi.org/10.1016/j.techfore.2021.121084.

17 Monash University (https://www.monash.edu/academicpromotion/academic-performance-framework), Curtin University (https://staffservices.curtin.edu.my/academic-capability-framework/), Federation University (https://policy.federation.edu.au/forms/Academic-promotions-criteria-framework.pdf), University of Newcastle (https://www.newcastle.edu.au/current-staff/working-here/performance-and-development/leadership-framework). Many others are behind staff logins, such as University of Western Australia, Curtin University, Western Sydney University.

18 Creative Australia (2023) Arts projects for individuals and groups. Retrieved July 2023: https://australiacouncil.gov.au/investment-and-development/arts-projects-for-individuals-and-groups/

19 Martin-Sardesai, A., Irvine, H., Tooley, S. and Guthrie, J. (2017). Accounting for research: Academic responses to research performance demands in an Australian university. Australian Accounting Review 27(3), 329–343. doi: 10.1111/auar.12151

20 Adams, J., Beardsley, R., Bornmann, L., Grant, J., Szomszor, M. and Williams, K. (2022) Global Research Report: Research Assessment: Origins, Evolution, Outcomes. Institute for Scientific Information, Clarivate.

21 de Rijcke, S. D., Wouters, P. F., Rushforth, A. D., Franssen, T. P. and Hammarfelt, B. (2016) Evaluation practices and effects of indicator use—a literature review. Research Evaluation 25(2), 161–169. doi: 10.1093/reseval/rvv038

22 Watermeyer, R. (2012) Issues in the articulation of 'impact': the responses of UK academics to 'impact' as a new measure of research assessment. Studies in Higher Education 39(2), 359–377. doi: 10.1080/03075079.2012.709490

23 Li, D. and Li, Y. (2022) 'Trust the people, not the institution': University preparation for the Research Assessment Exercise 2020 in Hong Kong. Higher Education Research and Development 42(3), 633–648. doi: 10.1080/07294360.2022.2096574

24 Butler, L. (2007) Assessing university research: A plea for a balanced approach. Science and Public Policy 34(8), 565–574. doi: 10.3152/030234207x254404

25 Noorden, R. V. (2010) Metrics: A profusion of measures. Nature 465(7300), 864–866. doi: 10.1038/465864a

26 Wang J., Veugelers, R. and Stephan, P. (2017) Bias against novelty in science: A cautionary tale for users of bibliometric indicators. *Research Policy 46(8)*, 1416–1436. https://doi.org/10.1016/j.respol.2017.06.006

27 Australian Bureau of Statistics (2023) Research and experimental development, businesses, Australia. Retrieved August 2023: https://www.abs.gov.au/statistics/industry/technology-and-innovation/research-and-experimental-development-businesses-australia/2021-22

28 The University of Queensland (2023) *A slippery slope: Basic research underfunded in Australia*. Retrieved May 2023: https://www.uq.edu.au/news/article/2023/04/slippery-slope-basic-research-underfunded-australia

29 Global Innovation Index (2022) *Global Innovation Index 2022*. Retrieved June 2023: https://www.globalinnovationindex.org/Home

30 Gulbrandsen, M. and Thune, T. (2017) The effects of non-academic work experience on external interaction and research performance. *The Journal of Technology Transfer 42(4)*, 795–813. doi: 10.1007/s10961-017-9556-1

31 Cañibano, C. and Bozeman, B. (2009) Curriculum vitae method in science policy and research evaluation: The state-of-the-art. *Research Evaluation 18(2)*, 86–94. doi: 10.3152/095820209x441754

32 Open Researcher and Contributor ID (2023) Retrieved June 2023: https://info.orcid.org/researchers/

33 McCulloch, S. (2017) The importance of being REF-able: Academic writing under pressure from a culture of counting. Retrieved May 2023: https://blogs.lse.ac.uk/impactofsocialsciences/2017/02/09/the-importance-of-being-ref-able-academic-writing-under-pressure-from-a-culture-of-counting/

34 Rodrigues, M.L., Nimrichter, L. and Cordero, R.J.B. (2016) The benefits of scientific mobility and international collaboration, FEMS Microbiology Letters *363* (21). doi: 10.1093/femsle/fnw247

35 UK Department of Business, Energy and Industrial Strategy (2022) International comparison of the UK research base. Open Government License. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1078073/international-comparison-uk-research-base-2022-accompanying-note.pdf

36 IP Australia (2022) Scoping study on standalone IK legislation. Australian Government. Retrieved July 2023: https://www.ipaustralia.gov.au/tools-and-research/professional-resources/data-research-and-reports/publications-and-reports/2023/07/03/05/26/scoping-study-on-standalone-ik-legislation

37 Bonn, N. and Bouter, L. (2023) Research assessments should recognize responsible research practices. Narrative review of a lively debate and promising developments. In: Valdés, E., Lecaros, J. A. (eds) *Handbook of Bioethical Decisions. Volume II*. Springer, pp. 441–472. https://doi.org/10.1007/978-3-031-29455-6_27

38 DORA (2012) *San Francisco Declaration on Research Assessment (DORA)*. https://sfdora.org/

39 Council for Advancing Research Assessment (2023) Agreement on reforming research assessment. Retrieved June 2023: https://coara.eu/agreement/the-agreement-full-text

40 Human Frontier Science Program (2023) HFSP Funding. https://www.hfsp.org/funding/hfsp-funding/research-grants

41 Recognition and Rewards (2019) *Room for everyone's talent: Towards a new balance in the recognition and rewards of academics*. Retrieved April 2023: https://recognitionrewards.nl/wp-content/uploads/2020/12/position-paper-room-for-everyones-talent.pdf

42 Recognition and Rewards (2019) *Room for everyone's talent in practice: Road map: How we are shaping a new system of recognition and rewards*. Retrieved April 2023: https://recognitionrewards.nl/about/roadmap/

43 Moher, D., Bouter, L., Kleinert, S., Glasziou, P., Sham, M. H., Barbour, V., et al. (2020) The Hong Kong Principles for assessing researchers: Fostering research integrity. *PLoS Biology 18(7)*, e3000737. https://doi.org/10.1371/journal.pbio.3000737

44 University of Tasmania and Elsevier (2022) *The Tasmanian Societal Impact Model (TSIM) playbook*. Retrieved July 2023: https://www.societalimpactmodel.org/

45 University of Tasmania and Elsevier (2022) The Tasmanian Societal Impact Model (TSIM) playbook. Retrieved July 2023: https://www.societalimpactmodel.org/

46 Elsevier (2023) Research evaluation collaborations. Retrieved June 2023: https://www.elsevier.com/about/partnerships/research-performance-collaborations

47 Elsevier (2023) Oxfordshire plays a pivotal role in UK's ambition to be a scientific superpower according to a new report by Advanced Oxford. Retrieved June 2023: https://www.elsevier.com/about/press-releases/science-and-technology/oxfordshire-plays-a-pivotal-role-in-uks-ambition-to-be-a-scientific-superpower-according-to-a-new-report-by-advanced-oxford

48 Gauffriau, M. (2023) Navigating responsible research assessment guidelines. Leiden Madtrics. Retrieved June 2023: https://www.leidenmadtrics.nl/articles/navigating-responsible-research-assessment-guidelines#:~:text=RRA%20%22is%20an%20umbrella%20term,diverse%20and%20inclusive%20research%20cultures.%22

49 CSIRO (2020) *Impact evaluation guide*. https://www.csiro.au/en/about/corporate-governance/ensuring-our-impact/evaluating-our-impact

50 ARC (2018) *EI 2018: Assessment Handbook*. https://www.arc.gov.au/evaluating-research/ei-assessment/past-ei-evaluations-0/ei-key-documents-0

51 CSIRO (2018). How CSIRO ensures it delivers impact. https://www.csiro.au/-/media/About/Files/Our-impact-framework/How_CSIRO_ensures_it_delivers_impact-PDF.pdf

52 CSIRO (2021). A CSIRO-wide approach to impact. https://www.csiro.au/en/about/corporate-governance/ensuring-our-impact/a-csiro-wide-approach-to-impact

53 NHMRC (2022) Research impact position statement. Retrieved 15 March 2023: https://www.nhmrc.gov.au/research-policy/research-translation-and-impact/research-impact

54 Anderson, W.P. (2023) Trust in Medical Research: What Scientists Must Do to Enhance It. Open Access, Monash University. https://doi.org/10.26180/23827920.v1

55 ACIL Allen (2023) *Impact assessment of ARC-funded research. Final report*. Retrieved August 2023: https://www.arc.gov.au/news-publications/media/feature-articles/research-excellence-delivering-exceptional-outcomes-australia

56 Gärtner, A., Leising, D. & Schönbrodt, F. (2022) Responsible Research Assessment II: A specific proposal for hiring and promotion in psychology, PsyArXiv. doi:10.31234/osf.io/5yexm

57 Schulz, R., Barnett, A., Bernard, R. et al. (2022) Is the future of peer review automated? *BMC Research Notes 15*, 203. https://doi.org/10.1186/s13104-022-06080-6

58 Kreitz, J., Friedrich, M.J., Guru, A. et al. (2023) Programmable protein delivery with a bacterial contractile injection system. Nature 616, 357–364. https://doi.org/10.1038/s41586-023-05870-7

59 Chubb, J., Cowling, P. and Reed, D. (2022) Speeding up to keep up: Exploring the use of AI in the research process. *AI and Society 37(4)*, 1439–1457. doi: 10.1007/s00146-021-01259-0

60 Foley, C. (2021) Unlocking the academic library: Open access. *Australian Quarterly 92(4),* 11–19. Retrieved June 2023: https://www.chiefscientist.gov.au/news-and-media/unlocking-academic-library-open-access

61 Langham-Putrow, A., Bakker, C. and Riegelman, A. (2021) Is the open access citation advantage real? A systematic review of the citation of open access and subscription-based articles. *PLoS ONE 16(6)*, e0253129. https://doi.org/10.1371/journal.pone.0253129

62 Nagaraj, M. N. and Bhandi, M. K. (2017) Physics researchers' perception of advantages and disadvantages of open access journals: A study. *International Journal of Library and Information Studies 7(1)*, 132. http://hdl.handle.net/2289/6698

63 Barnett, A. G. (2016) Funding by lottery: political problems and research opportunities. *mBio 7(4)*, e01369-16. doi:10.1128/mBio.01369-16

64 Liu, M., Choy, V., Clarke, P. et al. (2020) The acceptability of using a lottery to allocate research funding: A survey of applicants. *Research Integrity and Peer Review 5*, 3. https://doi.org/10.1186/s41073-019-0089-z

65 Tigges, B. B., Miller, D., Dudding, K. M., Balls-Berry, J. E., Borawski, E. A., Dave, G., Hafer, N. S., Kimminau, K. S., Kost, R. G., Littlefield, K., Shannon, J. and Menon, U. (2019) Measuring quality and outcomes of research collaborations: An integrative review. *Journal of Clinical and Translational Science 3(5)*, 261–289.

66 Wheeler, J., Pham, N. M., Arlitsch, K. et al. (2022) Impact factions: assessing the citation impact of different types of open access repositories. Scientometrics 127, 4977–5003. https://doi.org/10.1007/s11192-022-04467-7

67 RAND (2020) UKRI-commissioned study conducts real-time review of the upcoming REF 2021. https://www.rand.org/randeurope/about/news/2020/ref2021-real-time-review.html

68 Arnold, E., Simmonds, P., Farla, K., Kolarz, P., Mahieu, B. and Nielsen K. (2018) Review of the Research Excellence Framework: Evidence report. Technopolis Group. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/768162/research-excellence-framework-review-evidence-report.pdf

69 van Drooge, L., de Jong, S., Faber, M. and Westerheijden, D. (2013) *Twenty years of research evaluation*. The Rathenau Institut, The Hague. https://www.rathenau.nl/sites/default/files/2018-05/Twenty_years_of_research_evaluation_-_Rathenau_01.pdf

70 Sinclair, J. (2022) Review of Performance-Based Research Fund makes progress. *Research Professional News.* https://researchprofessionalnews.com/rr-news-new-zealand-2022-2-review-of-performance-based-research-fund-makes-progress/

71 Currie, J. (2008) The research assessment exercise in Hong Kong: Positive and negative consequences. *International Education Journal: Comparative Perspectives 9(1)*, 53–68. https://files.eric.ed.gov/fulltext/EJ894342.pdf

72 DORA (2012) *San Francisco Declaration on Research Assessment (DORA)*. https://sfdora.org/

73 Woods, H.B & Wilsdon, J. (2021) Experiments with randomisation in research funding: scoping and workshop report, RoRI Working Paper No. 4, H.B. Woods & J. Wilsdon (eds), Research on Research Institute, London, UK.

ACOLA
AUSTRALIAN COUNCIL OF LEARNED ACADEMIES

By providing a forum that brings together great minds, broad perspectives and knowledge, ACOLA is the nexus for true interdisciplinary cooperation to develop integrated problem solving and cutting-edge thinking on key issues for the benefit of Australia.

www.acola.org

The Australian Council of Learned Academies (ACOLA)
combines the strengths of the Australian Learned Academies.

LEARNED ACADEMIES

ACADEMY OF
THE SOCIAL SCIENCES
IN AUSTRALIA

Australian
Academy of
Science

Australian
Academy of the
Humanities

ATSE
Australian Academy of
Technology & Engineering

Australian Academy
of Health and
Medical Sciences