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# Foreword from the Chief Scientist and the Chief Economist

In almost all respects, life in Australia is better now than it was a generation ago, a positive bequest to hand on to the next generation. Innovation, the human desire to improve things, underpins this. It is what explains rising life expectancy, levels of education and living standards.

An entire generation of Australians has grown up without experiencing a recession. Australia, unlike the rest of the developed world, dodged the Global Financial Crisis a decade ago. In doing so, we broke the global record for years of consecutive economic growth. At the same time, Australia has remained persistently ranked in the bottom half of developed economies, and slipping, across a range of comparative measures such as the Global Innovation Index and the World Competitiveness Index. How is it that both can be right?

Our view is that these measures are not right — they are failing to capture aspects of Australia’s economy. Summary measures of Australia’s innovation performance seem to get things both wrong and muddled. For example, Australia ranks last, by some margin, among all OECD countries in business-researcher collaboration. There is plainly room for improvement on this measure in Australia, but the international comparisons do not ring true.

For instance, Australia is mid-ranking among OECD countries in patent collaboration between businesses and researchers. It is also easy to demonstrate that the official statistics for Australia undercount the actual extent of collaboration between agencies like the CSIRO and business.

It is well known that in industries like mining and agriculture Australia is a world-leader. These primary industries are seen by some as less important than secondary and tertiary industries, somehow primitive compared to advanced manufacturing. Nothing could be further from the truth. Australian mining and agriculture are highly innovative, indeed pioneering in their application of new technologies. Driverless

trucks and trains are already in operation in the Pilbara, remotely controlled from 3000 kilometres away in Perth, supported by a local ecosystem of high-end data analysts. These industries do not typically feature in international measures of innovation performance. That is an oversight.Australia also seems to be at the forefront of embracing new technologies in the digital economy, as seen in industries such as retail, finance, logistics and hospitality, which raises questions about how much weight should be given to home grown innovation versus being fast followers in embracing innovation from abroad.

We have embarked on this Review because we believe that innovation matters; indeed, hardly anything else matters as much in raising the well-being of Australians over the long run. If we are to continue to raise the

well-being of Australians, and if we want to shift the dial on productivity, we need to track our progress on innovation. We need to understand innovation across all of Australia’s industries and regions, and make adjustments to policy settings as needed. In a data-rich world, we also need to be sure that we are harnessing new data sources, including from the private sector, to meet our needs better.

Our initial round of stakeholder consultations has yielded a rich variety of perspectives on what is needed to improve innovation indicators in Australia. It is already evident that we will not be able to please everyone, as the different demands are wide-ranging. We invite you to read this first consultation paper, and contribute your views on where you think we should focus our efforts. Combined with the insights of international experts, we are confident that we can offer up a next generation of innovation indicators to meet the needs of policy makers and serve the interests of Australians over the next decade and beyond.





**Alan Finkel**

Australia’s Chief Scientist

**Mark Cully**

Chief Economist, Department of Industry, Innovation and Scienc



# Overview of the Innovation Metrics Review

Innovation is essential to improving Australian productivity and living standards and creating new jobs. Recognising this, it is important innovation is measured as accurately as possible.

The Innovation Metrics Review (‘the Review’) was recommended in the Innovation and Science Australia (ISA) [2030 Plan](https://www.industry.gov.au/data-and-publications/australia-2030-prosperity-through-innovation), accepted by the Government and included as a measure within the [2018-19 Budget](https://www.budget.gov.au/2018-19/content/bp2/index.html). The Review commenced in May 2018 and is due to be completed on 30 June 2019.

The purpose of this consultation paper is to acquaint innovation system stakeholders with the Review’s progress to date, and provide a broader range of stakeholders with the opportunity to provide input.

## Goals and principles of the Innovation Metrics Review

In embarking upon the Review, the Chief Scientist and Chief Economist established a guiding set of goals and principles, and these were refined and agreed with the international Steering Committee.

### Goals

The Review will deliver a report to the Australian Government recommending:

1. an appropriate data and measurement infrastructure for capturing innovation metrics that:
   * is underpinned by a sound conceptual framework
   * captures data at the most efficient cost
   * sets out a roadmap for change.
2. a suite of robust innovation metrics that:
   * accurately measure and effectively communicate innovation performance and its impacts across all

sectors of the Australian economy

* + are presented in a way that is useful for government policy and program development
  + can measure the impact of government policy initiatives on innovation
  + may be useful for international adoption and comparisons.



### Principles

The Review recognises the breadth of benefits that innovation delivers to society, but focuses on the economic impacts of innovation (in particular productivity, investment, jobs and exports), as these are where innovation policy can have the greatest impact on living standards.

The Review sets innovation in the context of a modern economy characterised by an increasing dominance of service industries, high levels of investment in intangible capital and deployment of digital technologies.

A key assumption is that Australians want the benefits of innovation from wherever it is sourced — for example, in sectors such as mining and agriculture — which means we must be open to all sources of innovation and uncover hidden innovation.

A mapping exercise based on a conceptual framework will demonstrate which of the existing metrics in use are of sufficient quality and where new metrics need to be developed to fill gaps. A starting position for the framework is in the [Australia 2030 Prosperity through](https://www.industry.gov.au/data-and-publications/australia-2030-prosperity-through-innovation) [Innovation report](https://www.industry.gov.au/data-and-publications/australia-2030-prosperity-through-innovation).

Metrics must be directly relevant to government policy development and program performance. Ultimately high-level metrics will be presented in a scorecard

format of a useful number of indicators (around 10 to 15). The full suite of metrics will serve broader purposes in monitoring, evaluation and research on the innovation system and the impact of government policy. Criteria for deciding metrics will be developed to ensure objective metric selection.

Where metrics are also collected and published internationally for advanced economies, these will be favourably considered. The recommended metrics should aspire to be internationally comparable (with zero or minimal correction required).

It is likely that we will recommend some significant changes to the capture of innovation metrics. Where appropriate to do so, these will leverage off existing statistical collections and administrative data sources, but not shy away from using novel sources.

In setting out a roadmap for change, we will aim to ensure the longevity of the changes to the data and measurement infrastructure remain in place to 2030 and beyond.

Underpinning all of the above principles is the principle of pragmatism. The Review’s recommendations will be practical, achievable, have due regard for the burden imposed on data providers, and will focus on the most important improvements that could be made.

## The approach of the Innovation Metrics Review

The Innovation Metrics Review is being funded by the Department of Industry, Innovation and Science (DIIS). The

Review is being undertaken by: a Taskforce of officers from DIIS, the Australian Bureau of Statistics (ABS) and

IP Australia; and by the Australian Academy of Technology and Engineering (ATSE). ATSE’s role is to provide an independent viewpoint, but ATSE is working in close collaboration with the Taskforce to ensure the Review is robust and conducted in a resource-efficient manner.

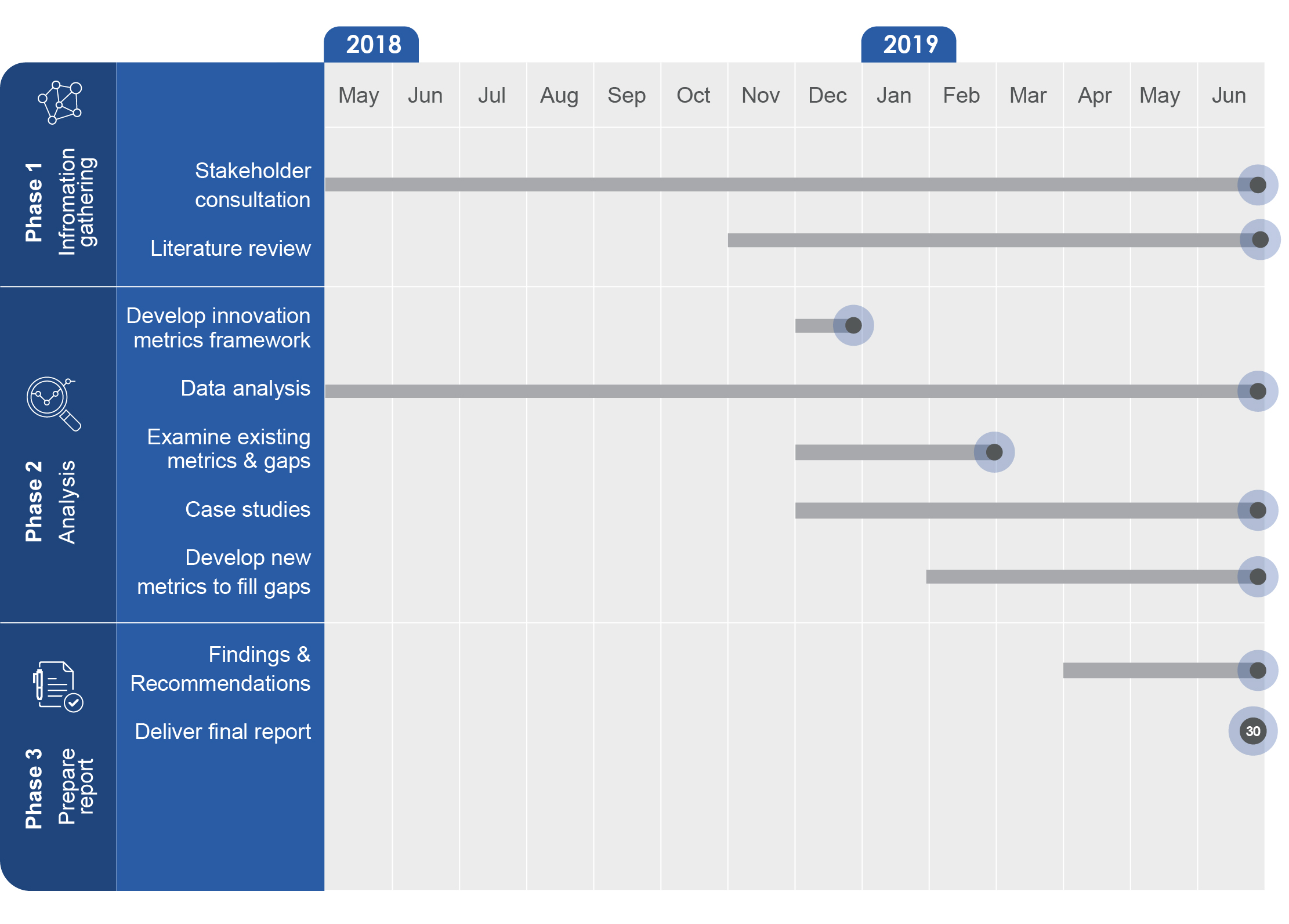
ATSE is being funded to undertake a literature review ad advise on a framework; the data currently available – including gaps; and the metrics to be used or developed for future use.

### Governance of the Review

The Innovation Metrics Review Taskforce is directed by a Steering Committee, and receives advice from an Expert Working Group. Selected international technical advisers are also providing expert guidance. The composition of these groups is provided in the Appendix.

The main Review activities are shown below.

#### Figure 1 — Innovation Metrics Review timeline



**Consultations**

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The purpose of the consultation process is to understand stakeholder needs, concerns and priorities to inform the review. Consultations are being undertaken in two phases:

#### Targeted consultations.

About 50 consultations were undertaken with stakeholders from the government sector (international, Commonwealth, state and territory), research sector (independent academics, research organisations and research sector peak bodies) and the private sector (including bibliometric providers) between July and December 2018.

Key messages provided by stakeholders during the targeted consultations are summarised below. Note that these reflect the opinions of and statements made by stakeholders and should not be considered as findings of the Review. Their concerns are being assessed and their needs prioritised as part of the Review.

#### Public consultation

In March 2019, we will undertake public consultation to acquaint innovation system stakeholders with the

Review’s progress to date and provide a broader range of stakeholders with the opportunity to provide input to the Review. That is the purpose of this document.

In April or May 2019, we will make draft findings and recommendations available for public comment, ahead of the Review’s report to the Government at the end of June 2019.

### Literature review

The objectives of the literature review, undertaken by ATSE, are to:

1. summarise state-of-the-art thinking about the role of innovation in modern economies, and the drivers of innovation, in the context of rising investment

in intangible capital, the growth of the service economy, and the uptake of digital technologies

1. examine conceptual frameworks and approaches used for measuring innovation in key advanced economies, and evaluations and critiques of these
2. highlight novel approaches in metrics and data collection
3. identify any approaches that might help to better measure innovation activity in Australia, including in areas of the economy that are not currently measured.

### Development of an innovation metrics framework

The Innovation Metrics Framework, developed jointly by the Taskforce and ATSE, is central to the Review’s metric collection and categorisation efforts. We acknowledge the many innovation system frameworks currently in existence and that some of these are already used to categorise innovation metrics. Some of the better known frameworks are those used by the Global Innovation Index, the Global Competitiveness Index and the European Innovation Scoreboard.

These other frameworks were developed in order to organise metrics that currently exist.

The Review aims to identify and measure components of the innovation system that are not currently being adequately identified and measured. We developed our own framework to include measures which were not included in existing frameworks. A summary diagram of this framework is shown below.

#### Figure 2 — Innovation metrics framework

**Image shows Innovation System Framework developed by the Review to guide categorisation of existing innovation metrics and identify gaps in innovation metrics. 

The framework is represented as innovation impact at the centre surrounded by four concentric circles. 

The first concentric circle represents three categories of innovation activity which include creation, diffusion and adaptation, and application and outputs. 

The second concentric circle represents the innovation ecosystem, the six elements of which are the research system; non research and development creativity; distribution of knowledge; human capital; application capabilities; application performance.

The third concentric circle represents the operating environment, the four elements of which are: domestic governance and institutional environment; international environment; business environment; infrastructure. 

The fourth and outermost concentric circle represents the policy levers, which include: taxation environment; procurement, standards and regulation; finance and investment policy regulation; nation building projects; research funding; business migration policy; education, training and migration policy; direct and indirect government investment; competition policy; foreign and trade policy; support for networks. 

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**Examination of data**

The Review has examined the data presently available for analysis from government administrative and transactional data and surveys and is assessing private sector data which could potentially be made available or collected in order to meet needs that are not currently being met.

### Examination of metrics

We examined metrics obtained from a wide range of sources — including Eurostat, the Organisation for Economic Cooperation and Development, the Global Innovation Index, the Global Competitiveness Report, the Innovation and Science Australia scorecards and the Australian Innovation System Report — and assessed them against a range of performance criteria. These are relevance, timeliness, accessibility and clarity, accuracy and validity, reliability and precision, coherence, and comparability. We then mapped metrics against the components of the framework, and identified components of the innovation system for which there are either few or no innovation metrics available and fit for use.

#### Figure 3 — Number of quality-assessed metrics within each Framework component

**Chart showing the number of quality-assessed metrics within components of the Innovation Metrics Review Framework. 

Of the 138 metrics available for the Operating Environment, 31% are rated as having no issues, 51% are rated as having some issues, and 18% are rated as having significant issues. 

Of the 89 metrics available for the research system 8% are rated as having no issues, 65% are rated as having some issues, and 27% are rated as having significant issues. 

Of the 8 metrics available for non-R&D based knowledge and idea creation, 50% are rated as having no issues, and 50% are rated as having some issues. 

For the 130 metrics available for human capital, 30% are rated as having no issues, 47% are rated as having some issues, and 23% are rated as having significant issues. 

Of the 83 metrics available for the distribution of knowledge, 31% are rated as having no issues, 47% are rated as having some issues, and 22% are rated as having significant issues. 

Of the 34 metrics available for application capabilities 18% are rated as having no issues, 59% are rated as having some issues, and 24% are rated as having significant issues. 

Of the 12 metrics available for application performance, 100% are rated as having some issues. 

Of the 98 metrics available for innovation impact, 64% are rated as having no issues, 33% are rated as having some issues, and 3% are rated as having significant issues.  **

**Case studies**

Case studies are being developed to determine if key industrial and business areas within Australia’s economy are generating innovation that is currently not being adequately measured, and the nature of the innovation that is occurring. Focal areas for the case studies include mining, agriculture, health services and financial and insurance services.

### Development of new metrics

Where there are gaps in the suite of metrics currently available, we will attempt to develop new metrics to meet stakeholder needs.

### International workshop

We are holding an invitation-only workshop during March in Canberra. Participants at the workshop will primarily be innovation system measurement experts based in Australia and overseas. The topics discussed will include entrepreneurship; the international state of play with regard to innovation metrics; hidden innovation in mining;

and the measurement of: research and development and innovation; creative inputs into innovation; knowledge diffusion and research commercialisation; intangibles; and capability and absorptive capacity.

### Delivery of a report to Government

We will deliver a final report to Government in June 2019. The report will be published and will include a literature review; the findings of the Review, including a roadmap to improve the quality and range of data on innovation performance; the suite of innovation metrics available now and an assessment that shows which of

these are most useful; a scorecard comprising a limited number of innovation metrics that best track innovation performance now; and the suite of innovation metrics and scorecard that the Australian Government should aim to produce in future if and when data improvements have been made.

The Government will consider the Review’s recommendations and any funding implications as part of its consideration of the 2020-21 Budget.

# A preliminary opportunity to comment

To date, the Review Taskforce has met with government, research, and private sector stakeholders. Having conducted initial targeted consultations, we now welcome input from a broader range of stakeholders, including industry groups and businesses.

Given the complexity and breadth of the innovation system and its measurement, these consultations have unsurprisingly revealed great diversity in the ways that different stakeholders use innovation metrics; their concerns with innovation metrics and the underlying data used to produce them; and their views on the opportunities for improving innovation metrics and underlying data.

A summary of the key messages from targeted stakeholder consultations to date is provided below. These represent the opinions of and statements made by stakeholders. We are assessing these stakeholder views and statements and their validity and prioritising the issues raised.

We will not be able to address all stakeholder concerns comprehensively. Some trade-offs will be necessary. We will be prioritising the measurement issues of greatest importance to Australia that can realistically be addressed effectively and which will enable the development of better policies and programs to improve outcomes for Australia.

In developing strategies and prioritising areas for action, we will be guided by the goals and principles discussed on pages 4-5.

We seek stakeholder views on what issues and actions the Review should prioritise and why.

We invite comments on any matters that fall within the parameters of the Review. Please frame your response by addressing the following questions.

1. Do you agree or disagree with the key messages received from targeted consultations to date? Why?
2. Are there any other issues that fall within the parameters of the Review but which have not been raised in targeted consultations to date?
3. Where do you believe the Review should focus its efforts? Why?

If you would like to provide input to the Review, please do so before **Thursday 28 March 2019**. Input should be sent via email to [InnovationMetricsReviewTaskforce@industry.gov.au](mailto:InnovationMetricsReviewTaskforce@industry.gov.au).

A further opportunity to comment on the Review’s draft findings and recommendations will be provided in April

or May 2019.



# Summary of key messages from targeted consultations

## What do stakeholders want innovation data and metrics for?

* Stakeholders have indicated that they want innovation data and metrics to help them determine how to increase innovation activity. However, innovation is a means to an end. Stakeholders want more innovation because they believe it will lead to:
  + higher living standards
  + higher productivity
  + job growth
  + increased exports
  + social and environmental benefits.
* Stakeholders want innovation data and metrics to:
  + compare innovation performance (across countries, states, industries, and participants within an industry)
  + determine where the innovation system in Australia is working well and where improvements can be made
  + help develop cost-effective policies and programs that encourage more innovation
  + determine whether government interventions should be broad-brush or highly targeted
  + measure whether policies and programs are working and should be continued, redesigned, or ceased, by providing comparison data.
* Stakeholders also want to know the relative effectiveness of investing in innovation compared to alternative

avenues for government investment.

## Theory of innovation and implications for innovation measurement

Consultations have yielded some consistent themes relating to the innovation system, the changing nature of innovation, and conceptual implications for how and what should be measured. Key messages from stakeholders include the following:

### Innovation metrics should be approached from a macroeconomic perspective

* Stakeholders highlighted that a key objective of innovation is to increase productivity and thereby living standards. Innovation indicators should be viewed as intermediate indicators.
* Stakeholders highlighted that innovation can be considered in terms of demand and supply.
* Some stakeholders expressed the view that Australia’s perceived poor performance on innovation is predominantly due to deficient domestic demand rather than deficient supply. That is, Australia funds scientific research and development (thereby driving innovation supply), but there is a lack of domestic demand (referred to by some as “absorptive capacity”) for innovative products and processes once developed.

### Innovation is not just about new- to-world innovation, but is also about innovation adoption and diffusion

* Innovation requires both invention and implementation.
* The rate of development of new-to-world products and processes could drop to zero, and productivity could continue to grow for some time, merely

from the adoption of existing innovations and new technologies.

* Being a fast adapter and adopter of innovation and new technologies is important. A considerable number of stakeholders think that adapting and adopting is more important — in terms of getting more firms producing on or near the production possibilities frontier (i.e. efficiently) — than new-to- world innovation, because it has the potential to affect so many more firms.
* There is agreement that many Australian businesses absorb internationally developed innovations

and adapt them to Australian circumstances, but considerable disagreement about the relative speed and extent with which this happens.

* Stakeholders note that innovation diffuses geographically as firms expand into new areas or as skilled workers move between firms. They believe that this diffusion happens more quickly across adjoining areas.
* Some see Australia as a fast follower of innovation, whereas others cite Australia’s physical isolation as slowing the movement of skilled labour and hence diffusion.
* Some stakeholders believe that there would be value in further exploring where Australia is innovating across the spectrum of simple to complex, and understanding what kinds of innovation Australia adopts.
* There is a need to understand technology diffusion across different types of businesses and business uses of technology, and whether this is world-leading or old technology.
* It is not clear that continuous improvement is being counted in measures of innovation.

### Management capability is a key factor in determining the success of innovation in firms

* The development and adoption of innovation and digital technologies, how successfully they are implemented, and whether firms profit from having introduced such innovations, depends on management practices.
* Managerial quality explains some of the differences

observed in productivity.

* There is concern about the lack of appropriate risk taking by directors and managers. Shareholders may be willing to accept risks which may involve firms becoming insolvent, particularly as shares in these firms may account for only part of their portfolios, in the hope of greater gains. However, directors and managers tend not to support risks that may result in job loss.
* Some stakeholders suggest that the Australian mining sector has high managerial quality and should be considered as a case study.



### Measuring the stock of and flows in intangible assets well is important

* Investment in intangible assets may indicate innovation is in progress.
* The proportion of total assets that are intangible has risen steadily in recent years.
* The formation of intangible assets now exceeds the financial investment made in tangible assets for most developed countries.
* It appears that the 2008 System of National Accounts does not comprehensively include the measurement of all intangibles in the categories of:
  + database development
  + design and other product development
  + market research and branding
  + business process re-engineering and organisational structure.

Some expenditure in these areas may represent costs to businesses in the current period, but some represents intangible assets formation.

* The measurement of the stock of and flows in intangible assets is a key issue for many statistical agencies.
* Stakeholders suggest that the Financial and Insurance Services sector should be considered as a case study to help improve understanding of intangible capital in Australia.

## Stakeholder comments on innovation metrics

### Stakeholders question the data underpinning some collaboration metrics

* Many stakeholders value collaboration metrics, and various metrics have been developed to quantify collaboration in different ways. However, stakeholders are concerned about the quality of the data underpinning collaboration metrics.

### Metrics on innovation adaptation and adoption are needed

* There is a lack of information on the rate of diffusion of innovation, as well as the rate of adaptation and adoption of innovation across different sectors and different types of businesses. Stakeholders have suggested that it would be useful to have a metric to indicate how fast Australia is adopting new technologies, and a metric that quantifies the lag between a new technology becoming available and being adopted.
* Metrics on adaptation and adoption would provide insight into whether Australian firms are fast or slow followers, relative to the rest of the world.

### Stakeholders value firm-level economic indicators

* Some stakeholders have identified that the most important indicators of innovation to them are standard, firm-level, industrial economic indicators, such as employment numbers and composition, sales growth, employment growth, productivity growth, and profitability.
* However, stakeholders have also indicated that there are problems with the quality of the data that could potentially underpin such metrics — particularly timeliness and extent of coverage —and the accessibility of this data.

### Improved data, metrics and analysis on the scale of innovation spill-overs are needed

* Existing measurement systems do not measure spill- overs of innovation activity.
* Stakeholders have indicated that metrics are needed to quantify the extent of spill-overs between firms, especially with regard to research and experimental development.
* Where possible, stakeholders would like to gauge the extent of spill-overs from innovation activities that affect health and the environment.
* To date, the approach to measuring spill-overs have been via case-studies.
* Hubs of innovation activity occur around research infrastructure. Research infrastructure can help foster industry engagement and collaboration. However, often research infrastructure is taken for granted and should be better measured.
* Several stakeholders need metrics to inform place- based innovation, including the impact of innovation precincts. This could require a significantly larger sample in some surveys.

### Better metrics on managerial quality are needed

* Many stakeholders indicated managerial quality exerts an important effect on innovation, and therefore indicators of managerial capability are needed.
* There is concern about science, technology, engineering and mathematics (STEM) capability at the managerial level, and a metric on this would be welcomed. However, as innovation may involve creativity rather than science, other metrics are needed as well.
* There is concern over management risk aversion and a metric on this would be welcomed.

### Better metrics on employee quality are needed

* There is a lack of data on the quality of labour. Stakeholders regard metrics on workforce skills as just as important as managerial quality.
* Stakeholders want to know whether firms can access the skills they need, and whether the workforce has the required skill sets in the right quantity. That is, stakeholders want to understand whether the supply of skills available matches that in demand.
* Stakeholders are particularly interested with regard to

STEM, creative, and certain specific skills.

* There is interest in the extent to which the workforce engages in life-long learning. Stakeholders questioned whether the change in qualifications and skills of the workforce is being driven by new workers entering the workforce and older workers retiring or by people choosing to retrain or upgrade their qualifications and skills mid-career.

### Better metrics on innovation impact are needed

* Stakeholders believe that more effort goes into measuring innovation inputs and activities than innovation impacts.
* Several stakeholders want better data on cost savings, economic benefits and productivity improvements resulting from innovation, and metrics summarising changes in these parameters.

### Better metrics on innovation transfer and networks are needed

* Stakeholders indicated an absence of quality metrics for technology and knowledge transfer, but also that such transfers can be informed by data on talent flow.
* Consultations have indicated that understanding talent flow is of policy relevance because governments are frequently concerned with whether they are attracting talent, and how to attract talent.
* Some stakeholders indicated that they would value metrics on networks between people and how these networks change.

### Better metrics are needed on publication citations

* Stakeholders highlighted that existing scorecard metrics for publication citations are uninformative because they do not take different disciplines into consideration.
* The number of citations considered “usual” differs radically across disciplines, and different disciplines have different citation profiles. For example, in physics, a successful author might be cited 3000 times in five years, whereas in maths, five citations over the same period may be considered a good outcome.
* Some stakeholders believe that without taking discipline into consideration, a single, high-impact publication may change the citation metrics not only for the discipline of the publication, but may distort the overall citation metric.

## Stakeholder comments on innovation-related data sources



### Better linking of existing data will enable new insights

* Many consultations have emphasised that new insights do not necessarily require different data collection processes but can be enabled by linking existing datasets.
* The Business Longitudinal Analysis Data Environment (BLADE) contains Department of Industry, Innovation and Science program data, as well as tax data and ABS survey data. However, it does not contain data that may be valuable for measuring innovation from other portfolios, such as grants data and customs data.
* BLADE is considered useful for data-linking.

### Time lags until data are available hinder policy and program evaluation and design

* Australian Taxation Office and Australian Bureau of Statistics data are often not available until significantly after a reference period has concluded, and much of this delay is unavoidable because of how long firms take to respond to official data requests.
* This means the Australian Government is unable

to use official data to determine if its policies and programs have been effective or not in a particular reference period until well after that period has ended.

* This is a significant problem. Ineffective policies and programs may continue until there are enough data available to evaluate them and demonstrate that they do not achieve their aims. There may then be a further delay until they can be redesigned or replaced. This delay is costly.
* Having some indicators that are available quickly should be a priority, even at the compromise of some quality.
* The Review should explore the possibility of innovation indicators based on private sector administrative and transactional data which can be made available in real time, to enable the Australian Government to respond more quickly where appropriate.
* Short lag indicators (or, ideally, leading indicators) should be part of a suite of indicators, rather than replacing high quality but significantly lagged indicators. BLADE is only as good as the data that can be linked through it. The time lags involved before key data becomes available limit BLADE’s ability to support timely analysis.
* The access restrictions on data that are potentially available through BLADE limit the analytical work undertaken.

### Data inaccessibility hinders analysis and program and policy design and evaluation

* Consultations emphasised that the barriers to accessing data through BLADE, and to unlinked government administrative datasets, are hindering data analysis, and thus policy and program design and evaluation.
* An enormous amount of existing data is not being analysed because would-be analysts cannot obtain access.
* Data inaccessibility is causing a ‘chicken and egg’ problem. Deeper econometric analyses are needed, but there is a lack of people with the skills to perform them, in part because the data is so difficult to access that academics and graduate students cannot develop the requisite skills to analyse it.



### Australian data are missing from OECD data publications

* Some stakeholders have highlighted that there are indicators in the OECD Science and Technology Indicators (STI) Scoreboard for which no comparable Australian data are available, and that some Australian data published by the OECD is dated.

### Data are not capturing ‘hidden innovation’

* Some stakeholders consider survey data to be old- fashioned and designed at a time when interest in innovation was focussed on the manufacturing sector. This sectoral focus is potentially problematic from a metrics perspective because innovation occurs in all industries.
* There is a lack of data on the importance of enabling technologies in businesses, as opposed to specific process technologies.
* Not all innovation occurs as a result of research and development (R&D). It is important that data on all components of innovation are captured, including in creative industries.

### Collaboration data issues

* Stakeholder consultations highlighted a number of issues with data on collaboration, including problems of accuracy and precision.
* Some stakeholders suggested that having trusted collaboration data should be a high priority.
* Australia’s poor international performance on research-industry collaboration may be a statistical artefact. The Oslo Manual, and hence the Business Characteristics Survey (BCS), excludes ‘fee-for- service’ arrangements from counting as collaboration. This underestimates the number and total value of collaborations reported by the Australian Bureau of Statistics (ABS). This is particularly concerning for Australia, as some stakeholders believe that fee-for- service arrangements are more common in Australia than overseas.
* Even when the fee-for-service definition does not apply, stakeholders highlighted that ‘collaboration’ is not clearly and consistently defined, and it is interpreted differently by different survey respondents.
* BCS survey data on collaborations is inconsistent with the results obtained from comprehensive administrative data from Australia’s public sector research organisations. This is confusing to users and results in distrust of Australian collaboration data.
* Various types of research-industry collaborations occur, which further complicate the reliability collaboration metrics. For example:
  + some universities hire out R&D infrastructure to businesses, which may not be reflected in collaboration data
  + different universities structure their collaboration efforts differently: some have strategic partnerships involving multiple projects with one or several large companies, others have a large number of small collaborations with many firms. These two different collaborative models result in different numbers of collaborations, yet could result in the same dollar value
  + ideally, data should be collected and published for both the number and value of collaborations.

### Inconsistency between R&D data sources

* Stakeholders stated that the various sources of data on R&D expenditure provide inconsistent information. Stakeholders are confused about which data to use under which circumstances. Allowing expenditures that would not be included as research and development according to the Frascati Manual to be claimed under the Research and Development Tax Incentive seems to be exacerbating this.

### Detailed feedback on the Business Characteristics Survey (BCS)

* The BCS is heavily used for both innovation and other purposes by a wide range of users, and there is very strong support for the continuance of the BCS or some other surveys that do the same jobs. However, most users believe the BCS could be improved.
* Users feel the BCS provides good data on the revenue impacts of new products (goods and services) but not on the cost impacts, or productivity impacts, of innovation.
* There is interest in picking up international work on categorising firms by innovation type (strategic, intermittent, adaptive and adoptive), as the scale of their effect on GDP differs.
* There is concern about comparability of the BCS with the Eurostat’s Community Innovation Survey.
* There is interest in being able to compare Australia’s performance with other resource-based economies to see if Australia is innovating faster or slower than they are.
* Several stakeholders want R&D vs non-R&D breakdowns within the BCS.

### Make better use of non-traditional data sources

* Many consultations have indicated that non- traditional data sources can provide relevant data in real-time, overcoming the time lag associated with traditional data sources.
* There are limitations with non-traditional data sources relating to representativeness. Coverage is partial and bias in the subpopulation is common. Some stakeholders noted that international benchmarking based on metrics generated from non-traditional data sources may be compromised by different uptake of relevant platforms in different countries.
* Some stakeholders have used re-weighting techniques to address these limitations, and claim some success in obtaining early and meaningful results from their analyses.
* Stakeholder suggestions for the most useful metrics potentially generated from alternate data sources include:
  + connections between businesses and researchers
  + business-to-business collaboration
  + skill supply, demand and transfer
  + entrepreneurship.

### ANZSIC and ANZSRC classifications

**are no longer comprehensive enough**

* Concerns with the Australian and New Zealand Standard Industrial Classification (ANZSIC) system impact on data quality.
* Some stakeholders have indicated that the economy has moved on since the last iteration of the ANZSIC in 2006, and that it no longer meets their needs, particularly with regard to the green economy, advanced manufacturing and the digital economy.
* Current ANZSIC sectors may not be capturing new and emerging industries. Innovation strategies that are targeting these new industries may encounter measurement issues when mapping against current ANZSIC classifications.
* Specific examples of problems raised by stakeholders

include:

* + boundaries between sectors are difficult to discern with the ANZSIC system — for example, where does healthcare end and information technology (IT) begin?
  + it is difficult to determine R&D expenditure in health and medical research, given that such research falls not only under a health classification, but also increasingly under a manufacturing classification. The high degree of aggregation with which ABS data is published further complicates this issue. It is important to track the performance of health and medical research, but currently the data produced is inadequate for this purpose
  + ANZSIC classifications do not align with industry growth sectors, presenting a challenge to policy analysts
  + some vital industries are invisible to ANZSIC classifications. For example, some cybersecurity businesses can be classified as either ‘IT businesses’, or ‘Professional, Scientific and Technical Services’
  + Professional, Scientific and Technical Services is a particularly problematic category, which captures many, vastly different types of activity, and has become considerably more complex since 2006
  + firms are not updating their ANZSIC codes when they pick up a second or subsequent line of business, or when they change their line of business
  + errors in reporting are being generated by firms not big enough to be broken up into separate type of activity units (TAUs) having multiple ANZSIC codes apply to their business.
* A review of Australian and New Zealand Standard Research Classification (ANZSRC) codes is currently underway. Some stakeholders consider the ANZSRC a backward-looking approach, which does not aid our understanding of interdisciplinary research and new fields of research.

### Stakeholders want better quality data on start-ups and entrepreneurship

* There is a lack of an agreed definition of ‘startup’, and this reduces the reliability of relevant data. A consistent definition of startups and startup activity is needed for comparability.
* LinkedIn was noted as a potential alternative-data source for measuring entrepreneurship.

### Stakeholders want better access to better quality innovation-related ABS data

* Stakeholders view the data gathered by ABS surveys (the annual Business Characteristics Survey, the

two-yearly Survey of Research and Experimental Development, and the annual Survey of Venture Capital and Later Stage Private Equity) as incredibly valuable. However, stakeholders feel opportunities are missed due to the high level of aggregation of this data, which does not allow insights on activity and trends in:

* + specific sectors
  + specific geographies
  + fields of research
  + socio-economic objectives.
* Many stakeholders use the ABS R&D survey data and most had suggestions for its improvement. Most of these suggestions concerned higher specificity of data, for example:
  + publication of data with greater geographical resolution (e.g. at the state and territory level and at the Australian Statistical Geography Standard SA3 level), to allow inter-jurisdictional benchmarking
  + publication of data at the 4-digit level for ANZSRC, ANZSIC, and Field of Research
  + administration of surveys annually rather than biennially.
* R&D expenditure provides an input view of innovation activity. Although R&D expenditure is relatively easy to measure compared to other facets of innovation and is directly influenced by government, stakeholders do not have a clear picture of R&D occurring in businesses, and would like to see breakdowns by industry.
* Stakeholders suggested that better quality and more transparent business R&D data would allow

universities to better target their research programs to business trends and opportunities.

* They also want the ABS Survey of Research and Experimental Development to be conducted annually.

### Research and Development Tax Incentive (RDTI) data

* Stakeholders would use RDTI data if it were available with sectoral and geographic breakdowns. Without these breakdowns, it is difficult to determine the impact of the program and changes made to it, both generally and within specific sectors.
* There is a demand for RDTI data at the level of

different industry sectors.

* The alternatives to RDTI data include Australian Stock Exchange data and private, subscription-based data sources, but using these data sources is laborious, expensive or both.

### Stakeholders want access to administrative datasets

* Stakeholders would value better access to industry- related datasets, including those containing program data, such as those held by Innovation Connections, Cooperative Research Centres, Rural R&D Corporations, National Collaborative Research Infrastructure Strategy (NCRIS) supported facilities and industry growth centres.



Innovation Metrics Review

### Information collected by the NSRC is useful, but of limited value

Innovation Metrics Review



* Stakeholders indicated that in principle, the data collected through the National Survey of Research Commercialisation (NSRC) is useful, but also noted that improvements are needed.
* Some stakeholders stated that some of the data which the NSRC collects can be generated or approximated using data from other sources.
* Some issues identified include:
  + a need to improve quality controls over the data
  + the long and variable time lag between data collection and publication
  + a need to clarify some definitions in the NSRC and address inconsistent interpretation across universities (e.g. ‘invention disclosure’ and collaboration’).
* Stakeholders noted some unique and valuable data gathered by the NSRC which is not available from other data sources, such as data about consultancies and start-up companies.
* Some stakeholders indicated that the NSRC would be a good way to capture data on which organisations universities engage with as end-users of research. For example, it could capture data on the proportion of these users that are from government and from the business sector, the size distribution of end-user businesses, and the geographical location of end-users.
* Some stakeholders indicated that it would be useful to capture data on where R&D funding is coming from.

# Appendix: Governance of the Innovation Metrics Review

### The Steering Committee that will direct the Review includes:

#### Dr Alan Finkel

Australia’s Chief Scientist, Co-chair

#### Mr Mark Cully

Chief Economist, Australian Department of Industry, Innovation and Science, Co-chair

#### Dr Charles Day

Chief Executive Officer, Office of Innovation and

Science Australia

#### Ms Luise McCulloch

Deputy Australian Statistician, Statistical Services Group, Australian Bureau of Statistics

#### Prof Hugh Bradlow

President, Australian Academy of Technology and Engineering

#### Dr Alan Bye

Vice-President, Technology (Strategy and Innovation), BHP

#### Prof Pauline Nestor

former Vice-Provost of Research, Monash University (retired)

#### Dr Dirk Pilat

Deputy Director of the Directorate for Science, Technology and Innovation, Organisation for Economic Co-operation and Development (OECD)

#### Dr Francis Gurry

Director General of World Intellectual Property Organisation (WIPO)

#### Ms Christine Williams

General Manager, Innovation Metrics Review Branch, Australian Department of Industry, Innovation and Science (ex officio).

### The Expert Group advising the Review includes:

#### Dr Alan Finkel

Australia’s Chief Scientist, Co-chair

#### Mr Mark Cully

Chief Economist, Australian Department of Industry, Innovation and Science, Co-chair

#### Ms Jacky Hodges

General Manager, Industry Statistics Division, Australian Bureau of Statistics

#### Mr David Turvey

General Manager, Insights and Evaluation Branch, Australian Department of Industry, Innovation and Science

#### Dr John Bell

Senior Associate of Acil Allen Consulting and Fellow of the Australian Academy of Technology and Engineering

#### Dr Benjamin Mitra-Kahn

Chief Economist, IP Australia

#### Dr Amanda Caples

Lead Scientist, Victorian Department of Economic Development, Jobs, Transport and Resources

#### Dr Andrew Charlton

Managing Director, Alpha Beta

#### Mr Mark Thomas

Group Manager, Procurement and Information Systems, Fortescue Metals Group Ltd

#### Ms Christine Williams

General Manager, Innovation Metrics Review Branch, Australian Department of Industry, Innovation and Science (ex officio).

### The Review is also being provided with guidance by selected international technical advisers, including:

#### Prof Anthony Arundel

United Nations University (UNU) Maastricht

#### Mr Stian Westlake

Visiting researcher, Imperial College and Senior Fellow, Nesta

#### Mr Juan Mateos-Garcia

Director of Innovation Mapping, Nesta

#### Prof Scott Stern

Massachusetts Institute of Technology (MIT)

#### Prof Maryann Feldman

University of North Carolina

#### Dr Sacha Wunsch-Vincent

Head of the Composite Indicator Research Section, Economics and Statistics Division, World Intellectual Property Organisation (WIPO)

#### Dr Fernando Galindo-Rueda

Senior Economist at the OECD Directorate for Science, Technology and Innovation

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