



2017

PERFORMANCE REVIEW OF THE RURAL INNOVATION SYSTEM: ISSUES PAPER

HOWARD PARTNERS

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1 Introduction

1.1 Requirement

The National Primary industries Research and Innovation Committee has initiated this performance review of the rural innovation system. Howard Partners, who are undertaking this review are required to:

- Assess and articulate the performance of the rural innovation system.
- Identify gaps in the available evidence.
- Make recommendations regarding opportunities for improvement.

The current review of the Australian national innovation system by [Innovation and Science Australia](#) (*add link*) is an important context for this review of the rural innovation system (agriculture, fisheries and forestry). The rural perspective tends to get lost in this broader context.

This review will help to ensure that the significance of innovation in the rural sector and the innovation-related priorities of the rural industries are clearly articulated in national innovation policy considerations.

The aim of the project is to collate and analyse evidence across a range of metrics in order to present a comprehensive review of the overall performance of the system, highlighting areas of strength, opportunities for improvement and gaps in the knowledge base.

Towards these ends, the project requirements reflect elements of both Performance Review (evaluation) and *Performance Improvement* (policy and strategy).

The project will be completed by the end of January, 2018.

1.2 Project team

The Project will be undertaken by a core Project Team constituted as follows:

1. Dr John Howard, Managing Director, Howard Partners
2. Dr Mark Matthews, SDG-ED, Manchester, UK
3. Don Scott-Kemmis, Associate, Howard Partners

Résumés for each Member can be found at [Howard Partners](#).

1.3 Purpose of this document

Our approach to the project envisages entering conversations with industry leaders, research providers, representative organisations, producers, processors, and service providers through forums/workshops and direct interview. We would like to reach out as far as possible across the innovation system.

The purpose of this paper is to provide background information about our approach to performance assessment, canvas some key issues and pose some questions for discussion and feedback. Some “starter” questions are listed on page 15 below.

Meeting “face-to-face” is our preferred approach to consultations. We prefer not to make extensive use of telephone, email, or web-based survey techniques – except as a follow-up arrangement to capture the strength of opinion on certain issues.

Our approach is collaborative and focused on discovery and insights into factors that impact on performance that may not be generally well-known. We would also be looking for “good practice” “case” examples of innovation and achievement.

At this stage we envisage holding 10-12 forums/workshops across the country and 30 interviews with innovation leaders across the rural innovation system, covering all major stakeholder groups.

2 Assessing the performance of the Rural Innovation System

2.1 The scope of the innovation system

The Australian rural innovation system is a very significant component of Australia's National Innovation System and State based innovation ecosystems. It has a strong commitment to research, funded in large measure by the rural industries levy system which in 2016-17 generated \$482.5m in revenue and a matching Commonwealth payment of \$282m¹. Levies fund research undertaken predominantly in government research organisations and higher education institutions. Levies also fund RDC involvement in CRCs.

- ABS data indicates that in 2014-15 *governments* invested \$643m in research and experimental development relating to plant and animal production and primary products, amounting to 19 per cent of all government research investment. Specific investments in agricultural and veterinary sciences amounted to \$501m, or 15.1 per cent of GERD. State/Territory governments were responsible for almost 70 per cent of this investment.
- *Higher education* expenditure on research in plant and animal production and primary products amounted to \$464m, or 4.6 per cent of HERD. Investment in the agricultural and veterinary sciences research field totalled \$419m. Investment in the related biological sciences field amounted to \$897m.

Business expenditure on research in plant and animal production and primary products amounted to \$616m, or 3.3 per cent of BERD. Research classified as business expenditure on Agriculture and Veterinary Sciences amounted to \$554m, or 2.9 percent of BERD. *This level of BERD does not necessarily reflect the full business commitment to research – as businesses fund research through the primary industries levy system (which would appear as GERD or HERD above).*

2.2 Innovation system dynamics

The rural innovation system is dynamic and multi-dimensional and relationships are constantly changing. In addition to research organisations, government agencies and businesses connected with the rural sector, there are a large number of other organisations with a 'stake' in the system. These include:

- the major banks, often with specialist agribusiness divisions
- other financial intermediaries, including venture capital investors
- innovation intermediaries, trade and market access facilitators and other professional advisers
- rural representative and advocacy organisations
- agribusiness consultants.

This constellation of organisations, the relationships among them, and the policies, regulations, laws and customs that coordinate and influence them, forms the rural innovation system².

While the overall number of farm businesses is declining the proportion of larger farms is increasing. Private sector and not for profit organisations are also playing an increasing role in extension, as are farmer-led organisations and the rural CRCs.

2.3 Strategic context

Economic growth in Asia and particularly the demand from increasingly affluent and selective consumers is bringing major opportunity for Australian agriculture. This is the key conclusion of

¹ <http://www.agriculture.gov.au/SiteCollectionDocuments/ag-food/levies/documentsandreports/mid-year-levies-report-2016-17.pdf>

² The rural innovation system refers to the set of institutions and arrangements which contribute to the development and diffusion of new knowledge, technologies and practices, and which provide the framework within which governments form and implement policies to influence the innovation process.

several significant recent reports³. It is also the starting point for strategies to respond to these opportunities⁴.

The reports on the opportunities for exports to premium, and hence higher value markets, stress that they come with demanding requirements for quality, food safety, marketing, sustainability and provenance. The assessments of how to respond to these opportunities and the strategies proposed stress the need to raise productivity, increase differentiation (based on quality, provenance etc) and build relationships with customers and value chain intermediaries.

It is clear from these and many other reports that innovation⁵ must be a central aspect of effective strategies –both through the more widespread uptake of existing productivity-raising technologies and through the generation and application of new knowledge and methods. It is also clear that information technologies (automation, robotics, intelligent technologies, data analysis etc) are having pervasive impacts on agriculture and are changing the types of knowledge and capability required for innovation.

The increasing potential of genomics, while slower to develop, will also have pervasive impacts. Climate change will accelerate the importance of these technologies and more generally of capacities at all levels to respond and adapt – primarily through acquiring new knowledge, improving capability and innovating. Continuous, and at times disruptive, adaptation and adjustment is likely to become a defining characteristic of Australia's rural innovation system.

Productivity improvement comes both from major innovations and from a myriad of small innovations that cumulatively over time overcome problems and raise output and quality. Non-technological innovations, such as those in marketing and organisation, are often as important as technological innovations. Innovations in how research is coordinated or at the level of policy that influences investment may have strong effects on the performance and evolution of the innovation system.

2.4 Issues to consider in performance review

An extensive international literature has developed around the review of agricultural innovation systems. In most cases these studies focus at the sub-sector level, where the knowledge base is shared among the actors and where, at this more concrete level, it is possible to understand innovation processes and the factors that support or hinder them. Several issues that arise from these studies are relevant to the current review at the aggregate rural innovation system level:

- Although communication and collaboration among actors within the innovation system is vital, the different actors are often driven by very different incentives.
- The capacity to innovate throughout the innovation system, including in production and marketing organisations, is critical and this requires effective absorptive capacity.
- Innovation processes are embedded in institutional contexts and these Institutions, including practices, rules and policies, strongly shape behaviours and outcomes.
- Support organisations, including banking and financial organisations, transport and marketing organisations, professional networks including trade and farmer associations, and the education organisations, are important actors in rural innovation systems.
- A key issue in innovation system is the quality of learning – by all participants, including about the performance of the IS (what works and what does not) and its components.

³ For example: Commonwealth of Australia, 2013, Australia in the Asian Century. Daly, J, Anderson, K, Ankeny, R, Harch, B, Hastings, A, Rolfe, J and Waterhouse R, 2015, Australia's agricultural future. Report for the Australian Council of learned academies, Department of Agriculture, Fisheries, and Forestry, 2013. National Food Plan, Our Food Future. Canberra.

⁴ For example: Australian Academy of science, 2016, Grow. Make. Prosper. Decadal plan for Australian agricultural sciences 2017-26. Business Council of Australia, 2015. Building Australia's comparative advantages: a 21st-century agri-food sector. Commonwealth of Australia, 2014, agricultural competitiveness issues paper, Canberra. CSIRO futures, 2017, food and agribusiness: a roadmap for unlocking value-added growth opportunities for Australia. FIAL, 2016, industry growth centre: food and agribusiness sector competitiveness plan: Rural research and development Council, 2011. National strategic rural research and development investment plan, Department of agriculture, fisheries, and forestry.

⁵ Innovation is the implementation of new ideas that create value.

- Innovation systems at the specific sector level (e.g. aquaculture, dairy) are usually distinctive in terms of actors, knowledge bases and relationships, and in terms of links with other national, regional and international innovation systems.
- The integration of agricultural innovation systems (AIS) into general National Innovation System (NIS) is of increasing importance.
- Government will continue to have a key role in AIS, due to the need for shared infrastructure, underpinning basis research, research with long term public good aspects, facilitating cooperation between actors, regions and sub-sectors, and spillovers from public and international research.
- Trade and education policy are of increasing importance for AISs.

These aspects will be taken up in our approach to the Performance Review of the Australian Rural Innovation System.

2.5 Suitability of the ISR framework for review of the Rural Innovation System

The ISR Framework is summarised in Attachment 1. It is a useful representation of relationships between knowledge production, transfer and application. But there are some limitations which would require adjustment to the Framework in addressing rural innovation system performance.

Framework logic

The ISR framework represents the traditional and much criticised ‘linear flow’ view of knowledge generated through scientific discovery and technological invention and transferred into application and use. It is attractive for its simplicity and avoidance of complex ‘spaghetti’ or ‘hydraulic’ diagrams, but it tends to encourage a ‘supply side’ or ‘science push’ focus, and can overlook important demand/market side factors that initiate and ‘pull through’ new discoveries, inventions and technologies.

The approach also tends to neglect non-technological forms of innovation, for example in marketing, organisation, collaboration, institutions, business models.

The development of contemporary and critically important enabling technologies rarely follows the “linear flow” trajectory. These include, for example, micro/nano-electronics, nanotechnology, semiconductors, advanced materials, robotics and mechatronics, photonics, artificial intelligence and machine learning, analytics, digital imaging, visualisation, prototyping, and augmentation, biotechnology, advanced manufacturing (including 3D printing), and many other aspects of information and communication technologies.

Over the last 10 years, work on agricultural innovation systems in the World Bank, OECD and other international organisations, has led to a marked shift away from a research or research and extension focused framework for rural innovation. This shift is summarised in the three frameworks outlined in Table 1 below.

Table 1: Main characteristics of the three main frameworks used in promoting and investing knowledge in agriculture sector

Defining feature	NARS	AKIS	AIS
Actors	Research organizations	Farmer, research, extension and education	Wide spectrum of actors
Outcome	Technology invention and technology transfer	Technology adoption and innovation	Different types of innovation
Organizing principle	Using science to create new technologies	Accessing agricultural knowledge	New uses of knowledge for social and economic change
Mechanism for innovation	Technology transfers	Knowledge and information exchanges	Interaction and innovation among stakeholders
Role of policy	Resource allocation, priority setting	Linking research, extension and education	Enabling innovation
Nature of capacity strengthening	Strengthening infrastructure and human resources	Strengthening communication between actors in rural areas	Strengthening interactions between all actors; creating an enabling environment

Ley: NARS = National Agricultural Research System; AKIS = Agricultural Knowledge Information Systems; AIS = Agricultural Innovation System.

Source: (*The World Bank, 2006*)

The contribution of service industries

The services sector makes up around 80 per cent of the Australian economy. Science and technology has been enabling productivity growth and international competitiveness in the service industries that are closely connected to rural industries. These comprise construction and infrastructure, merchandising (sales, marketing, public relations), logistics, transport, education and training, commercial services, water and the environment. The full extent of the contribution of science and technology to services is not easily visible to those outside the process. Accordingly, it can be underappreciated by policymakers and the academic research community.

Intermediaries

Our understanding of the innovation system, and the rural innovation system, acknowledges the important role of *innovation intermediaries* who build and sustain connections and relationships between ‘actors’. They can facilitate the formation of networks, development of technology markets (connecting buyers and sellers), and design organisations that bring capabilities together. Intermediaries provide advisory, mentoring, brokage, and support roles and are a key element in innovation system performance (Howard, 2007). The scope, extent and contribution of intermediary activity can be underestimated. Improvements and adjustments in this area offer substantial potential for improving system performance.

Failures and frictions

An innovation system is complex and complicated. There are “stop/go” and “no go” points. It is therefore important to acknowledge the possibilities for *system failure* – where, perhaps, policies determined and decisions taken in one part of the system, that might seem like a good idea by some, could have potentially adverse effects in other parts of the System – impacting on overall system performance (Dodgson et al., 2010, Woolthuis, 2015).

There is also a need to acknowledge the presence of *system friction* where differences in objectives, incentives, and institutional missions work against achieving optimal system performance. Much has been written about frictions in university-business collaboration, for example and this is seen as a critical area for innovation system performance improvement.

Our research and knowledge of the innovation system suggests that whilst the ISR System appears to be highly interconnected, it is essential that these connections are built around steadfast collaboration and sustained partnership, rather than short term, and often opportunistic transactional relationships

3.2 Some challenges for the Rural Innovation System

Set out below are several challenges that provide context for the Performance Review of the Rural Innovation System and would need to be addressed in approaching performance improvement.

Investment in research capacity

In comparison to other OECD nations, Australia is underinvesting in science, and particularly the physical sciences (chemistry, physics, and mathematics and material sciences). The CSIRO had undertaken an analysis of Australia’s relative scientific specialisation as part of its submission to the Boosting the Commercial Returns from Research Review.

According to an analysis undertaken by CSIRO Australian science has a specialisation in the fields of geosciences, environment/ecology, and plant and animal sciences. This most likely reflects the long-standing importance of the mining and resources and agricultural sectors of the Australian economy and the direct financial support provided by Commonwealth and State Governments.

The ISA Performance Review reported that only five universities were “well above world standard” in the research field *agricultural and veterinary sciences* (La Trobe, Macquarie, New England, Southern Cross and UTS), a further 12 that were above world standard, and seven at world standard.

Efficiency and effectiveness

Whether or not there are substantial increases in research investment in coming years, it is imperative that the efficiency and effectiveness of the arrangements are addressed. Effectiveness issues were addressed in the ACOLA SAF 09 project and have emerged in consultations for the development of the Australian Innovation Science and Research System Strategic Plan.

Effectiveness also means looking at the *scale* of research, and ensuring that the limited resources are located in world class research centres and institutes. There has been a view for many years that Australia's very limited funds for investment in research are too thinly spread. The RRDCs have gone a long way to developing an investment model for research – that differs fundamentally from the criteria based grant models that apply in other areas.

There are opportunities for greater collaboration in research across RRDC sectors around enabling technologies that have broad industry application. But there may be challenges in convincing sector levy payers of the benefits and returns in their investments.

There are related issues that concern the strategic direction and appropriateness of research effort in relation to outcomes, extent of collaboration, cross sectoral research effort, critical mass, international engagement, and the sensitivity to demand and market signals.

New and different actors

With increasing farm consolidation, the role of larger farms (enterprises) in overall output has grown. The age profile of farmers, the levels of investment required to raise productivity, the scope for application of knowledge and technology in production and processing, and the levels of foreign investment suggest that this trend will continue. At the same time, private sector and non-for-profit organisations are increasingly important in extension (Australian Farm Institute, 2013).

Upgrading Innovation Systems

Innovation systems evolve as new capabilities, organisations and links are built in response to new challenges. But challenges that involve major and rapid shifts in performance requirements or in the knowledge base for production and innovation can involve particularly difficult transitions. They are likely to require the participation or formation of new organisations, new competencies, new linkages among organisations, and new investment in capability or equipment in producers, suppliers and research and education organisations.

Such transitions may also require institutional change (ie major change in regulations, policies, sectoral strategies and priorities) and new infrastructure, which may be dependent on investment from outside the sector. Strong tensions among innovation system participants often develop in periods of transition due to conflicts over priorities, which, unresolved, may block change.

Hence, an important part of this review will be an assessment of the capacity of the rural innovation system to change and upgrade (ie its dynamic performance) in response to new challenges and priorities.

With a need for increased innovation it is important to assess in what ways the innovation system can be strengthened to support higher rates, and different types, of innovation. An innovation system is more effective when:

- Competition, cooperation and investment drives and supports continuous improvement in performance and a continuous search for productivity raising innovations of all types.
- Significant opportunities for improved performance, and problems that limit performance, are identified and acted on effectively.
- The sector attracts the investment, human resources and policy attention required to respond to problems and opportunities that require inputs from outside the sector.
- New firms (producers and suppliers) can enter the sector to pursue new ideas.

- New knowledge and capability is developed or acquired and diffused rapidly in response to new needs.
- The ‘knowledge infrastructure’ (education, research and extension organisations and the mechanisms that coordinate and link them) is responsive to new needs but also maintains a broad base of capability in order to foresee and respond to new challenges.
- The physical infrastructure (communications, transport, water etc) is appropriate and is upgraded as required.

However, an innovation system is in trouble when:

- Rates of productivity improvement and innovation decline due to either a lack of incentive or a lack of capability.
- Organisations (producers, suppliers, education, research, extension etc) cannot manage a transition to new requirements for production and innovation due to a lack of capability or preparedness to change.
- Networks and relationships – those along value chains and those that link knowledge supply and demand – are not renovated in response to innovation and new requirements.
- Significant challenges (new opportunities or problems) are not addressed effectively due to the way the system is organised, regulation is developed and applied, issues communicated or decisions made - and there is a lack of collective action to make the changes needed to overcome these limitations – or due to a lack of capacity to attract external resources (investment, human resources and policy attention).

Innovation and rural industry transformation

A critically important example of a challenge involving a major transition is the increasing ‘disruption’ of rural industries by digital technologies. Their pervasive impact is opening many new opportunities for value and wealth creation and leading to the birth of new sub-sectors and firms. Innovation is key to the development and application of *digital technologies* – the use of digital resources to find, analyse, create, communicate and use information, and to develop and apply software.

A range of innovations typically contribute to such transformation – digital equipment and software, new business models, innovations in organisation and in value chains and often changes in the specification of inputs. These important changes may involve no R&D in Australia. However, where Australia is an early adopter of digital technologies in agriculture there is a higher probability of local innovations following, and related new enterprise development in sensors, equipment and software.

It is vital that the scope, extent and impact of digital transformation is assessed and the barriers to further digital applications are identified.

Linking rural innovation to rural industry strategy

Innovation is one of several “domains” in a comprehensive rural industry development strategy. With the unpopularity of industrial strategy over the last 20 years, innovation policy has been loaded into broader industrial strategy objectives. There is now an awareness that innovation cannot of itself deliver all potential industry strategy outcomes. Innovation must be part and parcel of policies and investments relating to a broader industrial strategy (UK. Prime Minister, 2017).

It is possible to identify at least eight areas where innovation and components of broader industrial strategy intersect:

1. *Investing in science, research and innovation* - to become a more innovative industry and do more to commercialise our world leading science base to drive growth. *This tends to be the focus of innovation policy.*
2. *Developing skills* - to help people and businesses (farm and non-farm) to thrive by: ensuring everyone has the basic skills needed in a modern rural sector; boosting STEM (science, technology, engineering and maths) skills, digital skills and numeracy; and by raising skill levels in lagging areas.

3. *Upgrading infrastructure* - to upgrade standards of performance on digital communication (broadband, 5G, etc), energy, transport, water and flood defence infrastructure, and better align central government infrastructure investment with industry growth priorities. Not all of these policy areas are driven by an innovation agenda, although innovation can be a critical enabler.
4. *Supporting businesses to start, grow and sustain* - to ensure that businesses can access the finance and management skills they need to grow, and create the right conditions for companies to invest for the long term. These businesses may not be specifically rural, but they might provide services to agriculture – particularly around technology – e.g. firms that supply and manage drones.
5. *Encouraging trade and inward investment* - government policy to help boost productivity and growth across the rural economy, including by increasing competition, market access, and helping to bring new ways of doing things to Australia through inward investment strategies.
6. *Delivering affordable energy and clean growth* - to keep costs down for rural businesses, and secure the economic benefits of the transition to a low-carbon economy.
7. *Creating a framework to build on the strengths of different places* - to address factors that hold places back – e.g. by investing in key infrastructure projects to encourage growth, increasing skill levels, or backing local innovation strengths.
8. *Creating the right institutions to bring together sectors and places* - to consider the best structures to support people, industries and places. In some places, there may be missing institutions which could be created, or existing ones strengthened – such as education and training institutions, producer associations, or financial networks.

A feature of the Australian institutional framework is that each of these areas have *policy levers* owned by different Ministers and agencies, within and between governments. It is a major challenge to ensure policy alignment, commitment and resourcing.

Not all rural industry policy and strategy will be driven, in the first instance, by innovation. However, the desire to deliver much needed infrastructure, 'create jobs', etc., should be encouraged to incorporate an innovation component.

3 Key issues to consider

A number of issues have been identified in assessing innovation system performance and overcoming barriers to improvement. These lead into a number of questions that will be addressed in the consultations element of the project.

3.1 Assessing innovation system performance outcomes

Assessing innovation system performance involves considering the following baseline questions.

Baseline questions for innovation system performance
<p>The extent to which the rural innovation system is <i>creating value</i> for -</p> <ul style="list-style-type: none"> • The economy. • The agricultural sector and sub-sectors – production, processing, services. • Businesses - on farm/off farm. • Rural communities. • Consumers. • Future generations. <p>Value can be indicated by the extent to which the system has been -</p> <ul style="list-style-type: none"> • <i>effective</i> in delivering outcomes – indicated by factors such as output quantity, quality, cost, and end user satisfaction • <i>efficient</i> in production and distribution – indicated by factors such as productivity, costs per unit of output, cycle times. • <i>economic</i> in the allocation of scarce resources – indicated by factors such as availability of, and access to, knowledge (RDE, IP, best practice), skills and talent, investment capital, land, markets. • <i>appropriate</i> – policies and practices that support priority setting, resource allocation, and dealing with external contingencies.

These questions will be developed further during the course of the project.

3.2 Barriers to improved innovation performance

Recent enquiries, research, reports and statements have identified several key issues concerning the performance of the rural innovation system. These relate to:

- low rates of productivity improvement
- limited value adding and participation in global value chains
- insufficient product differentiation
- low rates of uptake of new technologies
- inadequate investment in research
- human resource constraints
- questioning of the social licence to operate
- inappropriate research governance
- climate change impacts
- lack of support for the development of specialist suppliers
- inadequate infrastructure for agriculture and communities
- underinvestment in extensions.

There may be other issues that have not been identified in the intensive scope of investigation, analysis and reporting which we would like to identify in discussion and consultation.

In exploring this we would like to canvass the following questions. This will be followed up with the expert opinion survey outlined in our methodology and approach.

4 Questions for discussion and feedback during consultation

1. What should be the priority criteria and indicators for assessing rural innovation system performance (see 3.1 above)?
2. What are the key strengths of Australia's rural innovation system?
3. What are the key weaknesses of Australia's rural innovation system? What prevents these weaknesses being identified and overcome?
4. What types of performance-limiting problems are Australia's rural innovation systems generally effective in addressing?
5. What types of performance-limiting problems are Australia's rural innovation systems generally *not* effective in addressing?
6. Which sectoral (ie specific rural industry) innovation systems are effective in supporting innovation in enterprises? Why are these particular sectoral innovation systems effective?
7. Which sectoral (ie specific rural industry) innovation systems are less effective in supporting innovation in enterprises? Why are these particular sectoral innovation systems less effective?
8. In different rural industries, what limits the *incentives* for enterprises to innovate?
9. In different rural industries, what limits the *capacity* for enterprises to innovate?
10. What types of initiative or organisation have been most effective in promoting and supporting innovation (the application of new methods, equipment, varieties etc) by enterprises?
11. Do any particular *economic* policies, regulations or laws have strong impacts (positive or negative) on the functioning of agricultural innovation systems?
12. Do any particular *social* conventions or attitudes have significant impacts (positive or negative) on the functioning of agricultural innovation systems?
13. Who is responsible for monitoring the performance effectiveness of Australia's agricultural innovation systems?
14. What are the priorities for raising the performance of the rural innovation system?
15. To summarise - what do you think are the most important problems to address in order to raise innovation performance? What needs to be done to address these problems?

These questions will be used as a basis for discussion at interviews and meetings during the early part of the project. Our approach will be open-ended, and people will be more than welcome to raise issues that they see of importance from their own perspectives.

5 Approach to the project

5.1 Overview

The Performance Review of the Rural Innovation System will be approached *through three lenses*.

A three-lens approach

1. An **innovation system** lens (structure & connectivity based performance drivers): to focus on the overall configuration of the rural innovation system.
2. An **institutional mapping** lens (organisations' competencies, staff skills and mind-sets): to focus on the discrete organisational competencies in the wider innovation system (this is especially important with respect to shortcomings in competencies that cannot be compensated for by the system as a whole).
3. A **measurement** lens (reliability of what we currently know & ways of improving in the future): to address the challenges faced in providing the evidence necessary to track and understand performance and used to inform decisions.

Even in a well configured innovation system a gap between intended and actual performance can be driven by deficiencies in individual organisational competencies, capabilities, available talent and skills, and cultures and mind-sets.

The review will involve an explicit hypothesis testing approach. Each hypothesis will provide a competing explanation of a specified key aspect of Australia's rural innovation system – and will relate directly to particular metrics. The evidence will then allow the hypotheses best supported by the available evidence to be selected.

To support the assessment the team will assemble an extensive range of data from existing reliable data bases and reports. Valuable insights can arise from comparisons of agricultural sectors that have high performing innovation systems with those sectors where innovation systems have not performed well.

Similarly, understanding why some types of challenge (opportunity or problem) are usually identified and addressed effectively, while other types are not, will generate insights into the functioning of innovation systems.

Consultation with a representative cohort across industry, government, the R&D community, and education and training will inform the development of hypotheses. Our preliminary insights and conclusions will be tested and developed through forums and workshops, interviews with innovation leaders and a survey of expert opinion.

5.2 Project phases

Our work will be organised in the following four phases.

Phase 1: Discovery	
Purpose	Assemble the necessary evidence for the Review Appraise the fine details of the Review methodology based on previous studies and agree detailed approach for this study Develop and agree broad testable hypotheses
Activities	Assemble available material – reports, papers, statistics, etc., for classification and review (including an examination of methodological aspects and their implications) Consult with a representative cohort across industry, government, the R&D community, and education and training – recorded and transcribed. Translate literature review and consultation findings into a set of testable hypotheses Prepare Issues Paper to stimulate the provision of additional evidence and to present the hypotheses being tested in the Review process Circulate the Issues Paper for comment, including a structured questionnaire for feedback.
Outputs	Issues Paper as basis for analysis
Timing	16 Oct-3 Nov

Phase 2: Analysis	
Purpose	Analyse the evidence using hypothesis tests
Activities	Analysis of innovation system effectiveness via hypothesis tests Analysis of institutional effectiveness via hypothesis tests Synthesise preliminary conclusions Hold 10-12 forums/workshops to consider preliminary conclusions – cross sectoral - across the country – recorded and transcribed Undertake up to 30 interviews with innovation leaders across the rural innovation system, covering all major stakeholder groups – recorded and transcribed Undertake an <i>Expert Opinion Survey</i> aimed at validating & filling evidence gaps in hypothesis tests – following the methodology used in the development of the ISA Strategic Plan Draw out recommendations based on the above
Outputs	Analytical Assessment Paper (detailed project working document) Draft Table of Contents for Final Report
Timing	6 November – 8 December
Phase 3: Review	
Purpose	Translation of evidence-based hypothesis tests into Review conclusions
Activities	Continue with the analysis based on feedback from the project committee Further analysis following evidence gap filling (tracking down additional evidence not initially captured) Translation of the analytical assessment into Review conclusions (via considering the practical realities of generating and updating a Scorecard of rural innovation performance)
Outputs	Key 'headline' Review Findings paper Updated Table of Contents for Final Report
Timing	11-22 December
Phase 4: Documentation and reporting	
Purpose	To present the report as a combination of text, and graphics, and diagrams
Activities	Report drafting and finalisation
Outputs	Final Report that is easy to comprehend with an extensive use of Infographics
Timing	18 December – 25 January 2018

6 Participating in the Performance Review

Participation from a diverse range of stakeholders in the rural innovation system is vital for this review. If you would like to participate in a workshop or the survey, or to suggest innovation leaders who we should contact, please contact us:

- John Howard John@Howardpartners.com.au
- Don Scott-Kemmis don@howardpartners.com.au

Attachment 1: The Innovation and Science Australia Innovation System Performance Framework

Innovation and Science Australia describes the *Innovation, Science, and Research (ISR) System* as an open network of many diverse actors who interact to produce and spread innovations that have economic, social and environmental value.

The people and organisations in the ISR System include businesses (big and small, old and new), not-for-profits (publicly funded and private), education providers, investors, governments (federal, state, territory and local), researchers and end-users (consumers and communities). ISA notes that the composition of the ISR System changes, as actors join and leave, and the intensity of activity also changes as investments and risk appetites rise and fall. The Australian ISR System is highly interconnected with international systems, as knowledge, talent, and competitor organisations move across national and regional boundaries (Innovation and Science Australia, 2016).

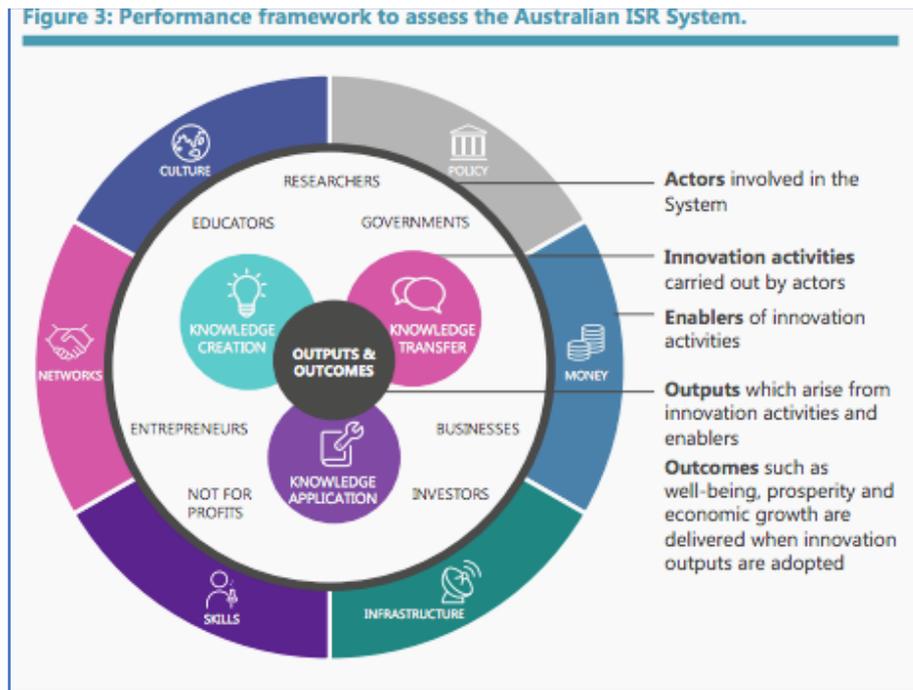
In the *Performance Review* ISA used a ‘simple framework’ to guide performance review, which is represented in the categories Knowledge creation, Knowledge transfer, and Knowledge application.



Source. Innovation and Science Australia. (2016). *Performance Review of the Australian Innovation Science and Research System*. pix.

The System generates outputs (new and improved products, processes and services) that deliver outcomes “such as improved productivity, longer life expectancies and a more resilient Australian ISR System”. The framework does not specifically cover an expectation that System outcomes would meet a customer or societal end user need or demand – results that people, organisations, and governments are prepared to pay for either directly or through their taxes.

The ISR framework identifies six categories of “enablers: that facilitate innovation activities: policy; money; infrastructure; skills; networks; and culture”. The linkages across, within and between innovation activities and enablers are of critical importance to eventual outcomes.



Source. Innovation and Science Australia. (2016). *Performance Review of the Australian Innovation Science and Research System*. px.

The enablers are represented in some strong and complex institutional frameworks, such as financial institutions, infrastructure delivery agencies, and education and training institutions. The performance of these institutions has important impacts on rural innovation system functioning, and there is potentially substantial scope for improvement in delivery of system outcomes and impacts. This would be addressed in our approach to Performance Review of the Rural Innovation System.

The performance review approach in the *ISR Performance Review*, “Part B: Measuring performance” (pages 15-110), provides detailed commentary on enablers, outputs and outcomes. It would be a straightforward matter to adapt and provide specific commentary in relation to the rural innovation system following this approach. It would also be possible to present material in a similar format to “Part C: Overall findings and next steps” (pages 111-118). The project brief envisages that this work would be undertaken over an eight-week period – 7 August to 6 October.

But, as argued below, this may not give an adequate profile of the rural innovation system and articulating the scope for performance improvement that will achieve a rural industry vision and economic, industry, and social outcomes.

Attachment 2: Recent Reports on Innovation and Performance in Rural Industries

At least 30 reports papers and statements on agriculture and rural innovation have been prepared over the last five years. These are listed below.

1. ABARES, 2017, Agricultural Commodities, research by the Australian bureau of agricultural and resource economics and sciences, March quarter, 2017.
2. ABARES, 2017, Rural Research, Development and Extension Investment In Australia. Research by the Australian bureau of agricultural and resource economics and sciences. Research report 17.11, September 2017.
3. AFGC and Ernst & Young, 2015. State of the Industry: essential facts and figures.
4. Alston, J. Babcock, B. Pardey P, The Shifting Patterns of Agricultural Production and Productivity Worldwide (2010). CARD Books, Book 2.
5. ANZ Insight 2012. Greener pastures: the global soft commodity opportunity for Australia and New Zealand. Issue 3, October 2012.
6. Australian Academy of science, 2016, Grow. Make. Prosper. Decadal plan for Australian agricultural sciences 2017-26.
7. Australian Academy of Technological Sciences and Engineering 2014. Food and Fibre: Australia's Opportunities, ATSE, Melbourne.
8. Australian Farm Institute, 2016 The implications of digital agriculture and big data for Australian agriculture. AFI
9. Business Council of Australia, 2015. Building Australia's comparative advantages: a 21st-century agri-food sector. Melbourne, BCA
10. Commonwealth of Australia 2015. Agricultural Competitiveness White Paper, Canberra.
11. Commonwealth of Australia 2015. Our North, Our Future: White Paper on Developing Northern Australia, Canberra.
12. Commonwealth of Australia, 2013, Australia in the Asian Century. Canberra AGPS
13. Commonwealth of Australia, 2014, Agricultural Competitiveness Issues Paper, Canberra.
14. CSIRO Futures, 2017, Food and Agribusiness: A Roadmap For Unlocking Value-Added Growth Opportunities For Australia. CSIRO
15. CSIRO, AFGC and MLA, 2013, National food and nutrition research and development and technology transfer strategy.
16. Daly, J, Anderson, K, Ankeny, R, Harch, B, Hastings, A, Rolfe, J and Waterhouse, R, 2015. Australia's agricultural future. Report for the Australian Council of Learned Academies.
17. Department of Agriculture, Fisheries, And Forestry, 2013. National food plan, our food future. Canberra.
18. Food Innovation Australia Ltd, 2016, industry growth centre: food and agribusiness sector competitiveness plan. FIAL
19. Food Innovation Australia Ltd, 2017, sector competitiveness plan: food and agribusiness growth centre. FIAL
20. Gray E, Oss-Emer M, Sheng Y, 2014, Australian agricultural productivity growth: Past reforms and future opportunities, Australian Bureau of Agricultural and Resource Economics and Sciences, Research report 14.2 p. 10
21. Kajkowicz, S and Eady, S, 2016, rural industries futures – megatrends impacting Australian agriculture over the coming 25 years CSIRO and RIRDC.
22. Liao, B and Martin, P 2009. Farm innovation in the broadacre and dairy industries 2006–07 to 2007–08. ABARES research report 09.16, Canberra.
23. Manyika J, Chui M, Bughu J, Dobbs R, Bisson P and Marrs A. 2013. Disruptive technologies: Advances that will transform life, business and the global economy. McKinsey Global Institute report.

24. Mullen, J and Keogh, M 2013. The future productivity and competitiveness challenge for Australian agriculture. Proceedings of 57th AARES Annual Conference, Sydney.
25. National Farmer's Federation. Farm-Facts (Retrieved on 23rd June 2016). NFF
26. National Farmers Federation, 2013, Blueprint for Australian Agriculture 2013-2020. NFF.
27. Nossal, K and Lim, K 2011. Innovation and productivity in the Australian grains industry. ABARES research report 11.6, Canberra.
28. PMSEIC 2010. Australia and food security in a changing world. Prime Minister's Science Engineering and Innovation Council, Canberra.
29. Pratley, J 2013. Review into Agricultural Education and Training in New South Wales. NSW Government. ISBN 978-0-646-59653-2.
30. Rural Research and Development Council 2011. National Strategic Rural Research and Development Investment Plan, Department of Agriculture, Fisheries and Forestry, Canberra.

Attachment 3: Summary of Issues identified in Recent Reports

1. Characteristics of Australia's Rural Industries

Australia's GDP in 2017 stood at \$1.69 trillion. ABARES has reported that that agricultural output in 2016-17 was \$63.8 billion, thus contributing 3.8 per cent to GDP. Rural industries (agriculture, fisheries and forestry) account for over 15% of Australia's merchandise exports. They are vital for maintaining employment and communities across rural and regional Australia.

Less than 30% of farms (generally the larger and more profitable farms) account for 70% of output. A long history of innovation lies behind the export success and productivity of these industries. They are increasingly technology-intensive and draw on a widening knowledge base.

2. Market and Technological Opportunities

Due to increasing market and technological opportunity there is a strong potential for sustained growth in output, product diversity and profitability.

The growth of market opportunity is driven largely by the growth in the number of wealthier consumers, particularly in Asia. Associated changes in demand preferences place a premium on higher protein foods (such as animal products) and on foods differentiated by quality, traceability and provenance.

Multilateral and bilateral trade agreements have increased access to markets and continue to be important for increasing that access. As competitive pressure from other suppliers will continue to increase, sophisticated marketing and strong value chain relationships – in addition to product quality and responsiveness to customer demand – are essential for pursuing these compelling market opportunities.

Increasing technological opportunity is driven by, in particular, the development and increasingly wide applications of transformational technologies. Digital technologies and biotechnology are enabling 'game changing' innovations. They often provide routes to productivity improvement that address otherwise difficult problems that limit performance, for example, labour scarcity, a need for pest control with reduced use of agri-chemicals, differentiation through enhanced product attributes, more effective use of expensive inputs.

3. Barriers to Exploiting Market and Technological Opportunities

This identification of barriers is based on the reports listed below.

- **Slow rates of productivity growth**
Rates of productivity improvement have remained low since the mid-1990s
- **Insufficient product differentiation**
With increasing competition product differentiation - based on quality and branding with traceability and provenance to support sustainability and ethical production claims – will be increasingly important in winning market share and enabling premium pricing.
- **Limited value-adding and participation in global value chains**
While bulk commodities will be likely to account for the major share of Australia's agricultural exports, the increasing scope for value added products will require the development of deeper market knowledge and more extensive links with marketing agencies and distributors
- **Human resource constraints**
While the education level of farmers and operators is improving, evidence suggests that current education levels contribute to slow uptake of new technologies and a wide range of productivity levels. The demand for agricultural science graduates exceeds supply. The early career opportunities for agricultural science researchers and the financial support during post-graduate study are strong disincentives for this career choice. With increasing and changing skill and knowledge requirements a lack of appropriate human resources could be serious constraint on innovation and productivity growth.

- **Low rates of uptake of new technologies**

While many farmers are innovative, inadequate skill and knowledge among some farmers and operators has led to slow rates of uptake of new technologies. With the increasing capital intensity of operations access to capital will often also be a constraint on investment in new technologies.

- **Questioning the social licence to operate**

Community concerns regarding sustainability, food safety and animal welfare have undermined the 'social licence to operate', led to increased regulation, and diminished the attractiveness of careers in rural industries.

- **Impacts of climate change**

Long term changes in weather patterns will impact the viability of current land use in some areas. Increasing variability of rainfall, temperatures and wind will threaten the viability of particular industries in many areas and at least require changes in species, practices and infrastructure.

- **Inadequate infrastructure and services**

While transport infrastructure is limited in many areas, inadequate digital connectivity is likely to become a serious barrier to the uptake of digital technologies. The relative decline in profitability of many rural enterprises, the shrinking rural workforce and the reduction in the number of rural enterprises erodes the viability of many small communities and consequently reduces the accessibility of health, education and other services.

- **Reduced public sector support for extension**

State governments have reduced their role in rural extension and many operators rely on suppliers for advice.

- **Lack of support for the development of specialist suppliers**

While specialist suppliers of equipment, inputs and services will have a vital role in innovation and in marketing there are few policies or programs to support the development of the Australian supply sector. Some agri-tech firms have gained support through general entrepreneurship support programs.

- **Inadequate investment in research**

A declining proportion of Australia's investment in R&D has been allocated to agriculture. Research intensity (the ratio of public investment in R&D to gross agricultural domestic product) has more than halved over the past 20 years. Australia's share of international agricultural publications has steadily declined over the past 20 years. Public R&D investment in agriculture has declined in real terms over the past 10 years.

Responding to the widening frontier of technological opportunity will require a substantial increase in R&D investments – in the context of an integrated strategy for industry development.

- **Inappropriate research governance**

As a result of the governance structures agricultural research is increasingly allocated to short term – near to market - objectives. The governance arrangements limit the scope for long-term (potentially) transformative research, the types of inter-disciplinary research that are increasingly required to enable the more complex 'whole of system' change, collaboration among researchers and coordination both of research investments and of participation in international research.

Due to the widening knowledge base for innovation in rural industries the linkages between the agricultural innovation system and the national innovation system are of increasing importance.

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